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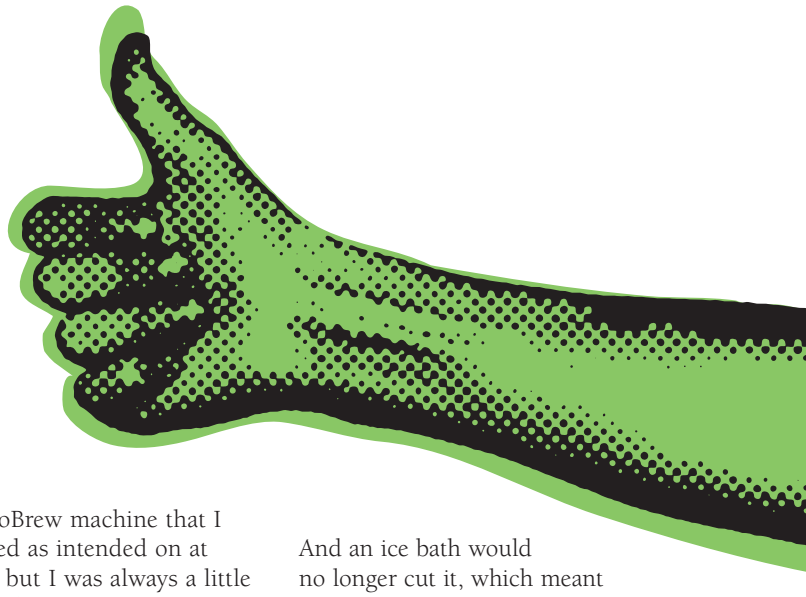

Douglas Adams's six-volume *The Hitchhiker's Guide to the Galaxy* "trilogy" played a key role in my childhood development (which should explain a lot). Even today, when I encounter any sort of beverage dispenser—from self-service hotel lobby coffee machines to my own kegerator—a little voice pops into my head and shouts, "Share and enjoy!"

For those unacquainted with the *Hitchhiker*'s trilogy, first of all, get acquainted ASAP because it's a treat. Second, know that "Share and Enjoy" is the tagline of the Complaints Division of the Sirius Cybernetics Corporation, whose Nutri-Matic Drinks Synthesizer attempts to forecast a user's beverage preference. It then produces a plastic cup filled with a liquid that is, as Adams famously writes, "almost, but not quite, entirely unlike tea."

This continues to resonate with me, not only because I work in the beverage industry, but also because the Nutri-Matic Drinks Synthesizer maintains a cheery indifference and insists that it knows exactly what the customer wants, even when confronted with fierce user protests. I imagine that, were I in the mood for a brilliantly clear helles, I would be handed one hazy IPA after another.

On second thought, this scenario is quite likely even without clairvoyant vending machines.

We're not quite to Nutri-Matic–level automation, and for the sake of our taste buds, let's hope we never are. But brewing equipment, like everything else in our homes, has become increasingly sophisticated and, if not fully automated, at least more functionally capable.

I recognize that many *Zymurgy* readers have been brewing on automated systems for some time, but the idea is still rather novel to me. Before COVID-19 sent AHA staff to remote home offices, we had been experimenting with an Anvil Foundry on staff brew days as a smaller, more approachable alternative to our classic propane-fired, three-tier rig. For a number of years, the AHA's office kitchen housed an early-model PicoBrew machine that I recall having worked as intended on at least one occasion, but I was always a little wary of it because of the way it loomed in the particular manner of a first-generation microwave oven.

More recently, I had the opportunity to try out the all-in-one BEERMKR, a countertop machine that makes about a gallon of beer with relatively little user intervention (see Now on Tap, Nov/Dec 2021). And then, I got to test Grainfather's latest all-grain brewing system, the G40, which mashes and boils according to your wishes (see page 9 of this issue). Both machines rely on WiFi and a smartphone app to manage your brew day.

I've genuinely enjoyed trying out all these beer machines. Now cue the "back in my day" soliloquy…

Flash back to 2009. The pandemic du jour was H1N1 swine flu. Iceland's banking system collapsed. Chesley "Sully" Sullenberger bravely ditched an A320 on the Hudson River and, in other aviation news, Balloon Boy's helium-filled saucer slipped the surly bonds of earth over northern Colorado and captivated a nation.

When I embarked on my homebrewing journey in 2009, I started with a basic bucket-and-carboy equipment kit. It didn't include a brew kettle, but an underused 3-gallon stockpot in one of the darker corners of the cupboard proved more than adequate. I bottled my first couple of batches in used green bottles because I didn't yet know about skunking, and I was drinking a fair amount of Spaten at the time.

In the years since, I followed what used to be a fairly predictable sequence of steps, each of which spawns a number of offspring. I wanted to try all-grain brewing, so I built a mash tun from a cooler. But that meant boiling the full volume, so I also needed a larger stockpot. Because my stove couldn't handle such a large boil, I also needed a high-powered propane burner. And an ice bath would no longer cut it, which meant a wort chiller was in order. Then garden hose connections. Oh, and a more reliable thermometer (see Last Drop, Nov/Dec 2012). And, and, and…

Let's not even go into kegging.

Were one to sum all of those *and*s, the total would undoubtedly exceed the price tag of even today's most sophisticated all-in-one homebrew machines. But that cost is more palatable when you assemble your system Johnny Cash "One Piece at a Time" style over a period of years than it is if you plunk down a solid chunk of change in one go.

Homebrewers in 2022 who know they're in it for the long haul may well come out ahead by "buying once, crying once" with a self-contained machine. I'm glad, though, that I took the piecemeal approach I did, disregarding for the moment that there were no all-in-one systems when I got started. There's no inherent virtue in choosing one particular approach over another, but there is value in recognizing how one learns and choosing a path accordingly.

I've enjoyed building up my brewery incrementally, and I think doing it this way has taught me considerably more than I would have learned with an all-in-one. But everyone learns differently, and I know many who would find a long, drawn-out approach discouraging. But they very likely might enjoy the set-it-and-forget-it convenience of an integrated system.

All this is to say that, as attached as we tend to get to our own particular way of doing things, it's worth remembering that there's no one-size-fits-all approach in homebrewing. No path is inherently better than another. Multiple paths lead to great beer.

Except for the Nutri-Matic Drinks Synthesizer. It will only disappoint.

Share and enjoy!

Dave Carpenter is editor-in-chief of Zymurgy.

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TABLE OF Contents

Features

38

THE VALUE OF MALT ANALYSIS

Understanding barley and malt analysis can be very useful for all brewers. From beginner homebrewers to the largest craft brewers, knowing barley is knowing beer.

By Joshua Cody

44

THE HOMEBREWER'S GUIDE TO BARREL-AGED STOUTS

Modern barrel-aged stouts are thick, smooth, and flavorful. Learn to make these rich stouts yourself the same way the world's top breweries are brewing them.

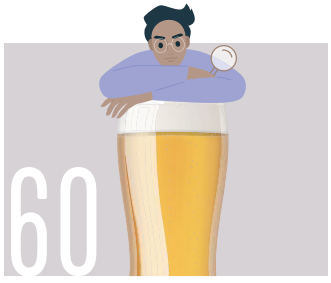
By Ryan Pachmayer

54

DOES YOUR BEER SAY, "ALOHA?"

Pineapple sage transports one far away, with notes of fresh-cut pineapple and piña coladas. Use this unusual ingredient to deliver tropical notes that complement today's most popular hops.

By Lee Case and John Herreid



60

SKEPTICAL BREWING, PART 2

This second installment in the Skeptical Brewing series examines chalk additions, zinc toxicity, and aerobic fermentation. Challenge your assumptions!

By Leandro Meiners and Matias Cavanna

68

MY GRANDFATHER'S CROCK

Grandpa's beer was an acquired taste. I always wondered what it was like. Once the idea entered my head, it refused to leave. I had to do it: it was time to resurrect Grandpa's brewing crock.

By David Schmidt

76

COLOR CALCULATIONS AND MEASUREMENTS

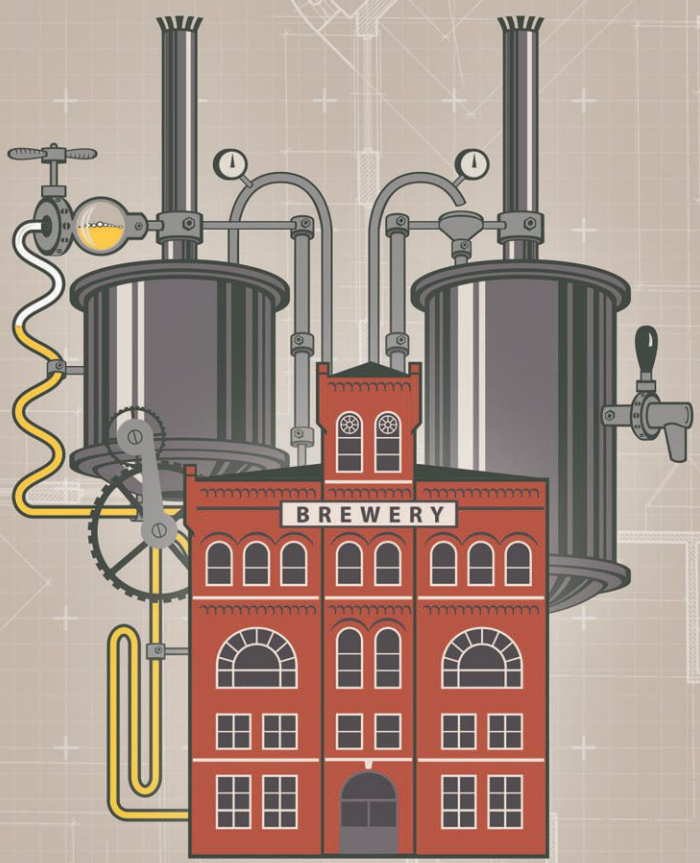
EVOLUTION OF MEASUREMENTS

First in a three-part series examining how beer color is determined.
By Thomas Kraus-Weyermann and Horst Dornbusch

DUDE, LET'S START A BREWERY!

"I WAS ON THE PHONE EVERY DAY TALKING TO BANKERS, TRYING TO CONVINCE THEM THAT IT WAS A GOOD IDEA TO OPEN A BREWERY DURING THE PANDEMIC.

ONE OF THE BIGGEST CHALLENGES WAS JUST FINDING FUNDING. IT WAS INCREDIBLY DIFFICULT, AND IT'S ALREADY DIFFICULT WITHOUT A PANDEMIC. THERE ARE HIDDEN COSTS THAT YOU HAVE TO WORRY ABOUT AS YOU START GOING INTO THIS. YOU ALSO HAVE TO MANAGE MULTIPLE PROJECTS AND IF YOU DON'T FOLLOW UP WITH PEOPLE, THEY WILL NOT FOLLOW UP WITH YOU."



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Dude, Let's Start a Brewery!
Season 2, Episode 23

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(zī'm ər 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

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HOME BREW CON 2022

Homebrew Con 2022

The 44th annual National Homebrewers Conference will take place June 23 to 25 at the David L. Lawrence Convention Center in downtown Pittsburgh, Pa. We haven't seen one another in person since 2019, so come to *Pittsbeergh* and reconnect with your homebrew community.

Registration for Homebrew Con 2022 opens March 23! Sign up by April 24 to receive Early Bird discounted pricing. Two registration levels are available for Homebrew Con 2022:

- **Full conference registration** includes access to all educational sessions, plus all social events
- **Social registration** includes access to the Homebrew Expo, Social Club, National Homebrew Competition awards ceremony, book signings, and nightly social events. It does not include access to educational sessions.

In addition to selecting a base package, attendees can tap into exclusive extras at registration with the Very Important Brewer (VIB) add-on. A limited number of VIB tickets are available, so get them while they're hot.

Discounted room rates at Homebrew Con partner hotels—The Westin Pittsburgh and Omni William Penn Hotel—are available through May 24 and May 1, respectively. Book early for best selection.

All 2022 Homebrew Con attendees must be members of the American Homebrewers Association and of legal drinking age (21). All attendees, exhibitors, volunteers, and staff will be required to show proof of full COVID-19 vaccination or supply a negative COVID-19 test result taken within 72 hours of arrival. More details can be found at HomebrewCon.org.

See you in Pittsburgh!

Tested Products

By Dave Carpenter

Every now and then, manufacturers offer to send us demo products to review. The Tested Products section offers us a chance to try out homebrewing supplies and let you know what we think. Everything we consider gets put through the wringer by AHA staff homebrewers who brew regularly and understand what makes and breaks great brew gear and ingredients.

Our policy at *Zymurgy* is to only publish reviews for products we genuinely like. If we wouldn't recommend it to a friend, you won't read about it (but we *will* offer the vendor suggestions for improvement).

If you're a homebrewer who'd like us to consider a specific item, or if you're a manufacturer who thinks you might have the next great thing, send us an email at zymurgy@brewersassociation.org. We'll talk. No big whoop.

GRAINFATHER G40

With its latest all-grain brewing system, the G40, Grainfather builds on years of user feedback gleaned from the Grainfather Connect (now called the G30) and offers a number of design improvements. I recently had the opportunity to run it through a few test batches.

The Grainfather G40 is *big* and, thus, only available in a 230-volt model. You'll need a 220- to 240-volt circuit that supplies at least 15 amps. The included power cord features a NEMA 6-15 plug, but the product manual suggests connecting to a 30-amp dryer socket or a 50/60-amp electric oven supply with an appropriate adapter. If this makes you nervous, know that the G40's design incorporates thermal fuses to prevent its overheating.

Like its predecessor, the G40 relies on a removable grain basket to mash and boil in the same unit. Unlike the G30, however, there's no top plate or overhead pipework. Instead, the updated grain basket includes perforations in the side wall, while the recirculation pipe mounts directly to the main body and mates to a flexible silicone hose whose output can be directed wherever you like.

After you've cleaned the G40 for its initial run, you can use the included controller or the Grainfather app to control your brew. It really is just a matter of following directions, although novice brewers may want to read up on the brewing process for context. I ran a single-temperature mash on my first try and step mashed a New Zealand–style Pils on the second go (see recipe for A Lager He Couldn't Refuse on page 14). Although the G40 includes a false bottom, I still recommend a hop spider to reduce kettle trub.

Grainfather suggests occasionally removing the internal pump for deep cleaning. Getting the pump out of the base is a cinch, and the use of pinch hose clamps is a thoughtful design touch. Reassembling the pump is straightforward, but reinstalling it may frustrate those not blessed with small fingers. I ultimately deployed tweezers and a magnetic screwdriver to work in the restricted space.

What impresses me:

- The G40 produces ridiculously clear wort. That's typical for a recirulating mash system, but it's nonetheless impressive.
- Mash efficiency is high, and sparging is easy, with batch sparging and fly sparging similarly straightforward.
- The sight glass within the external pipe is reversible. U.S. models default to gallon markings, but if you prefer rational units of measure, just loosen the pipe and spin the sight glass for liters.
- Step mashes are a breeze: program the required mash rest times and temperatures in the app, and the G40 takes care of them.
- The included counterflow chiller is intuitive to use and can be readily adapted to other equipment for homebrewers who brew on multiple setups.
- The G40 is compact considering its 10-gallon yield. It's nice that the heating element and pump remain hidden away inside the body of the unit.

What leaves me wanting:

- Fully draining the G40 requires removing a hex nut on the external pipe. For about $30, you can replace it with a specially designed ball valve from Grainfather, but given the price point of the G40, I'd rather the valve were included standard.
- On first use, the Grainfather app for Android periodically lost contact with the brew session, which was frustrating. This appears to have been fixed in the latest release, though.
- Lifting the grain basket is a challenge. This isn't specific to the G40, though—wet grain is heavy, and more wet grain is heavier. Nonetheless, solo brewers without a pulley system or titanic musculature might prefer the smaller G30.

I think the Grainfather G40 is an excellent choice for the large-batch homebrewer who prioritizes a compact, simple rig. Although the price tag is steep, it compares quite favorably with what one might spend to build a traditional three-vessel electric RIMS system. The Grainfather G40 retails for $1,499 and is available from homebrew shops and at grainfather.com.

Photos © Grainfather

AHA Elections

VOTE FOR YOUR AHA GOVERNING COMMITTEE REPRESENTATIVES

All AHA members are invited to vote in this year's AHA Governing Committee election. Members of the Governing Committee connect AHA staff with the greater homebrewing community, provide AHA staff with guidance, and make decisions about the future course for your association.

In this year's election, twelve AHA members are running to fill three open seats. Review the candidate statements on HomebrewersAssociation.org and cast your vote.

Many thanks to outgoing Governing Committee members Denny Conn, Donna Reuter, and Carvin Wilson! We all appreciate your service to the AHA and commitment to the homebrewing community.

Governing Committee members serve three-year terms, during which they participate in regular conference calls, serve on topic-specific subcommittees, and take part in an in-person meeting each June at Homebrew Con (the 2020 and 2021 meetings had to be virtual, though, because, you know, COVID-19).

Find the online ballot at HomebrewersAssociation.org and cast your vote by midnight on March 31, 2022. Thank you!

Homebrew Legislation

OHIO

Ohio homebrewers have new reasons to celebrate after Gov. Mike DeWine signed Senate Bill 102 into law on Wednesday, December 22, 2021.

Effective March 23, 2022, the newly enacted legislation allows, among several provisions, a brewpub, microdistillery, or winery to host a homebrew event if the entity suspends its permit privileges in the area where the event is held and informs the Division of Liquor Control and the Ohio Public Safety Commission that it is hosting the event within 10 days of the event. It also specifies that a homebrewer or a homebrewer's designee may transport homemade beer or wine, fermented by the homebrewer, without the normally required permit.

AHA Governing Committee member Goose Steingass's tireless efforts were instrumental in advancing this effort. Goose spearheaded the work, met with Ohio state senators and representatives, and coordinated with the AHA. Congratulations, Goose, on this achievement!

MISSOURI

House Bill 2070 would allow homebrewers to take their beer to licensed microbreweries three times per year or any number of times if the microbrewery is the primary meeting location of a homebrewing association. Homebrewers may also bring their beer to licensed microbreweries for organized events at which beer is available without a separate charge. The bill requires that homebrewing associations and hosts of organized events carry homebrewing liability insurance.

Homebrew Shop of the Year Award

Sponsored by: BSG HandCraft

The local homebrew shop plays an important role in our community, and not just as suppliers of ingredients and equipment. These small businesses serve as advocates for homebrewing and contributors to their local communities. Of the countless craft beer success stories today, how many started as aspiring homebrewers with a visit to their local shop?

The Homebrew Shop of the Year Award aims to recognize the integral role that homebrew shops play in the homebrewing community. All AHA members are eligible to nominate their favorite shop. If your go-to homebrew supply shop is deserving of recognition, take a few minutes to submit a nomination for the Homebrew Shop of the Year Award at HomebrewersAssociation.org/ShopAward. Members of the AHA Governing Committee evaluate all of the nominations and determine a winner.

The winner of the 2022 Homebrew Shop of the Year award will be announced at Homebrew Con in Pittsburgh on June 25.

Club Insurance

Club members, if you are looking for an affordable insurance plan specifically catered toward homebrew clubs, we've got you covered. The AHA works with West's Insurance to provide a general and liquor liability policy to clubs for just $4.40 per club member per year. March 1 is the deadline to sign up for the half-year policy term ($2.20/member) that runs from March to September. The annual policy term enrollment is open July 1 to September 1 and runs from September through August.

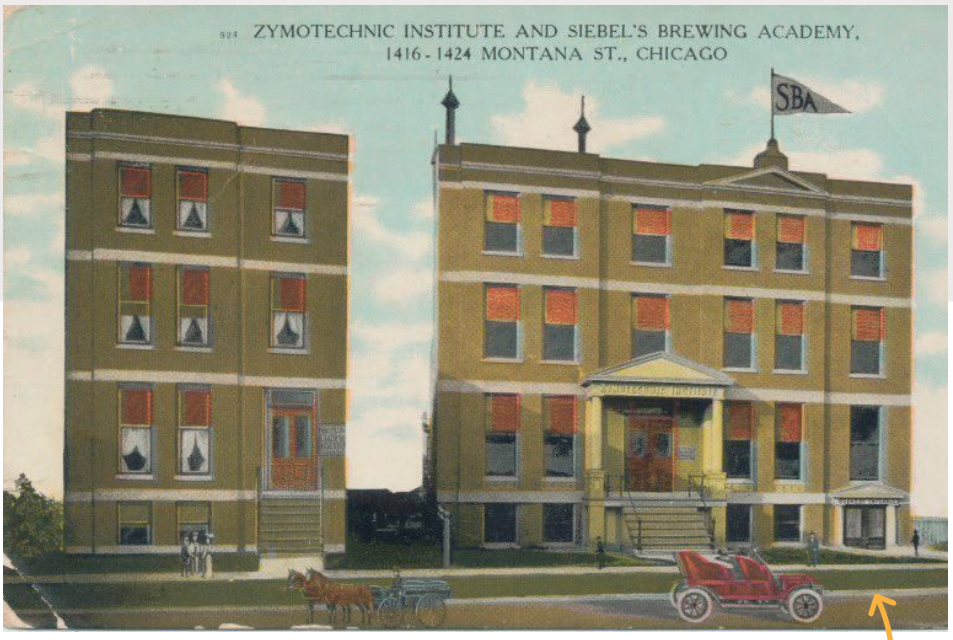
The AHA wants your club to be covered and, of course, we want club members to also be AHA members, so we will reimburse any club's insurance premiums if 75 percent or more of club members are AHA members.

More info on this program is available on HomebrewersAssociation.org.

Radegast Club of the Year Award

The AHA Radegast Club of the Year Award (a.k.a. the Awesome Club of Awesomeness Award) is all about showcasing what makes homebrew clubs awesome. Club nominations for the 2021 Radegast Club of the Year Award must be submitted by March 31. If you are a member of an awesome homebrew club, take this opportunity to share with the rest of us what your club is all about. Submit entries via the nomination form at HomebrewersAssociation.org. Entries will be judged by members of the AHA Governing Committee.

The winner of the 2022 Radegast Club of the Year Award will be announced this summer at Homebrew Con in Pittsburgh on June 25.



150 Years of the Siebel Institute

By Keith Lemcke

Since its formal establishment in 1872, the Siebel Institute of Technology has been most closely associated with brewing-related education and technology development as applied to large-scale commercial brewing operations. While the Institute's impact on the brewing industry over its 150-year history has been substantial, it has also immeasurably influenced brewing at every level.

Siebel Institute was established in the late 1800s by Dr. John Ewald (J.E.) Siebel, who arrived in the United States from Germany in 1866 among waves of European immigrants seeking a better way of life.

The late 19th century witnessed industry-changing innovations such as mechanical refrigeration and distribution via rail transportation, which allowed many breweries to grow substantially while others collapsed. Growing breweries needed to improve beer quality and stability to compete, along with training in engineering and laboratory sciences to understand how innovations in mechanization and microbiology applied to their practice.

With training and experience in multiple sciences related to brewing, Dr. Siebel saw an opportunity and established the Zymotechnic Institute in the late 1860s as a testing and research facility specializing in brewing practice. After several successful years of laboratory operations, he then recognized a need for brewing education and founded Siebel's Brewing Academy, and in 1872 the school title was officially changed to the Siebel Institute of Technology.

J.E. Siebel introduced a scientific approach to the American commercial brewing industry using methods that improved the standards of production while supporting business growth. J.E. was a prolific author and contributor to brewing publications who wrote more than 200 articles, including a standard reference textbook on mechanical refrigeration. He earned a patent for his counterpressure racking system for carbonated beverage packing that is used by breweries worldwide to this day. His work in adjunct brewing was critical for the development of what would become recognized as the international lager beer style. This new development would also lead to better shelf-life stability and drinkability, and the international lager style remains the most popular beer style in world to this day.

Of greatest importance for Siebel Institute was the establishment of long brewing courses in 1900, which marked the beginning of a family legacy of providing education in brewing practice.

The Institute provided training that was specifically designed to meet the needs of commercial brewers. As author and beer expert Randy Mosher states, "The courses offer 'right-sized,' practical, job-focused training that kept the US and the world with eager and well-informed brewers that allowed breweries to grow as market demand allowed." The Diploma

Photos courtesy of Siebel Institute

Program provided content that covered each critical area of brewing production and packaging and quality control, along with rapidly emerging areas of interest such as yeast and fermentation science. Training was conducted in a full-time study format to allow students to complete their studies and return to brewing operations in as short of time as possible, a format that has continued to this day.

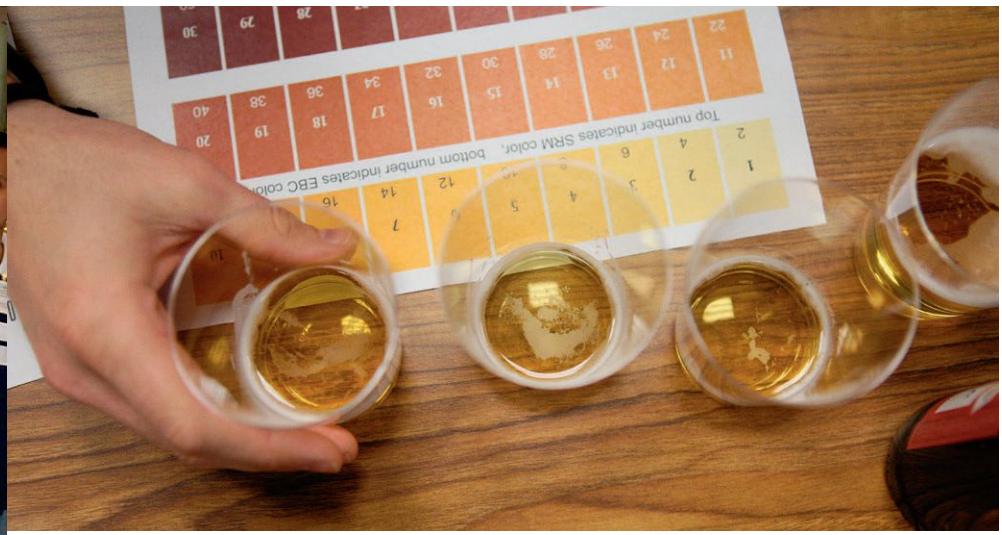
Mirroring the brewing industry itself, Siebel Institute has survived many changes and challenges. In 1919 at the onset of Prohibition, J.E. Siebel passed away. Prohibition caused the school to close to brewing instruction and focus instead on general beverage training and professional baking education, a subject the school had also taught in the lead up to Prohibition. The school did not return to brewing instruction until 1933, when Prohibition was finally repealed, at which time it again welcomed brewing students and reopened its lab for brewing-related analysis.

The late 1920s through the 1940s brought the Great Depression and World War II, both of which affected commercial breweries and the Institute. Despite those challenging times, the Siebel Institute survived, and under the leadership of Dr. Siebel's sons and grandsons, the company rose to serve the international brewing industry once more.

By the 1950s, breweries counted on the Institute for a wide range of products and services, including education, publications, analytical services, research, consulting, and other key areas. The Peterson Avenue location of the Institute was considered the crossroads for brewing industry innovation and education. Through the 1960s and 1970s, classes were mostly occupied by the staff of large breweries.

"Many, many large and mid-sized regionals were sending people, including overseas breweries," commented Ron Siebel, the last surviving member of the Siebel family. Along with courses, Siebel Institute was a leading research facility that conducted collaborative projects with companies and groups like the American Society of Brewing Chemists (ASBC) and Master Brewers Association of the Americas (MBAA), in addition to its own proprietary research. The school conducted annual technical seminars throughout the 1970s that brought the best researchers and scientists in brewing into one room for discussing common challenges facing the brewing industry.

By the 1980s, the school had introduced a short course to provide technical training for those seeking to enter the market with no prior commercial brewing experience, especially those entering what became known as craft brewing. According to Ray Daniels, founder and director of the Cicerone Certification Program, "Siebel has influenced the knowledge and careers of brewers throughout the industry since before the craft beer movement even began."



In 2007, Daniels designed the "Start Your Own Brewery" course, which has been key to the success of many entrepreneurs. Along with Ray Daniels, Randy Mosher conceived and developed the Master of Beer Styles course, which gives in-depth analysis in the history and how-to on creating authentic beer styles. "There was an obvious need for a clear delineation of the styles, aided by hands-on tasting and recipe information," says Mosher of the course, which formed the outline for Mosher's best-selling book, *Tasting Beer*.

In 2000, Siebel Institute, in partnership with Doemens Academy of Munich, created the World Brewing Academy (WBA) to offer brewing education with a global viewpoint and began running jointly created and run campus courses and programs in 2001. The year 2002 marked the first web-based brewing education ever offered, and to wide success. Siebel and its WBA partnership continue to offer a wide range of web-based brewing courses, programs, and individual subject matter lectures that address learner needs from beginner to advanced level.

Understanding the importance of the international nature of brewing, Siebel and Doemens introduced the only split-campus advanced-level brewing programs in the world, the WBA International Diploma in Brewing Technology and the WBA Master Brewer program, by which students first study in Chicago and then proceed to Munich to finish their programs.

In an increasingly diverse world of brewing techniques and beer styles, challenges remain for the Institute. New production techniques, "extreme" beer recipes, and use of alternative microbes and other practices require rethinking and researching how brewers brew. John Hannafan, Siebel vice president and director of education, states, "We aim to base the content structure in a way so no matter the size of facility one may be working at or wanting to work at, what is taught can be implemented anywhere. Within the past couple of years, I have added on to the time we spend covering these subject due to interest and demand, especially from the craft side."

Just as Dr. J.E. Siebel envisioned in his creation of Siebel Institute of Technology 150 years ago, today's Siebel Institute strives to stay ahead of the sciences, trends, and changes in technology towards meeting the needs of the brewing industry and helping today's students build their brewing knowledge.

Keith Lemcke is a former vice president of Siebel Institute. He holds a Diploma in Brewing from Siebel Institute and a Foundation Certificate from the Institute of Brewing and Distilling. He serves on the Brewers Association's Draught Quality and Draught Safety subcommittees.

Brew This!

A Lager He Couldn't Refuse

New Zealand–style Pils

Recipe courtesy of Dave Carpenter.

It's no secret that I'm a fan of the decoction mash for a handful of classic Continental beer styles. But this New Zealand–style Pils doesn't benefit from decoction. We're all about the hops here, but a step mash is still helpful for achieving that well-attenuated pale lager crispness. If you don't want to bother with a step mash, a single-temperature infusion mash at 150°F (66°C) is your best friend.

Batch volume: 10 US gal. (37.9 L)
Original gravity: 1.052 (12.9°P)
Final gravity: 1.011 (2.8°P)
Efficiency: 80%
Color: 3 SRM
Bitterness: 45 IBU
Alcohol: 5.4% by volume

MALTS

18 lb. (8.2 kg) Pilsner malt

HOPS

1 oz. (28 g) Magnum, 12% a.a. @ 60 min
1 oz. (28 g) Motueka, 7% a.a. @ 10 min
1 oz. (28 g) Waimea, 17.5% a.a. @ 10 min
1 oz. (28 g) Motueka, 7% a.a., whirlpool 10 min
1 oz. (28 g) Waimea, 17.5% a.a., whirlpool 10 min
1 oz. (28 g) Motueka, dry hop 5 days
1 oz. (28 g) Waimea, dry hop 5 days

WATER

Ca 50 ppm, Mg 10 ppm, Na 5 ppm, SO_4 105 ppm, Cl 45 ppm. Acidify sparge water to pH of 6. Use lactic acid or acidulated malt as required to target a mash pH of 5.3–5.4.

YEAST

4 sachets (44 g) Fermentis SafLager W-34/70

ADDITIONAL ITEMS

1 tablet Whirlfloc @ 10 min

BREWING NOTES

Mash 30 min at 145°F (63°C), 30 min at 160°F (71°C), and 10 min at 170°F (77°C). Boil 90 minutes. Chill to 47°F (8°C) and pitch yeast. Ferment at 47°F (8°C) until final gravity is reached. Lager for 5 weeks at 30°F (0°C), adding dry hops during the final 5 days of dry hopping. Carbonate to 2.6 volumes (5.2 g/L) CO_2.

EXTRACT VERSION

Replace the Pilsner malt with 16 lb. (7.25 kg) Pilsner liquid malt extract. Dissolve half the extract fully in hot water, bring to a boil, and boil 60 minutes, adding hops as indicated. Dissolve the remaining extract into the wort at flameout, add the whirlpool hops, and conduct a 10-minute hop stand. Top up with additional water if needed to achieve final batch volume. Chill to 47°F (8°C), pitch yeast, and proceed with recipe as indicated.

Beertographer Spotlight

JUSTIN GRAZIANO

We hired Justin Graziano to explore and shoot the cover of this issue of *Zymurgy*. He has shot beer for years now and was super excited to see what could be done to highlight the top ingredients you will read about in the features. Justin dropped us some behind-the-scenes photos and editor-in-chief Dave Carpenter asked Justin a few questions ...

Where do you live?
I am currently located in Santa Clarita, Calif., but prior to living here, I was located in Denver, Colo., for about three years, where I really learned about craft beer and the community that surrounds it.

How did you become a photographer?
Before I was a photographer, I was a graphic designer for more than 10 years, and I bought my first camera just as another creative outlet. I had no clue about cameras or even how to use them, but I knew it was something I really wanted to learn. I started by taking pictures of beer because I always loved label artwork, and I was already taking pictures of beer with my phone to check into Untappd, so it was an easy starting point. It quickly became an obsession, and my mind started to drift further and further into photography to the point that I knew I had to figure out how to make a career out of it. When I moved to Denver, that's when I was really able to spread my wings as a photographer working for small, independent breweries all over town. Now, I am currently working as a full-time content creator for The Bruery and freelancing on the side!

What is the inspiration for your craft?
I've always been inspired by storytelling, so I always do my best to tell a story through my photography, whether it's with props, ingredients, or setting a mood with lighting. When I'm photographing beer, I want the viewer to taste what they're seeing. So props and ingredients have always been key elements to my photography.

What is your connection to homebrewing and craft beer?
When I started drinking craft beer, it was pretty much the same thing as when I started becoming interested in photography. I became pretty obsessed with trying as many new beers as I could, and I was pretty intrigued by the process of making beer. When I heard that you could make beer from home, I immediately jumped online and bought my first 5-gallon homebrew kit and an AHA membership. I quickly learned that I am much better at drinking it than at brewing it! But the one thing that really connected me into craft beer had to be community. My wife and I always loved to go to new breweries and to sit at the bar to chat with the beertenders. We've made many great friends through it, and it's definitely a hobby that I am thankful for! It has opened up many opportunities for me.

How long have you been homebrewing?
I started homebrewing back in 2015 and I was brewing pretty consistently for about two years, but when I moved into a smaller apartment it became harder to do, so I slowed down a bit, but I occasionally still brew small 1-gallon batches for fun!

What is your favorite beer style or favorite beer to brew?
I've always been a hoppy beer lover, but when it comes to homebrewing, I've always loved making stouts.

Are there any Easter eggs or other details in the cover photo you'd like to draw our attention to?
One thing to point out is something you may not be able to see. The way I shoot these photos is by shooting each element in the photo individually and then combining them in Photoshop afterwards. It can be pretty challenging to make these photos look seamless, but I think it makes for a pretty fun and dynamic image!

FOLLOW JUSTIN ...
Instagram @ beerbreathco
youtube.com/justingraziano | beerbreathco.com

Photos © Justin Graziano

Women's Int'l Beer Summit

APRIL 22–24, 2022

The 2nd Annual Women's International Beer Summit (WIBS) will be held April 22 to 24, 2022, and is presented by Grainfather! The WIBS team has created another fantastic lineup of speakers who will inspire and empower attendees to think bigger about their goals in the craft fermentation space. Whether you want to improve your homebrewing skills, open the brewery you have always dreamed of, go for a job in the industry you've always wanted, or increase your confidence in your own skills, this is the digital event for you.

WIBS was founded in 2021 by Melissa McCann, the former director of Queen of Beer. Melissa saw the need for solid connections as the world endured this ongoing pandemic. Together with friends in the industry and members of the SheBrew comp in Portland, Ore., they worked to pull off an unprecedented event highlighting, featuring, and speaking directly to women who brew, drink, and enjoy craft beverages. The 2021 summit was such a success that they formed a nonprofit organization to further the mission and agenda of the summit far into the future.

The Women's Craft Fermentation Alliance (WCFA) was born in autumn 2021 and is a 501(c)(3) organization that not only creates and hosts the Women's International Beer Summit, but also works with cutting-edge women, organizations, and initiatives to further diversify the craft fermentation space. Melissa McCann serves as executive director, alongside community outreach director Vickie Olson, media/web/social media director Michele Wonder, and technology director Crystal Gupta.

So far, the WCFA has partnered with Brave Noise to create a homebrew fundraising digital toolkit and is now proud to be the home of the Hecate Fund. Created by Advanced Cicerone Jen Blair, the Hecate Fund will help more historically excluded people in the industry attend educational opportunities, such as WIBS 2022, the Craft Brewers Conference, and Homebrew Con.

The entire WCFA team is working hard to bring another epic event to the craft fermentation community, for both professionals and home enthusiasts. This year's event will feature more speakers and content and has broadened to include other craft beverages such as wine and spirits. Expect amazing sessions with exceptional speakers such as Dr. Christina Wade, a historian and anthropologist sharing her knowledge of Medieval Celtic brewing practices, Brienne Allen and Ash Eliot discussing the Women of the Bevolution, and a keynote by Julia Herz, Executive Director of the AHA.

WIBS 2022 will be virtually hosted on the Crowdcast platform. Early bird ticket sales ($40) run March 1–15, 2022. Tickets for the event will be $50 after the early bird period. Interactive Bonus Boxes will be available to the first 300 attendees with US shipping addresses. These boxes put in attendees' hands hops and malt samples that allow an interactive aspect to several of the scientific sessions. The boxes will also contain other swag and goodies from WIBS sponsors and supporting breweries.

Please visit wcfa.beer to see our lineup of speakers, view scholarships, and purchase tickets beginning March 1, 2022.

Melissa McCann

Crystal Gupta (top)
Vickie Olson (left)
Michele Wonder (right)

Photos courtesy of Women's Craft Fermentation Alliance

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Brewing for Good

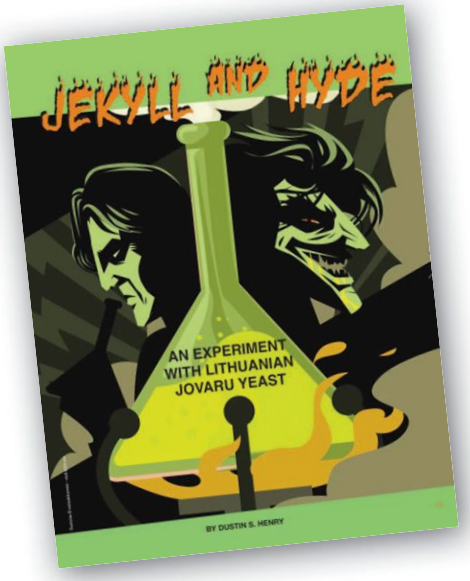
Photo © Getty/photo_chaz

***Dear* Zymurgy,**

I just received and read the Jan/Feb 2022 issue and wanted to say the article "Brewing in Memoriam" was very touching. I am a retired Marine and I have had the honor of notifying families of their fallen Marines. While I have never brewed for a specific Marine, I do brew an English barleywine once a year in honor of the Greatest Generation. I have a 3-liter boot, and the crowd we have over for the brew all stand in remembrance and toast—until the boot is empty—a generation that will never come again.

I thought Jared Spidel's article was exceptional because of the back story involving the beer. I have lost Marines who have succumbed to the troubles of PTSD and mental health, and I wish to send him my heartfelt condolences from this ol' Marine to his Air Force family. Much love to you and the folks at AHA.

Cheers!
Tim Ellenbecker
Master Sgt., USMC (ret.)
Deltona, Fla.



vors, but also a banana character similar to that from a hefeweizen yeast. The banana character disappeared a few weeks later once the yeast had settled to the bottoms of the bottles. Those beers usually fermented fast, within seven days.

Once, the same beer fermented with Jovaru earned two bronze medals in the 10A. Weissbier and 25B. Saison BJCP subcategories with a grist of 50 percent wheat (please don't tell Gordon Strong about it.)

Some months ago, I started controlling fermentation temperature with a thermostat and a thermal wrap, and I discovered that at 35ºC (95ºF), Jovaru brings a distinctive lemon-zest and lemon-pith aroma and flavor, along with the mild spicy Belgian character, while the hefeweizen character I had noticed before is not produced under those circumstances. At those temperatures, Jovaru ferments really quickly, within five days.

In my experience, Jovaru is a very versatile yeast that ferments fast and works for Belgian-style beers like saison, wit, and even tripel, and with a fermentation strategy, it can even produce very tasty weissbiers.

Cheers!
Luis Cuellar

Zymurgy *editor-in-chief Dave Carpenter responds:* *Thanks for sharing your experience with this yeast, Luis! While we were preparing the Jekyll and Hyde article for the Jan/Feb 2022 issue, I decided to experiment with Jovaru a little myself. My homebrew club hosted a wort share last November at a local brewery, from which I took home 15 gallons (56.7 L) of 1.066 sweet wort—the grist could be considered strong English brown ale—that hadn't yet been boiled. I pulled 5 gallons (18.9 L) and fermented a raw ale with the Jovaru yeast. I fermented the remainder with good ol' S-04.*

The finished beer is like drinking a liquid walnut and is unlike anything I've ever brewed before. Although the grist itself contributes some nuttiness, comparison with the other beer made from the same wort suggests the black walnut character comes from the Jovaru. I didn't apply strict temperature control, but both beers were pitched at 65°F (18°C) and probably never exceeded 70°F (21°C).

A MULTIFACETED YEAST, INDEED

***Dear* Zymurgy,**

I've been using Jovaru yeast for around two years, starting with fresh pitches and then reusing it for around eight to ten generations. I really love that yeast, and my experience is quite different from the one described by the author of the *Jekyll and Hyde* article (Jan/Feb 2022).

I live in Colombia, South America, and used to ferment at room temperature, around 25 to 28ºC (77–82ºF). At those temperatures I always got a mild spicy Belgian character, very similar to a saison yeast, with light lemon zest aromas and fla-

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

YOUR HOMEBREW LABELS

My daughter designed a simple label for my Talus-based IPA brewed in the garage shop, hence the "Shopworks Brewery," which has a view of the Topa Mountains in Southern California. (Homebrewer 5 years, AHA member 3 years)

Scott Sowers
Thousand Oaked Homebrewers
Thousand Oaks, Calif.

This label was made for me by a graphic designer friend who also enjoys brewing. Most of my beer names are inspired by something that happens during the brewing process. In this case, I was dodging bees and wasps during a warm spring afternoon. I took the German translation for "bee sting" for a little alliteration.

It was my first time using Philly Sour after a few years using kettle souring for my Berliner weisse, and I was pleased with the results. (Homebrewer 8 years, AHA member 2 years)

Patrick Lolli – *Kennett Square, Pa.*

YOUR HOMEBREW LABELS

This bottle label is for a session strength IPA named *Drøm*, which is the Norwegian word for "dream." This beer was based on my first-ever IPA brewed in 2019, which ended up winning gold in a local homebrew competition! It gave me the drive to continue pursuing my newfound passion. My wife designed the label art by hand to evoke a peaceful daydream about citrusy hops. The beer has a further, deeper meaning: I have a dream of moving permanently to Norway with my wife and brewing beer. It was a huge honor being able to bring this beer to Norway to share with a few of my wife's relatives. The accompanying photo was taken on top of a popular ski hill in Oppdal, Norway. We have met many challenges along our journey to relocate and have no intention of giving up on this dream. Skål! (Homebrewer 3 years, AHA member 2 years)

Matt T. Torjusen
Bellingham, Wash.

I brewed this beer for a homebrew competition in Lititz, Pa. We were one of the top 10 finalists and were able to pour the day of the festival. Our beer was chosen as the Brewers' Choice and will be brewed at Cox Brewing Co. in Elizabethtown, Pa.

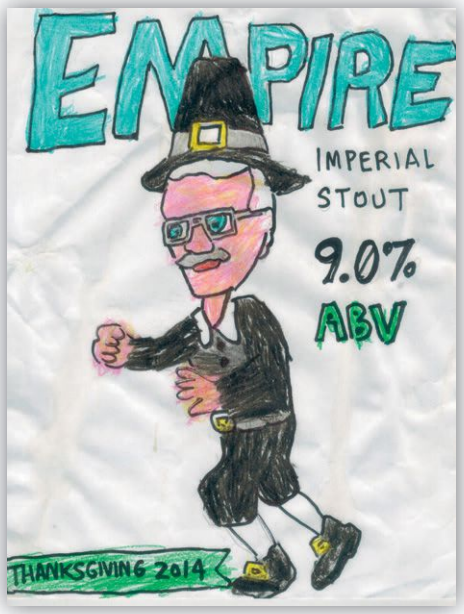
The beer is brewed with Proximity American two-row, flaked oats, and a touch of Vienna for color. It's hopped with Mosaic, Strata, and Simcoe. Our goal was to make a hazy American IPA with a little West Coast soul, which is why we added the Simcoe. We also mashed a little lower to push the final gravity lower and deliver a crisper finish.

We brewed and dedicated the day to one of our namesakes, Tucker, who passed away in August 2021. We had custom shirts made, which we sold online and raised $200 for the SPCA. (Homebrewer 16 years, AHA member 7 years)

Joshua Shock,
Co-Brewed with Dave Hume
West Chester, Pa.

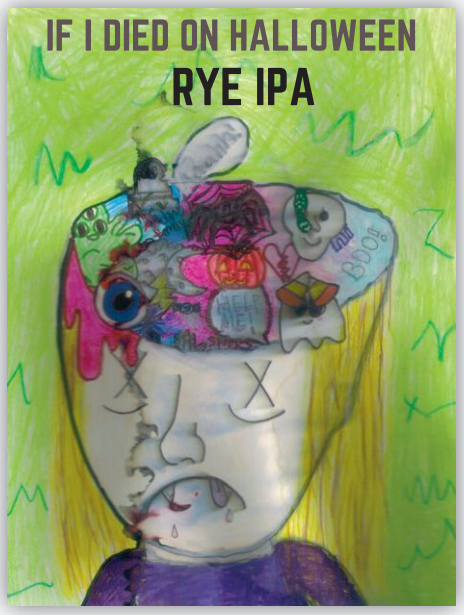
YOUR HOMEBREW LABELS

Our dad Chris, loves to brew beer and we love to make beer labels for him! – Ruby Anderson (10), Signe Anderson (12), and Chris Anderson (Homebrewer 15 years, AHA member 6 years) | *Edina, Minn.*



This label was inspired by a deceptively strong Imperial stout, the Notre Dame Fighting Irish, and the Empire carpet guy commercials from the 1980s.

– Drawn by Chris, colored by Signe (to give me time to enjoy a homebrew)

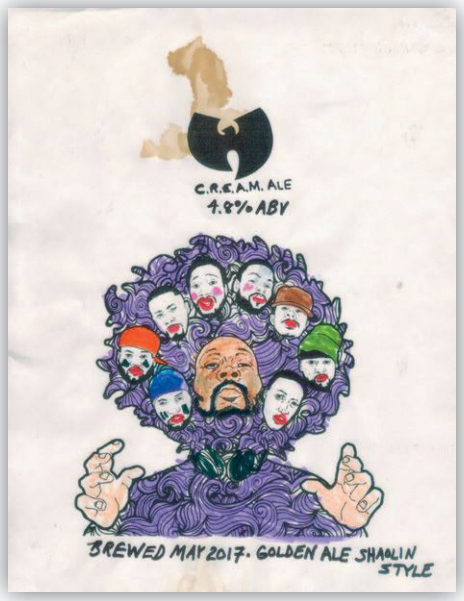


My goal was to collect all things Halloween—skull, candy corn, eyeball, and spider—and put them together for a spooky Halloween beer label!

– Signe

Ever heard of Santa Claus's evil twin Sinterklaas? Every child in Belgium and the Netherlands knows Sinterklaas because he rewards good kids with presents, gives the bad ones coal, and punishes the really bad ones by hauling them off in big burlap sacks to Spain via steamship.

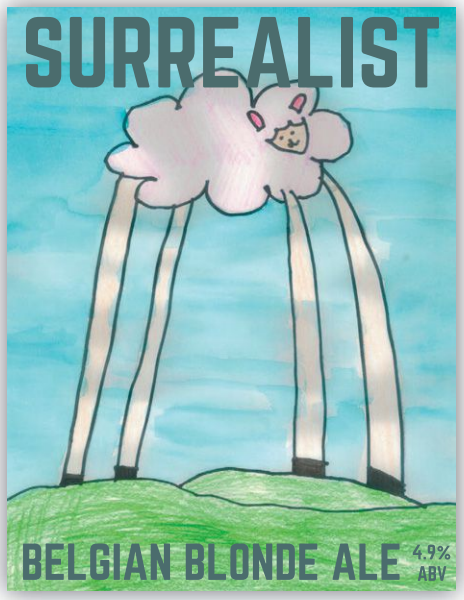
– Drawn by Chris, colored by Signe



<< As a longtime fan of the Wu-Tang Clan's music I brewed this C.R.E.A.M. Ale for my 40.5th birthday party. I had some creative differences with my co-label designer (then 8-year-old daughter Signe) because she gave the Clan members a kabuki/clown look. To RZA, GZA, Ol' Dirty Bastard, Method Man, Raekwon, Ghostface Killah, Inspectah Deck, U-God, and Masta Killa: she meant no disrespect.

Much love,
The CRZA (Chris Anderson)

>>
This fun, surrealistic beer label is inspired by Salvador Dalí.
– Ruby



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

My Rhodesian Ridgeback, Bjorn, snacking on spent malt during brew day.

Stephen Beukelman (Homebrewer 27 years, AHA member 11 years)
Sioux Falls, S.D.

Brewing an Oktoberfest and milk chocolate coffee imperial stout on a chilly day! The stout coffee beans are from a local roaster. Granola bars and dog treats made with spent grains.

Adam Meade (Homebrewer 1 year, AHA member 1 year)
Beckley, W.V.

The summer shandy will be served under careful watch by the one and only Shandy, a three-year-old Black Mouth Cur.

Bill Zarzycki (Homebrewer 2.5 years, AHA member 1 year)
South Jersey Fermentation Club
Marlton, N.J.

Mashing an Evil Twin clone with my homemade electric BIAB system.

Frank Beebe (Homebrewer 23 years, AHA member 10 years)
Golden, Colo.

My brew kitchen manager.

Jim Martin (Homebrewer 15 years, AHA member 2 years)
Georgetown, Ky.

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*!

SCAN ME

YOUR HOMEBREW EXPERIENCE

Mashing in for a pale ale with my wife and cohost Shannon of Double Hopbeat Podcast.

James Spicer (Homebrewer 12 years, AHA member 6 years)
Uxbridge, Mass.

Winston keeping an eye on the IPA.

Larry Bryant (Homebrewer 20 years, AHA member 7 years)
Louisville, Ky.

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Brewmaster, New Glarus Brewing Co.

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Watch Dan tell us Why He Brews with Briess
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Brewing with Popcorn

By Jason Simmons

Like many brewers, I am always looking for the next fun ingredient to brew with. While some ingredients might be rare, odd, or silly, others just make sense. I was reading about malts and adjuncts, and the topic of torrefied grains caught my attention.

Torrefaction is the process of slowly heating a grain kernel, which turns the kernel's internal moisture into steam. This steam is enough to hydrate and gelatinize the starch within the kernel. When the pressure becomes too great, the kernel explodes and exposes the gelatinized starch.

The gelatinized, exposed starch in torrefied grain is very useful to brewers because we can simply add it to our standard mash. A few torrefied grains are available to brewers, the two most common of which are torrefied barley and torrefied wheat. There's another commonly overlooked option, though: torrefied maize, better known as popcorn. And, it turns out you can brew with it. →

CHOOSING A POPCORN

Popcorn is undoubtedly the world's best-known torrefied grain. According to Northwestern AG Network, "The Average American eats 68 quarts of popcorn each year, and Americans consume 17.3 billion quarts each year." That is a lot of popcorn! The majority of it is sold as movie theater popcorn and is a billion-dollar industry. Corn was first domesticated roughly 10,000 years ago in what is now Mexico, and archaeologists have been able to trace the use of popcorn back to 3600 BCE.

While popcorn has been a snack for several thousand years, it was in 1885 that Charles Cretor, a Chicago candy store owner, invented the world's first modern popcorn machine. The machine was displayed a few years later in 1893 at the World's Columbian Exposition (Chicago World's Fair).

There are two main varieties of popcorn: butterfly and mushroom. The names refer to the shape formed when the kernel pops. Butterfly popcorn is snowflake shaped and irregular, with tender wings. This makes it perfect for movie theater popcorn, as it can support and hold butter and salt. Mushroom popcorn flakes out like a large puffball that resembles puffball mushrooms. The round shape of mushroom popcorn makes it an ideal vehicle for caramel or powdered cheese. These two varieties have the same flavor, and they can even come from the same cob. However, today's hybrid plants can now produce 100 percent of a particular variety on a single cob.

We all have had the experience of getting popcorn hulls stuck between our teeth. When it comes to brewing with popcorn, though, these hulls are not like other grain hulls that can help in lautering. They can prove to be problematic depending on the percentage of popcorn used in the grist bill.

Popped butterfly popcorn is much smaller than mushroom variety popcorn. This might not seem like a big deal, but when you are popping for weight, it will take much longer and leave more hulls to deal with in the mash. Mushroom popcorn is easier to handle because it yields large popcorn balls with hardly any hulls. I feel that mushroom popcorn is easiest to work with in the brewery, but the choice is yours.

CALCULATING DIASTATIC POWER

The cream ale recipe accompanying this article includes 4.75 lb. (2.15 kg) 2-row barley malt, 2.5 lb. (1.13 kg) 6-row barley malt, and 2 lb. (907 g) mushroom popcorn. Is there enough diastatic power in the two malts to convert the popcorn?

Diastatic power is measured in degrees Lintner (°L, not to be confused with Lovibond), though you might see Windisch-Kolbach used in Europe. It takes about 30°L to convert 1 pound of starch to sugar (30°L/lb.). Popcorn has no diastatic power (0°L/lb.), while 6-row and 2-row malted barley have about 160°L/lb. and more than 110°L/lb., respectively. To check the grist's ability to convert, you add up all the contributions to diastatic power and check that there's enough to go around.

The 2-row malted barley will yield at least 110°L/lb. × 4.75 lb. = 522.5°L. The 6-row malted barley will yield approximately 160°L/lb. × 2.50 lb. = 400.0°L.

We have two pounds of popcorn, each of which needs about 30°L to convert. So we can assign it a "negative" diastatic value: -30°L/lb. × 2.0 lb. = -60°L.

The total weight of the grist is 9.25 lb., which means we need a total value of 9.25 lb. × 30°L/lb. = 277.5°L for conversion. The amount of diastatic power available is 522.5°L + 400.0°L = 922.5°L. So not only is there enough to convert the popcorn, but we have 922.5°L – 60°L = 862.5°L extra, which is good for as much as 28.75 lb. (862.5°L ÷ 30°L/lb.) more unmalted grain, far more than is needed.

Photos courtesy of Jason Simmons

SOURCING POPCORN

There are plenty of popcorn choices at the local supermarket, but some are better suited to brewing than others. Skip the microwaveable popcorn, which can include salt, fat, and other inappropriate ingredients, and instead seek out packages of plain kernels. Occasionally, you might be able to find specialty popcorn such as standard mushroom variety, blue popcorn, red popcorn, multi-color popcorn, and other gourmet varieties. If your local supermarket does not have the specific variety you are looking for, then consider visiting a specialty market with better selection.

For our brewery, we wanted 50-pound bags of mushroom popcorn. We started by calling all the numbers on the popcorn containers that we found on the shelves at the supermarkets had a surprisingly difficult time finding what we were looking for. Eventually, we found Reist Distributors in Mount Joy, Pa., which offers a wide variety of popcorn and even had the 50-pound bags we wanted. They offer shipping, but as Lancaster County is a short drive from the brewery, it was worth the visit. For professional popcorn brewing needs I highly recommend Reist Distributors.

POPPING PROCEDURES

Popcorn's outer shell is strong and impervious to moisture. The moisture contained within the kernel is in the range of 14 to 20 percent moisture content. As the popcorn is heated, the steam gelatinizes the starchy endosperm, and when the popcorn reaches roughly 356°F (180°C), the kernel builds pressure until it expands 20 to 50 times its original size then reaches its pop pressure at roughly 135 PSI.

When the kernel pops, the gelatinized starch is exposed. If you heat the kernel too quickly, it will scorch and explode without gelatinizing the starches. If you heat it too slowly then the steam will escape from the tip of the kernel where it was attached to the cob. A popped kernel is called a "flake," and a kernel that fails to pop is called an "old maid."

Brew This!

Big Pink Flamingo

Cream ale brewed with popcorn

Recipe courtesy of Lindgren Craft Brewery.

Batch volume: 5 US gal. (18.9 L)
Original gravity: 1.042 (10.5°P)
Final gravity: 1.008 (2.0°P)
Efficiency: 75%,
Apparent attenuation: 82%
Bitterness: 15 IBU
Alcohol: 4.49% by volume

MALTS

4.75 lb. (2.2 kg) Rahr 2-row barley malt
2.5 lb. (1.1 kg) Rahr 6-row barley malt
2 lb. (907 g) mushroom popcorn

HOPS

0.75 oz. (21 g) Cluster whole leaf hops, 5.5% a.a., first wort

YEAST

11 g Lallemand Nottingham Ale and 21 g Lallemand Diamond Lager

WATER

Carbon-filtered Pennsylvania Appalachian mountain well water at the brewery on the farm.
Ca 24 ppm, Mg 10 ppm, SO_4 15 ppm, Cl 50 ppm, Na 69 ppm, HCO_3 108 ppm

ADDITIONAL ITEMS

2 mL Fermcap, optional @ 90 min
3 g Irish Moss, rehydrated 15 min @ 15 min
3 g diammonium phosphate (DAP), rehydrated 15 min @ 15 min
10 mL White Labs WLN4000 Clarity Ferm, optional @ yeast pitch
20 mL Biofine Clear before cold crashing, optional

BREWING NOTES

Assumed volumes are as follows:

- 9 gal. (34.1 L) pre-boil
- 6 gal. (22.7 L) post-boil (after evaporation losses)
- 5.5 gal. (20.8 L) into fermenter (after thermal shrinkage and kettle trub losses)
- 5.0 gal. (18.9 L) final batch volume (after fermenter trub losses)

Air pop the popcorn and add to the milled malt before mashing in. Mash at 150°F (66°C) for 1 hour, targeting a mash pH of 5.2–5.4 (adjust with 1% acidulated malt in grist or phosphoric acid if needed).

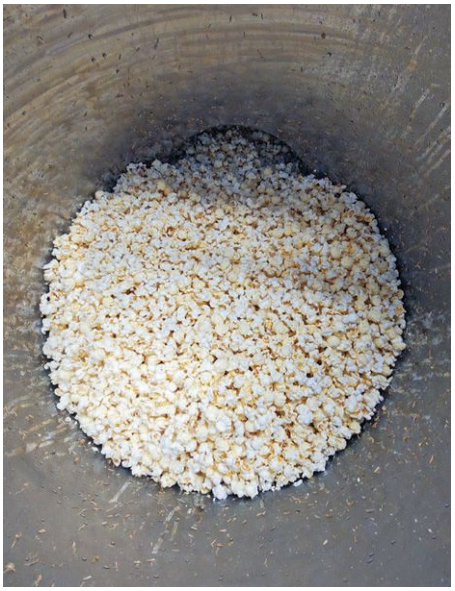
Vorlauf until wort is bright, usually around 30–45 minutes. Add first wort hops to kettle. Sparge with 172°F (78°C) water and lauter until target preboil volume reaches 9 gal. (34.1 L) or runoff specific gravity falls to 1.004 (2°P).

Add optional Fermcap to kettle to reduce foam. Boil 90 minutes. Rehydrate Irish moss and DAP for 15 minutes before adding to kettle.

Whirlpool for 10 minutes and then rest for 10 minutes. Knock out at 65°F (18°C).

Add optional Clarity Ferm, pitch yeast, and ferment at 60°F (16°C) until terminal gravity is reached. (Clarity Ferm promotes clarity and can reduce a beer's gluten concentration to below the 20 ppm required by the FDA to label a product "gluten free.") Allow beer to warm to 68–70°F (20–21°C) and hold 2–3 days for a diacetyl rest.

Add optional Biofine Clear, cold crash to 32°F (0°C), and lager for 1–2 weeks. Transfer beer to keg and force carbonate with 2.7 vol. (5.4 g/L) CO_2 or bottle with priming sugar and condition at 60–65°F (16–18°C) for 3 weeks.



> With a fresh outlook on popcorn as a torrefied grain, what ideas are popping up in your head?

Salt and oil are not beneficial to beer, so avoid using a movie-theater-style popper that you've already used to make snacks. Instead, use a clean hot-air popper so as not to contaminate the popcorn. This requires little effort for homebrewing, but that is not the case for the large volumes needed at a commercial brewery.

We discovered that we could only run three air poppers at a time at the brewery without tripping electric breakers. Even with three brand-new air poppers running simultaneously, it took six hours to air pop 25 pounds of popcorn kernels. During those 6 hours, the air poppers became very hot, and removing the plastic lid to refill the popper became a bit of a nuisance.

As with most ingredients, fresh is best. I suggest popping the popcorn the day of brewing if homebrewing or if brewing a large batch then the day or two before the brew day, depending on how much you have to pop.

BREWING SPECIFICATIONS

The biggest question I had when choosing to use popcorn concerned extract potential, or gravity points per pound per gallon (PPG). Knowing this is important to dialing in a recipe of an expected strength. Other torrefied and flaked grains yield the same PPG as their base grains, so I thought it safe to assume that this would apply to all torrefied grains including corn or popcorn. After brewing a few batches, I can verify that the extract potential of torrefied popcorn is the same as maize at 38 PPG.

Diastatic power (DP) refers to the amount of amylase enzymes within the malt and their ability to convert starches to fermentable sugars. As popcorn is not malted, its diastatic power is zero, which means we need to rely on enzymes from the other malts in the grist to convert the popcorn starches. Fortunately, modern malts are very well modified and have enough diastatic power that we don't need

AVERAGE CREAM ALE SPECIFICATIONS

Original gravity:	1.042–1.055
Final gravity:	1.006–1.012
Bitterness:	15–20 IBU
Alcohol:	4.2–5.6% by volume
Color:	3.0–5.0 SRM

to worry much about it. However, if you want to run the numbers, you'll find an example in the sidebar.

CREAM ALE: OUR TAKE ON THE STYLE

You can use popcorn in any recipe or style that calls for a corn (maize) addition. By replacing the corn with popcorn, or torrefied corn, you eliminate the need to conduct a separate cereal mash before adding it to the main mash. A few styles feature corn in the grain bill, including American and international lagers, Belgian ales, chicha, and cream ale. I immediately thought of cream ale, which can use up to 20 percent corn in the grist bill, so that is what we will focus on.

Cream ales are delicious for beating the heat in the summertime. These light-bodied, refreshing beers are clean, crisp, brilliantly bright, and effervescent. Cream ales are brewed to alcohol levels of around 4.5 to 5.0% ABV and are malt forward using two- and six-row American malted barley, along with up to 20 percent corn as an adjunct. The large corn addition allows the brewer to convert the corn starches to dextrose, which is 100 percent fermentable, without adding much flavor or body to the beer.

Dimethyl sulfide (DMS) is a cooked corn character that can be present and is acceptable to the style. DMS, which is notably present in Pilsner malt and six-row malts, can be removed through a vigorous kettle boil that drives off the volatile compound through steam. This is one of many reasons that homebrewers are advised to not cover the boil kettle with a lid, and for professional brewers to use a steam evacuation stack.

We wanted our popcorn cream ale to be as clean as possible with no traces of corn or DMS. Thus, we recommend a 90-minute boil, which drives off more DMS and achieves better hot break and protein coagulation that will yield a brighter finished beer.

Cream ales were created before Prohibition to compete against the modern American lagers of that time. Cluster was one of North America's main landrace hop varieties and was widely used in many styles, including early cream ales. A clean low bitterness of 15 to 25 IBU, usually from a single hop addition, was common. When designing our popcorn cream ale, we not only wanted to use traditional Cluster hops, but to use them in the traditional whole-leaf form.

Cream ales are often fermented with both ale and lager strains. Including an ale strain helps the beer finish more quickly than it would with a lager yeast alone. The yeast needs time to reabsorb diacetyl, which takes roughly two or three days at free rise temperatures of about 68°F to 70°F. When we talked to customers who had tried our popcorn cream ale, we learned most had been expecting movie theater butter popcorn and were pleasantly surprised not to find it or, for that matter, much corn character at all.

A short period of lagering time benefits this style to clean up any sulfur byproducts created during fermentation. Maturation time will depend on your brewing process, equipment, and time spent at cold temperatures, 32°F being ideal.

Traditionalists will say it is best to give the beer time, however modern clarifying additives such as gelatin, Clarity Ferm, and Biofine Clear can be added to accelerate clarification. Once the beer meets your standards of clarity, it is ready to package at 2.7 volumes (5.4 g/L) of CO_2. The elevated carbonation level makes this light style effervescent to release the delicate grainy maltiness and balanced hop aromas.

NOT A GIMMICK

When I first heard about torrefied corn, I thought of popcorn and a popcorn cream ale project. We designed our cream ale not as a gimmick beer, but as a solid traditional cream ale that sells more than one pint at the bar. This beer has performed so well for us that, despite the logistical challenges of popping popcorn and tying up tanks for lagering, we have brewed multiple batches two years in a row, and there is demand for more.

With a fresh outlook on popcorn as a torrefied grain and the possibilities it offers to brewers, what ideas are popping up in your head? Let's brew them!

Jason Simmons has brewed professionally since 2003 and has worked for several breweries on the East Coast as brewing consultant, parttime beer author, and, currently, head brewer at Lindgren Craft Brewery in Duncannon, Pa. Hombrewing remains one of Jason's passions—he encourages homebrewers to never stop learning, sharing, and reaching for their goals.

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

Amping Up Hop Aromatics WITH TERPENES

Photo © Getty/Александр Князько (bottle); Getty/osaznanie (hops)

By Amahl Turczyn

Terpenes are aromatic and flavor compounds found in all plants, but the ones of greatest interest to brewers are hop terpenes. A handful of companies are exploring different ways of extracting these compounds and making them available for brewers to amplify hop aroma in their beers. The use of hop terpenes in beer is not widespread yet with craft or homebrewers, but depending upon which company's products are used, they offer many potential advantages.

IPAs in particular can really benefit from a dose late in the brewing process, and both Telluride Brewing Co. (Telluride, Colo.) and Odd13 Brewing (Lafayette, Colo.) have experimented with them and seen promising results. Homebrewers have posted mixed results on various forums, but advances in extraction technology are producing better quality terpenes, which hopefully will move brewers towards wider adoption. →

Blending hop terpenes with the carrier.

One of the more attractive aspects for craft brewers beyond the huge aromatic punch terpenes can deliver to beer is higher beer yield. Dry hopping and whirlpool hopping, the usual methods for imparting hop flavor and aroma to beer, require massive amounts of hops, which leads to inevitable process losses. It's not a big deal for homebrewers, but craft brewers lose a significant percentage of each batch of beer when all that green hop matter at the bottom of the kettle soaks up so much liquid.

Using terpenes solves that problem and allows brewers to more precisely control the amount and type of hop aroma in a given beer. It is also true that heat drives off a lot of natural hop aroma in the kettle that terpenes, again depending upon the extraction process, can preserve. Let's look at a few of the companies making hop terpenes available to brewers and see how they compare.

Elevations Terpenes in Loma Linda, Calif., produces food-grade terpene isolates, meaning they have singled out individual aromatic compounds. Each hop variety is made up of dozens of these isolates, but usually only a handful stand out as major aromas. Elevations uses a steam distillation process for extraction and sells their isolates in 0.34-fluid-ounce (10 mL) bottles for about $15 each. Their products can be used for aromatherapy, topical use, or oral use (e.g. in beer).

I've had good results dosing growlers of beer with these isolates by dipping a toothpick into the bottle and swirling it into the beer…it doesn't take much. The company also sells terpenes that don't come from hops, and these products tend to be very popular with the vaping community. Here are a few of the more common hop terpene isolates.

LIMONENE,

as its name suggests, has a fairly straightforward lemon/citrus aroma. Elevations derives its limonene from Florida oranges. Hüll Melon hops have a high concentration of this terpene.

LINALOOL

is one of the better "team player" isolates that tends to enhance other isolates. It's been described as flowery, fruity, and minty on its own, and it is one of the major components of basil and lavender. Magnum and Ahtanum hops both have high levels of linalool.

MYRCENE

is very common in hops and has a minty, vegetal aroma. Elevations derives its myrcene from citrus fruits, but it can also be found in mangoes, eucalyptus, and lemongrass. Mandarina Bavaria hops have a high concentration of myrcene and linalool.

ALPHA-PINENE

is a monoterpene that provides that familiar woody, herbal pine scent so common in hops. It also makes up a big part of juniper, cypress, rosemary, sage, and frankincense aromas. It's one of the most widely occurring essential oils in nature. You'll recognize its distinctive signature in Chinook hops.

BETA-CARYOPHYLLENE

has been described as spicy and peppery, with components of clove and turpentine. It can be found in black pepper, cloves, basil, and cinnamon, and it provides that spicy kick to rye. Amarillo hops have high levels.

Elevations and Mainiacal terpenes.

Photos courtesy of Amahl Turczyn

Terpenator Pilsner

American Pilsner

Recipe courtesy of Amahl Turczyn.

Batch volume: 5 US gal. (18.9 L)
Original gravity: 1.056 (13.9°P)
Final gravity: 1.004 (1°P)
Bitterness: 40 IBU
Alcohol: 6.7% by volume

MALTS & ADJUNCTS

10 lb. (4.54 kg) Briess Pilsner malt
1.5 lb. (680 g) flaked maize

HOPS

2 oz. (57 g) Magnum hops, first wort

YEAST

Fermentis SafLager W-34/70

WATER

Use reverse-osmosis water. Add 5 g calcium chloride to mash and 5 g calcium lactate to sparge water.

ADDITIONAL ITEMS

10 drops Amylo-300, in fermenter after 1 week
0.4 mL Oast House Oils or Mainiacal Yeast hop terpenes
20 mL Everclear grain alcohol, as carrier for terpenes

BREWING NOTES

Mash grains and maize at 148°F (64°C) for 30 minutes. Raise to 152°F (67°C) and mash an additional 30 minutes. Lauter and sparge into kettle with first wort hops. Boil 60 minutes.

Chill to 52°F (11°C), oxygenate wort, and pitch hydrated, active yeast. Ferment one week. Add Amylo-300 to fermenter and continue fermenting until beer has reached terminal gravity. Cold crash to 35°F (2°C) and hold for 2 days to drop yeast.

Closed-transfer to CO_2-filled keg, adding gelatin finings if desired. Blend hop terpenes thoroughly with carrier and add to kegged beer. Force carbonate in keg to 2.5 vol. (5 g/L) CO_2 and lager at 35°F (2°C) for 3–4 weeks.

While it's instructive to be able to identify these isolates, natural hop varieties grown for brewers are blends of many, so to reconstruct a certain hop profile in beer, you'd have to be able to combine these isolates in precise amounts. Often, a hop variety will have a tiny amount of an isolate, such as geraniol (which, as you might imagine, smells like geraniums) or farnesene (think roses and oranges) that adds a dimension of aroma along with all the various others without standing out too much on its own. Reconstructing hop variety terpene profiles can therefore be tricky, and terpene producers have taken a variety of approaches to the problem.

Abstrax LLC in Middletown, R.I., sells several water-soluble blends specifically for brewers using an ultrasonic homogenization process to emulsify hop compounds. Since these terpenes are oil-based, the emulsion solves the problem of how to disperse them easily in water-based beer. Their SFV OG blend combines myrcene, limonene, and beta-caryophyllene, to produce an emulsion that's earthy and pungent, with pine and cannabis notes. They suggest using it for full-bodied IPAs. Or, you could try their Gelato blend, which combines the same terpenes, but in a different order of dominance (beta-caryophyllene, limonene, and myrcene), producing a surprisingly different aromatic profile as a result: it is described as creamy, floral, and berry-like, and they recommend it for pale ales. Abstrax sells a six-piece sample kit of 5-gram sample bottles of their blends for brewers to experiment with.

But what options do you have if you want to fully recreate a certain hop variety you really love? Mainiacal Yeast in Bangor, Maine, solves this problem using chromatography and fractional distillation to map terpene isolates and their proportions for a given hop variety. They then reconstruct the hop aroma according to this data and offer a series of popular hop varieties such as Strata, Citra, Mosaic, Simcoe, and Galaxy. They sell these in tiny 5 mL bottles for about $35 each. Five milliliters may not sound like a lot, but a tiny amount goes a very long way. They recommend blending the extremely volatile aromatic liquid with a carrier such as pure grain alcohol (Everclear is one brand of food-grade ethanol that works well) and then adding the result to a finished beer right at kegging, just prior to force carbonation.

Only 0.2 to 0.4 mL of the terpene blend per 5 gallons (18.9 L) of beer is necessary to impart bold hop aromatics easily recognizable as the namesake hop. I have experimented with their Citra, Simcoe, and Galaxy blends, usually in light adjunct lagers, and they do indeed produce strong aromatics and flavor. Over 0.5 mL tends to make the beers overwhelmingly perfumey. I blend the terpenes with about 20 mL of Everclear per keg. They also send you a 1 mL syringe with each bottle to more easily measure such minute amounts of liquid.

One of the extractors at Oast House Oils.

5ml bottles of Oast House Oils.

Vials of hop oil at Oast House Oils.

Oast House doesn't just extract hops.

Just realize that these terpene blends will not impart any bitterness to your beer, so you'll still have to hop the beer as you normally would in the kettle. I've found first-wort hopping with a clean, high-alpha hop such as Magnum works well, and the strong terpene aromatics seem much more pronounced when backed up with a good level of bitterness. It might be my imagination, but for some reason, the Mainiacal terpene hop blends tend to fade a bit from when I've first tapped the keg to when it's almost blown. I'm not sure if this is because the blends are so volatile that they get scrubbed out by CO_2, or if I just become desensitized to the aromatics over time.

Oast House Oils in Lafayette, Colo., decided to bypass the terpene isolate approach altogether. They start with select varieties of hops and extract all aromatic compounds present. They do this using supercritical CO_2 extraction by loading hop pellets into a chamber, flooding it with liquid carbon dioxide, and removing hop terpenes as a highly aromatic oil. Founder Rob Kevwitch, along with Kelly Knutson, were kind enough to explain the process to me and show me some of the shiny steel extraction equipment at their facility. They have a lab fridge filled with vials and beakers of various shades of bright gold hop extract, and I got to take a whiff of several of them—it's just like sticking your nose in a freshly-opened bag of hop pellets.

One advantage of Oast House's process is that they can work with hop growers to find fresh, high-oil hop varieties that will yield the very best-quality essential oils. Start to finish, the blend of terpene isolates are kept intact, in the same spectrum nature intended. They then sell these oils to home- and professional brewers. This allows them to work with small, local

growers—even homebrew clubs who grow their own hops—to extract and preserve the oils from a particularly cherished, rare, or high-quality harvest.

Unlike actual hops, the extract won't spoil, oxidize, or fade. It also won't contribute polyphenol haze, tannins, or astringency to beer—it's just pure hop essence. Of course, this also means that as hop harvests change from year to year, so will their extracts. But if a hop variety has a particularly good year, they can preserve the essence of that harvest for brewing posterity.

Kevwitch, in addition to founding a craft brewery in Highlands Ranch, Colo., called Grist Brewing, has a degree in organic chemistry, so he had to explain some fairly complex concepts in a way my relatively simplistic mind would understand.

For example, I asked him just what exactly was in those vials of golden fluid—how do you a get liquid from dry hop matter? He and Knutson explained that the lupulin sacs from a hop cone contain aromatic oils that dissolve in liquid CO_2, so once that oil is pulled from the hops and the CO_2 is driven off, only the hop oils remain. There is some water-based liquid that is extracted along with the oils and collected in a layer beneath, but that is usually discarded.

"It smells great, but there's not much you can do with it," Knutson said of the liquid. "We sometimes brew with it." And their gleaming steel in-house pilot brewery would be the envy of any craft brewer, not just homebrewers.

I asked them about doing extraction runs with freshly-harvested "wet hops," and they laughed. Apparently dried hops work a whole lot better for their process. The extra water in fresh hops really gums up the machines and results in a lot of cloudy, green, emulsified fluid rather than pure, golden oil.

The two were kind enough to share some sample bottles of Amarillo, Hüll Melon, Cashmere, and Mandarina Bavaria with me that have resulted in some excellent beers—I dosed an adjunct lager with one variety per keg, using Everclear as a carrier, just as I did with Mainiacal's terpene blends, again going with only 0.4 mL per 5 gallons. Because these are hop oils, you need to dissolve them in oil-soluble alcohol before they will disperse evenly into beer. The results were beautiful aromatics that I would have needed literally pounds of dry hops to replicate. They sell these 5 mL bottles to homebrewers for $35 each, or larger bottles to craft brewers, via their website. Logically, the higher oil content hop varieties result in better quality extract, and more of it. Conversely, low-oil hops are poor performers in their process. "Cascade's great, but it doesn't extract well," Knutson admitted.

Another question I asked them was "How much is too much?" Unlike the Mainiacal blends, using too much of the Oast House Oils blends doesn't result in an overwhelmingly fumy beer, but it can actually create a bitter sensation at the back of the throat, so about 0.5 mL per 5 gallons is as high as you want to go. Kevwitch said you can also add the oil late into fermentation for some interesting biotransformation interaction with yeast. They also noted that unlike some other extraction processes, using CO_2 allows them to keep the hops cool—heat that could drive off some of the more delicate nuances of a hop's aromatic profile isn't necessary.

With the popularity of juicy and hazy IPAs continuing to soar, hop terpenes could be that next great thing, a magic bullet for brewers to use for maximizing hop flavor and aroma in beer. They allow brewers the versatility to make hugely hoppy beers without the bitterness, if desired, and to maximize the efficiency of getting hops into beer.

***Amahl Turczyn is associate editor of* Zymurgy.**

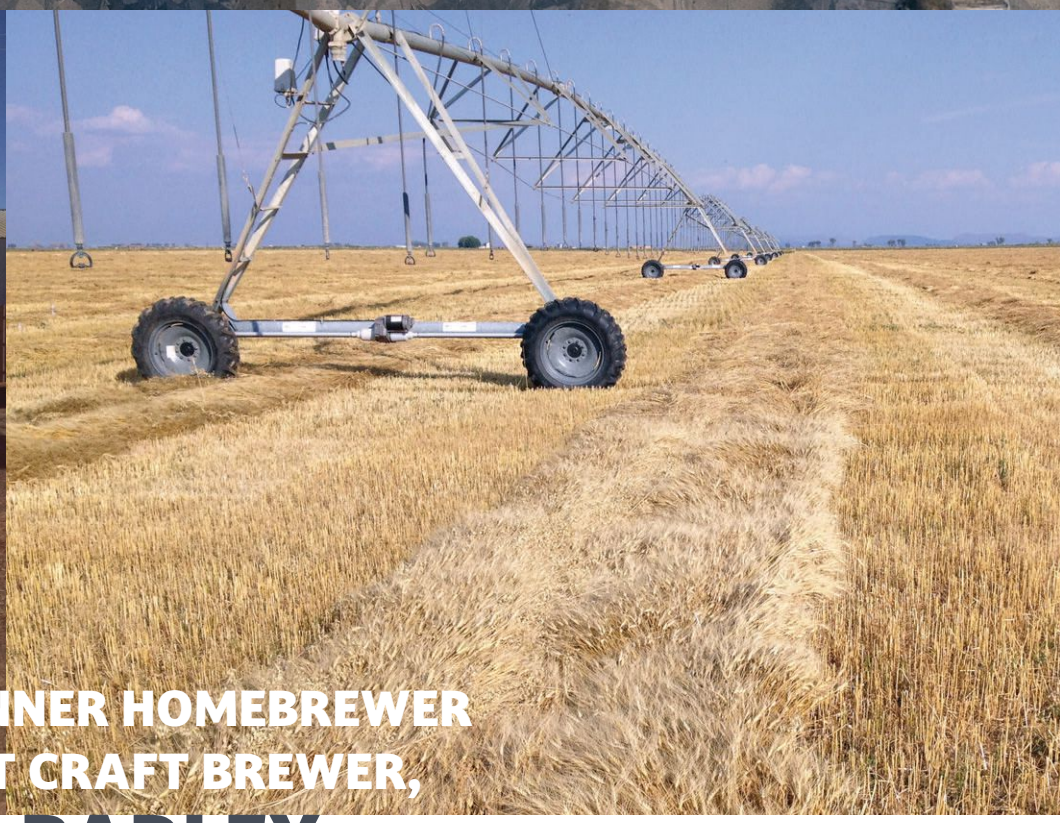
THE VALUE OF

MALT ANALYSIS

By Joshua Cody

Brewing is challenging, especially without a formal education in malting and brewing science. Brewing without the necessary information is like going hiking without a map. You may have an awesome experience that will hook you for life. Your hike may yield good outcomes, or you might get lost. Either way, it's impossible to reproduce the same journey.

A malt analysis can be a crucial aspect in the map to a brew day if understood correctly. Understanding the science of malt not only promotes good outcomes, but it can also accurately predict future experiments. Knowing the raw materials in a given brew is quite possibly the most important variable with which the brewer must engage. This can be quite a hurdle if, when viewing a malt analysis, one only sees disconnected numbers and acronyms that have little to no meaning. →



“FROM A BEGINNER HOMEBREWER TO THE LARGEST CRAFT BREWER, KNOWING BARLEY IS KNOWING BEER.”

As an owner of Colorado Malting Company, I come from an agricultural background. Along with my brother, I am a fourth-generation barley farmer in southern Colorado. We own and operate Colorado Malting Company and The Colorado Farm Brewery on our family farm. So, learning the scientific measurements of malted barley presented a steep learning curve to a farm kid with a degree in liberal arts. In those early years, we had some help from experts like Dave Thomas, who is still helping people learn malting. But from Colorado Malting Company’s perspective, we began as barley farmers and originally approached the quality of grain from that angle.

While this did give us a decided advantage at the beginning of our adventures in malting, learning the necessary parameters of scientific malt analysis was a necessity if we were going to succeed in the open marketplace of malting. The current state of malt (and brewing, even homebrewing) is one of high quality and excellent consistency. Subpar experiments and hopeful turnouts were more common 20 years ago, but now, excellence is the norm. That said, even a limited understanding of barley and malt analysis can be very useful for all brewers. From a beginner homebrewer to the largest craft brewer, knowing barley is knowing beer.

Barley

Barley is a seed of high variability. (Briggs, 1) The great diversity of varieties is nothing short of amazing. Because barley has been grown and cultivated for so many generations of people, over so many continents, in so many ecosystems, that change was inevitable.

Originally domesticated in the fertile crescent of the Near East (Briggs, 76), barley followed humans and was providentially distributed across the earth, anywhere human beings traveled. In the modern world, data proving that different varieties agriculturally perform better in different climates of the habitable zones of the earth have allowed barley breeders, farmers, and maltsters to hone their field of study and create malted grains with great predictability.

In our unique Southern Colorado ecosystem, Continental European varieties seem to thrive. Our family has grown Moravian varieties (thanks largely to Coors Brewing and AC Golden Malting) for more than 60 years, and other Bohemian varieties for almost as long. Moravian barley isn’t necessarily Coors barley. Moravia was a region of Europe (which together with Bohemia and Czech Silesia comprise today’s Czech Republic, or Czechia) where many varieties of ancient barley originated. My great grandfather was one of the first to grow malting barley in our region.

Note the distinction of “malting” barley—not all barley is created equal. Many barley farmers are well aware that their crop is going to be used for animal feed or other industrial purposes, but if malting barley is needed, then all the parameters must be correct. Barley that is grown to be malted for the food and beverage industry is done so in the proper climate, with intentional processes and is selected using predetermined criteria to secure quality and consistency. (Briggs, 528)

These parameters are defined in a grower’s contract. It ensures that malting facilities receive barley within the specifications required to make malt of

Photos courtesy of Josh Cady

consistent quality. The malting analysis that a brewer sees is then actually the second time that the same barley has passed a quality check, so one could say, the barley malt that a brewer receives has been double checked. It has been quality checked after harvest from the field, and then again after the malting process.

Raw Barley Analysis

The quality of the raw grain determines the quality of the malt. Any raw grain analysis is determined by important variables that potentially determine the quality of the malt and subsequent beer. The following content certainly isn't exhaustive, but it can help a brewer understand the agricultural variability in their raw material supply chain. The most important variables to a raw barley contract are

1. Moisture content
2. Screenings
3. Mold (color)
4. Protein

Moisture content must be under 12 percent so that, during storage, moisture doesn't cause the grain to prematurely germinate or propagate mold growth. Screenings indicate the plumpness of the kernels and reveal the previously immeasurable amount of foreign material (such as weeds and damaged kernels) present with a given raw barley sample.

Mold is quite obviously a variable of grain quality. If the barley is grown in a climate where high humidity is present, mold levels may be so elevated that a malting company will reject said grain. This variable is determined by the color of the kernel itself. If mold is present, then the color is darker. Some molds, such as *Fusarium*, can even cause the kernels to have a pink appearance. These molds can contain toxins that are harmful to people and animals. (Briggs, 403)

Protein is quite possibly the most important variable for the maltster and the brewer. If the protein level is higher than about 13 percent (probably more like 12 percent), then the barley kernel cannot properly modify in the malting process. This will obviously lead to extraction and efficiency issues in the mash tun. However, protein adds flavor and enzymes, so some is necessary for making beer. So, healthy levels are necessary for brewing quality and consistency. If all these variables are intact and inside of specification parameters, then and only then, the barley enters the malting process.

Malt Analysis

Malt analysis is a more complex story. Malting science as we know it was largely built on the beer industry and, therefore, much is known about malt. I will try to address the major components individually for clarity's sake.

Moisture

As with raw barley, moisture is a paramount variable in malt quality. The moisture content of malt must be under 5 percent, preferably lower, for it to be properly extractable. If the moisture content of the malt is higher, not only is the brewer buying water weight by volume, but the possibility of efficiency declines invariably with higher moisture content. Even more, moisture trapped inside malt packaging, even if it is absorbed in the malt itself, can cause off aromas, off flavors, and even mold growth, which can carry through, beyond the boil, into the final product.

Storage is an important piece to this puzzle. When a brewer uses malt from a major manufacturer that has been shipped around the world or stored in bulk, it is inevitable that the malt will absorb ambient moisture from the air. Proper storage and packaging are therefore very important to maintain quality. My dad, Wayne Cody, the "Godfather of Craft Malt," always said, "Finished malt is like a sponge." If the moisture is over 5 percent, either by reab-

THE FARMHAUS PORTER

American porter

Recipe courtesy of the Colorado Farm Brewery.

Colorado Malting Co. (CMC) products are available through Country Malt Group. If you can't get your hands on CMC malts, use what is locally available to you.

Batch volume: 5 US gal. (18.9 L)
Original gravity: 1.071 (17.3˚P)
Final gravity: 1.018 (4.6˚P) (usually finishes a little lower)
Color: 50 SRM
Bitterness: 35 IBU
Alcohol: 7% by volume

MALTS

11 lb. (5 kg) Colorado Malting Co. SoCO Gold
1.5 lb. (680 g) Colorado Malting Co. Colorado Chocolate Malt
1 lb. (454 g) Colorado Malting Co. Colorado Black Wheat Malt
6 oz. (170 g) Colorado Malting Co. Colorado Special C Malt

HOPS

0.6 oz. (17 g) Colorado Nugget Hops (High Wire Hops Pellets) @ 60 min
0.25 oz. (7 g) Colorado Chinook Hops (High Wire Hops Pellets) @ 20 min

YEAST

Wyeast 2308 Munich Lager

BREWING NOTES

Targeting a mash pH of 5.6, mash for 60 minutes at 149˚F (65˚C). Sparge at 172˚F (78˚C). Boil 90 minutes.

Ferment at 50˚F (10˚C) for 14 days, although it usually finishes a little faster. Rack to secondary and condition for 28 days at 41˚F (5˚C), or until complete.

sorption in a humid climate or through improper kilning processes, then the malt simply won't perform properly.

Friability

The term *friable* gets thrown around in brewing circles quite loosely, and I have often found that people only partially understand it. No matter the disclaimer, friability is another variable in the toolbox of the modern brewer.

The Friabilimeter machine produced by Pfeuffer out of Kitzingen Germany, is an all-in-one testing unit. By using an abrasive grinder, it tests the overall modification and potential extraction of malted barley. It grinds malted barley with a standardized amount of pressure for a predetermined amount of time in order to objectively test the modification of finished base malts.

Fundamentally, the machine separates the softer and harder parts of a malted barley kernel. (Operation Instructions, Friabilimeter) Then, by means of scale and observation, calculation by weight and identification of hard parts, the machine can predict both malt quality and potential extraction.

Interpreting the friability number provided on a malt analysis is quite simple. If the number 80 is provided, that quite literally means that 80 percent of the malted barley fell through the screen during the predetermined time of abrasion. To the maltster, this indicates that the malt is modified at or near industry standards.

In my experience as head brewer at the Colorado Farm Brewery, a correlation can definitely be seen between well-modified malt above 80 friability and rate of extraction in the brewhouse. The readings of fine grind (FG) and coarse grind (CG) extract can also provide the brewer with the potential extract of the malt in the mash tun. It can be helpful along with the friability to predict the outcome of a given mash.

This tool should probably be in every brewery to double-check malt consistency—unfortunately, it is prohibitively expensive. However, most malt analysis available today includes a friability measurement, and this simple number can assist craft brewers and homebrewers alike in determining malt quality and potential extract.

Protein

Protein is a much more complex situation. Upon entering the malting facility, barley brings with it a percentage of protein. It has already been stated that excessive levels will inhibit modification during the germination phase of malting, but that healthy levels are necessary for enzymes, flavor, and other aspects of beer health. The science of malt proteins is extensive and could itself be the subject of another article, but for our purposes, barley protein is directly related to the growth cycle of the plant. (Briggs, 403)

Barley variety is the first variable to consider. Different barley varieties are genetically bred, and thereby disposed to have higher or lower overall protein content than others. Six-row varieties are, on average, higher in protein. Most modern two-row barley varieties have been cross-bred in an ideal growing environment to develop a protein content of between 8.5 and 11.9 percent protein.

This is not an arbitrary window—it is based on years of consolidated data across a number of entities engaging in such research. (ambainc.org) Other variables further complicating the situation are climate and environment. If barley, while in the field and growth cycle, is unduly stressed, it will naturally protect itself by hardening its kernels, and thereby increasing protein levels.

For example, if a Bohemian variety is subjected to frost during certain stages of growth, or intense heat and sunlight during the long days of summer, it may react by producing higher protein levels. Or, if a Moravian variety is grown in a hot, humid climate where the nighttime low temperatures are in the 70s Fahrenheit (low 20s Celsius), and accordingly must resist mold and other toxins, it may also build up high protein levels. So, if a farmer properly choreographs the dance between climate, variety, and soil, the proteins will be high enough, but not too high, making the barley suitable for malting and then brewing.

Diastatic Power

Diastatic power (DP) is yet another important factor in the attempt to understand malt analysis. In short, DP is a measurement of the enzymes present in a given sample of barley malt. These enzymes, when subjected to the right conditions, convert starch

“BEER IS AN AGRICULTURAL PRODUCT AND HISTORICALLY HAS HAD A CLOSE RELATIONSHIP WITH FARMING.”

into sugar. The majority of a barley kernel is starch, (Briggs, 96–102) but there is much more going on in the malting and subsequent mashing processes than just hydrating starch.

Basically, the higher the measurement of DP, the more enzymes are available for converting starch into fermentable sugars. Now, that doesn't necessarily mean the higher the DP, the better the malt; remember that proteins provide enzymes, and excessive protein levels are problematic. A malt analysis may show that a given sample has a DP of over 200, but that doesn't mean it is “better” malt.

Most beer brewers have surplus enzymes in their mash that easily convert a predictable volume of malted barley starch into useful sugar. Every pound of malted barley has sufficient enzymes to convert at least twice its weight of raw starch into fermentable sugar. Many brewers use a level of unmodified, raw grains in the mash and still can achieve full conversion. However, a note of caution: The raw starch in different grains can have different gelatinization temperatures and are therefore best prepared by a pre-gelatinization process (a cereal cook) prior to conversion by enzymes in the mash. This is one reason that knowledge of barley variety is useful for a brewer—different varieties can perform and gelatinize at different temperatures. Not all barley is created equal.

Color

Color is also a very important variable in malting and brewing. It does not contribute to fermentability, but it still plays a crucial role in malt analysis. It may be the most important factor for specialty malts, especially if a brewer is looking to produce a beer of a specific color.

The color in a malt analysis is indicated with different nomenclature, depending on the origin of the product. If the malt is sourced from the United States or Canada, most likely color will be measured on the Lovibond (°L) scale, named for 19th-century brewmaster Joseph William Lovibond. If the malt originates in Continental Europe, color will most likely be specified by “EBC,” after the European Brewers Convention.

In my experience working in the malting industry in Europe, England uses a strange hybrid of imperial and metric measurements. The Lovibond scale and EBC can both be used, sometimes simultaneously. The scales are quite different in numerical value, and that difference widens as the scale increases, yet both strive to relay the same information. Both scales are designed to assign a numerical value to the intensity of the color of the wort produced by mashing.

In both systems, the higher the value, the darker the color. For example, 20°L is equal to 51.87 EBC. However, 40°L is equal to 105.25 EBC. So, as the Lovibond rating increases, so does the EBC value, but not at the same rate. For EBC, the rate of incremental increase amplifies as it climbs higher (darker) on the scale. A value of 300°L is equal to 799.07 EBC.

As you can see, EBC increases exponentially and provides a very specific numerical measurement. That is not to say that the Lovibond scale isn't specific, because it still allows brewers to create specific color combinations when crafting excellent beers.

Knowledge is Power

In summary, a brewer's ability to understand a malt analysis is crucial for brewing consistently and accurately. A basic knowledge of the raw barley, before malting, can also assist the brewer by providing a broader understanding of the agricultural roots of their raw material supply chain. Fundamentally, beer is an agricultural product and historically has had a close relationship with farming.

The Industrial Revolution separated people from their agricultural roots, and many sections of the economy lost that connection. Home- and craft brewers currently have the rare opportunity to reconnect with that ancient heritage, which can only happen through raw sensory experience and useful data. Proper understanding of malt analysis provides a brewer with the opportunity to approach brewing with a scientifically informed perspective.

Resources

5. Briggs, D.E. *Barley*. Chapman & Hall. London. 1978
6. saveur-biere.com
7. beerandbrewing.com
8. ambainc.org
9. Raupach, M. Bier: *Geschichte und Genuss*. Palm Verlag. Berlin. 2017
10. *Dictionary of Beer & Brewing: Second Edition*. Compiled by Dan Rabin and Carl Forget. Brewers Publications Boulder, CO. 1998

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THE HOMEBREWER'S GUIDE TO BARREL-AGED STOUTS

Unlocking the Secrets to Brewing Modern Barrel-Aged Stouts

By Ryan Pachmayer

Modern barrel-aged stouts are thick, smooth, and flavorful. From virtually every type of chocolate imaginable to flavors of coffee, vanilla, caramel, and more, breweries such as Side Project Brewing, Cycle Brewing, and Kane Brewing, to name just a few, are creating big, thick, luscious, dessert-type stouts.

These beers truly showcase the brewer's ability to marry strong stout-base beers with classic spirit-barrel flavors. The best of these are special-occasion offerings and can feel like works of art. In this guide to non-adjunct barrel-aged stouts, we'll break down the process of creating such beers from start to finish, with tips and tricks to help you brew them the same way top breweries in the world are brewing them.

RECIPE DESIGN

When I begin building a barrel-aged stout recipe, I'm reminded of a quote from Neil Fisher, cofounder and head brewer of WeldWerks Brewing Co. in Greeley, Colo. In a seminar at the Big Beers, Belgians & Barleywines Festival in Breckenridge, Colo., a few years ago, he said that when his award-winning Medianoche stout is initially put into barrels, it is basically undrinkable. It's too bitter and thick that early in its lifespan. But he's planning for the way the beer will taste in 17 to 24 months when it comes out of the barrel.

The barrel thins the beer out somewhat, the beer loses some bitterness, and the flavors of the beer and barrel harmonize. I've experienced firsthand what can happen when you build too light of a base stout, tuck it away in a barrel for a year or two, and then sample it: the result is thin and tastes more like you just poured a shot of whiskey into a more moderate 8- to 10-percent ABV imperial stout.

Build a Thicker Base

A key to building a base beer that can stand up to extended barrel aging is using a higher percentage of flavor- and body-building specialty malts in your recipe. Using as little as 55 to 65 percent base malt is pretty common

for many of today's leading barrel-aged stouts. There is also no need to bother with paying a premium for base malts such as Maris Otter—you won't taste the difference in these big, flavor-rich beers as you would in a typical English ale.

Starting gravities for these beers begin around 1.130 and can exceed 1.180, so make sure you have a hydrometer or refractometer that can take measurements that high. For long-term aging in full-sized barrels, over periods of fifteen months or more, aiming for a final gravity of at least 1.040 is a good idea, and many highly touted commercial examples go far higher.

Build Layers of Flavor

While many brewers are only using a little bit of roasted malt, around one to four percent of the total grain bill, chocolate malts can make up well over 10 percent of the grist. Brewers all have their own favorite chocolate malts, but I'd recommend taking a look at chocolate rye, pale chocolate malt, and even Weyermann Carafa II. Carafa II can taste more chocolatey than many malts labeled as chocolate, and it is a very smooth flavor as well. With so many maltsters offering chocolate malts these days, there are literally dozens to choose from, so take a nibble of different varieties, make some baby mashes by soaking the malt in hot water, and see what jumps out to your palate.

Crystal malts are an important component of many big stout recipes. Using four to 12 percent crystal malt is common. I tend to target the middle range of crystal malts, medium crystals, which are 40 to 70 Lovibond in color. Lighter crystal malts impart softer flavors, and darker ones can get a little fruitier, more towards plum and raisin flavors. I don't find those desirable in big stouts at that level, so I use very little crystal malt above 80°L, if any.

Oats are the secret weapon in many big stouts. Five to fifteen percent oats in the grist can really help deliver a smooth, thick mouthfeel. Oats increase the chance of a stuck mash, though, particularly when used as more than 15 percent of the grist, so plan accordingly by using rice hulls.

Black malts vary considerably, from almost none to more than 10 percent of the grist. Black malt flavors and astringency levels also vary quite a bit, so I'd recommend finding a black malt that you're comfortable with, perhaps starting at the lower Lovibond section of the field, and increasing this in future recipes as your tastes guide you.

Choose a Workhorse Yeast

Fermentis SafAle US-05 is very reliable and it's the choice of many top breweries. When treated well, it can ferment to more than 13 percent ABV. When going above that range, White Labs WLP099 Super High Gravity yeast can be a better choice. Another tip for some of these high-ABV stouts is to first make a lighter, sub-6.5-percent ABV stout with your

Photos courtesy of Ryan Pachmayer, New Image Brewing

GOING *REALLY* BIG

If you want to brew a beer at the upper end of the alcohol spectrum, going to 15 percent ABV and above, you'll want to do a second oxygen addition about 16 hours after pitching, to give the yeast cells a boost before they really get to work. You'll also want to consider adding some of the fermentable sugars (dried malt extract or sugar) in staggered additions during primary fermentation so as not to overwhelm your yeast all at once. You can also use multiple yeast pitches to get you to your target goal.

My preferred method is to pitch a good deal of US-05, hit the wort with a second oxygen infusion about 16 hours later, and then on day three, add a huge starter of WLP099 Super High Gravity Ale Yeast and begin my staggered dried malt extract additions (targeting 1.5 to 2 percent ABV worth of fermentable sugar per addition) over the next week. Over the last few years, I've reached above 20 percent ABV with these techniques. To read more about approaching 20-percent ABV beers and beyond, take a look at Andy Tipler's "An Unconventional Approach for Brewing Really Strong Ales" in the Nov/Dec 2020 issue of *Zymurgy*.

BARREL SHOPPING GUIDE

You'll see a lot of options online for buying used barrels. Many of them are barrels that have sat in warehouses, empty, for weeks or even months. They may tell you to simply rehydrate the barrel upon receiving it, or to throw citric acid in it to sanitize it, but that can really strip out the already-muffled flavor of a barrel that's been sitting empty. It's also very expensive to ship barrels. It can cost hundreds of dollars to ship a single barrel, and that's on top of what you'd spend for the barrel itself.

My recommendation is to look at these two sources for barrels.

LOCAL DISTILLERIES

With local distilleries, it can be easy to plan your brew day around their dump date: just look to brew at least a month before you receive the barrel. You can go in, sample their spirits, and decide which type of barrel will best suit the type of base beer that you want to create. You support the local economy and don't have to spend money on shipping.

BARREL BROKERS

With the exploding growth in the barrel-aged beer market, as well as the craft distilling market and the bourbon boom, there has been a proliferation of barrel brokers. These are companies that specialize in acquiring barrels from spirits makers and selling them to other distilleries or, more commonly, to brewers. While professional brewers are their biggest clients, most barrel brokers sell to homebrewers as well. Rocky Mountain Barrel Company is my local barrel broker and is located in the Denver area, with a second location in Virginia. There are other brokers around the country, so look for one local to you and see what types of options they can provide.

CARE

Steve at Rocky Mountain Barrel Company suggests that you soak the ends of the barrel upon receiving it. He says that while they test each barrel to 10 pounds per square inch (psi) and store them in their 60-percent humidity warehouse until sold, shaking on the ride home or some drying out may cause leaks, and the most common spots for leaks are on the barrel ends or around the bung.

PRICING

When visiting Rocky Mountain Barrel Company, I came across all types of barrels in the warehouse, from freshly dumped bourbon to Caribbean rum to European sherry. While supply and demand can change, current prices in North America are roughly as follows:

- Bourbon or US brandy $125–175
- Caribbean rum $200
- European Port wine or sherry $400–600

Due to both the high cost and the age of the port or sherry barrels (they have to be transported from Europe, which is also why they cost so much), I would not recommend them to homebrewers. Also note that there isn't usually much of a discount, if any, for smaller barrels. Smaller barrels aren't produced in as high a quantity as full-sized 53-gallon barrels, so don't expect to pay any less for a 10- to 15-gallon barrel.

yeast, and then pitch your high-gravity wort onto the yeast cake so that fermentation begins with a very healthy batch of yeast.

Wyeast 1318 London Ale III is another choice that brewers use for stouts in the 11 to 13 percent ABV range, particularly breweries that keep that as their house strain. It can take some time to get through fermentation, but it should work well when treated properly.

If you wish to venture out from these three strains, understand that many yeast strains on the market can go well above their listed ABV tolerance, particularly when you pitch a large amount of healthy yeast into well-oxygenated wort. Contacting individual yeast labs to discuss your recipe can help you find other viable options for these big beers.

Add Hops Strategically

Hopping big stouts is relatively straightforward for many breweries, and that's the approach I like to take. I like to use clean, high-alpha-acid hops for a 30 to 60 IBU bittering charge in the beer, and that is it. Magnum is my go-to, but I also use Columbus sometimes. I'd mostly just avoid overly flavorful hops such as Citra. You don't want the hop flavor to interfere with the chocolate- and roast-forward flavors of the beer, or the vanilla, oak, and bourbon flavors in your barrel.

I tend to match my IBUs to the planned age of the beer. For example, if I'm making a quicker wood-aged stout using barrel-charred chips, I might go closer to 30 IBUs, as the beer will be ready more quickly, and the bitterness will change relatively little in such a short time period. If I'm going to age a big stout for 18 months or more in a full-sized barrel, I might go to 60 IBUs to help the beer retain some bitterness over its long maturation period.

Another variable to consider is the amount of black malts and darker chocolate malts in your recipe, as those can provide bitterness as well. You may also have a preference for more bitterness in your stout. If that's the case, feel free to go above 60 IBUs.

BREWING TECHNIQUES

The Importance of Yeast Health

Yeast health can make or break your success in these beers. A proper pitch rate that targets at least 500 billion yeast cells for a 5-gallon (18.9 liter) batch is important. Use a yeast calculator and choose the high gravity ale option when available. I use four or five 11-gram packets of Fermentis SafAle US-05 for my typical 5-gallon stout recipes.

All Mashed Up

Many brewers use an amylase enzyme during the mash to help create more fermentable sugars. I would recommend using one according to the manufacturer's instructions. I usually target a 152 to 155°F (67 to 68°C) mash temperature for these beers. The range for success is wider, but that range allows the beer to be pretty much unaffected if you miss a few degrees on either side. I target a mash thickness of 1.2 to 1.4 quarts per pound (2.5 to 2.9 L/kg), but I don't think there is a major downside to going thicker, especially if you use rice hulls as recommended to help avoid stuck mashes.

To Boil Long or Not to Boil Long

Some breweries are notorious for doing very long and intricate boils. They do this to help create melanoidins and promote a bigger mouthfeel. If you're planning on doing a very long boil (4 or more hours), you may have to add water back into the wort to maintain the correct gravity and volume. I would, however, recommend a 90- to 120-minute boil to start—you can get a fantastic mouthfeel and plenty of deep, rich flavors from your specialty malts.

Give It Some Oxygen

Oxygen is another big component in the healthy fermentation of big barrel-aged stouts. If you have a way to measure your oxygen output, 15 to 20 parts per million (ppm) is a good target. Otherwise, 60 seconds of pure oxygen with a stone into the wort before pitching the yeast is a good rule of thumb. If you plan on making these beers multiple times, invest in an oxygen tank with a stone; it's a really important part of a healthy fermentation.

Slowly Rising Temperatures

Fermentation temperature is another major factor for producing a good-quality barrel-aged stout. If the beer is at too high a temperature for the majority of its fermentation, harsh alcohol fusels and fruity ester off-flavors can be produced. If the temperature is too low, the yeast may struggle, might not finish fermenting, and may give off other undesirable flavors such as acetaldehyde (commonly tasted as green apple).

An effective strategy is to knockout at 65°F (18°C), set your fermenter at 66°F (19°C) at the time of pitching, and after three days of activity, increase this temperature to 68°F (20°C). As activity slows to a trickle, ramp it up to 70°F (21°C) to help finish up any last bit of fermentation.

Plenty of Time

You can expect fermentation to finish up in about 21 days, but plan for up to a full month. Some breweries will rack the beer directly into the barrel at this point, while others use a method that I would suggest: rack the beer off of the yeast and cold crash it to near freezing temperatures for another five to seven days. The advantage of this is that you get a lot of the yeast out of the beer before it goes to sit in the barrel for months, if not years, and nothing good can really happen with a bunch of dead yeast sitting at the bottom of your barrel for that extended period.

BARRELS

Give Me Fresh or Give Me Nothing

Why is it taking so long in a barrel-aged stout article to get to discussing barrels? Freshness. It's incredibly important, particularly at the homebrew level, to procure fresh spirits barrels for your beer. For that reason, brewing your stout about a month prior to receiving your barrel is the very best strategy to use. This allows you to have a fully fermented and ready-to-go beer to transfer into that barrel the day you receive it. This minimizes the risk of the barrel drying out before beer is put into it, as well as that of wild yeast finding its way into the empty barrel.

When selecting a barrel, freshness is key. I'd much rather take a fresh barrel from a nondescript distillery than a barrel from a premier bourbon producer that has been sitting around for a month or two. There is nothing worse than waiting 6 to 18 months for your beer to mature in a barrel, only to find out that it is contaminated and undrinkable. Trust me; I've had this happen plenty of times!

CHIPS

Jack Daniel's Whiskey Barrel Smoking Chips are my preferred choice of wood, as they're made from actual used Jack Daniel's barrels. They're also very affordable. Take those chips, give them a little extra char—they're made from the entire barrel and not just the inside charred portion—and repeat the process described in the main text. This lends added complexity to the charred-toasted oak option.

Barrel Types

Another thing to consider with barrel selection is the type of spirit within that barrel. Whiskey is most common and might include anything from American bourbon and rye to Canadian rye to Irish whiskey. Beyond whiskey, you have options ranging from brandy or rum to tequila or gin. For barrel-aged stouts, I generally like to focus on whiskey, with brandy and rum offering fun options to play around with once in a while. I haven't found gin or tequila barrels to shine with stout bases as well as they can with some other styles.

Marrying your base recipe with the ingredients used to make the spirit in your barrel is pretty common too. Have a rye

whiskey barrel? Pump up the chocolate rye malt a bit to help accentuate those flavors. Did you score a coveted wheated-bourbon barrel? Adding some chocolate wheat and even white wheat in your grist might be a good idea.

Time in the Barrel

When aging your beer in a barrel, time is another important consideration. The smaller the barrel, the greater the ratio of surface area in contact with the liquid, meaning it'll extract the flavors from the barrel more quickly. To give an example of the time differences, I'll go six to eight months on a freshly dumped 10-gallon whiskey barrel, compared to 14 to 21 months on a full-sized 53-gallon barrel.

I never have a set time period in mind to barrel age a beer, just a rough expectation. I taste the beer along the way and package it when it tastes right to me. Sampling the barrel is best done by using a "Vinnie nail." Hammer a sanitized stainless-steel nail into the barrel, remove it to slowly fill a glass, and then reinsert it to seal that hole. I do not recommend ever removing the bung from the top of the barrel—it's an easy way for wild yeast to get into the beer and ruin the batch.

You can reuse barrels, especially small, fresh barrels that housed whiskey for only a short period of time, as they'll have more oak flavor to begin with. The flavor of the barrel will be reduced each time it is used, so going from high ABV to low ABV, and potentially dark to light in color, are good strategies to consider. An example sequence might be a 13-percent ABV stout, followed by a 10-percent ABV barleywine, and then an 8-percent ABV porter to get three uses out of one barrel. Have your beers ready to transfer into the barrel for its second and third uses the same way you did for the initial beer, to minimize the risk of contamination from a sitting, empty barrel.

20 Stout

Imperial stout

Recipe courtesy of Ryan Pachmayer.

This imperial stout was fermentation fed from a base recipe of roughly 13.5% ABV potential to about 20% ABV. I brewed this beer with my friend Nathan Rooen in early 2017. We entered it into the 2018 Big Beers, Belgians & Barleywines Festival in Breckenridge, Colo., in the experimental category, where it received scores of 50 and 46 from two professionals and BJCP judges. The beer is almost infinitely complex and has continually impressed when brought out for special occasions. I bottled my share in 187 mL (6.3 oz.) bottles.

While I would not recommend this as your very first big stout recipe, if you've successfully fermented beers over 12% ABV, give this recipe a shot—it really shows what you can do with bigger alcohols, and it almost tastes like a fine port wine, albeit with stout and bourbon flavors.

Batch volume: 5 US gal. (18.9 L)
Original gravity: 1.167 (37.6°P)*
Final gravity: 1.046 (11.4°P)
Efficiency: 65%
Bitterness: 58 IBU
Alcohol: 20.8% by volume

MALTS & ADJUNCTS

22 lb. (9.98 kg) pale 2-row malt
2.5 lb. (1.13 kg) flaked oats
1.5 lb. (680 g) Weyermann Carafa Special II
1.5 lb. (680 g) pale chocolate malt
1.5 lb. (680 g) chocolate rye malt
1 lb. (454 g) crystal malt, 60°L
8 oz. (227 g) roasted barley
8 oz. (227 g) black malt

HOPS

2.3 oz. (65 g) Columbus, 14% a.a. @ 60 minutes

YEAST

44 g (1.55 oz.) Fermentis SafAle US-05
800 billion cells White Labs WLP099 Super High Gravity Ale Yeast

ADDITIONAL ITEMS

rice hulls, as needed for mash runoff
2 lb. (907 g) demerara sugar, primary, in 2 additions
4 lb. (1.81 kg) light dried malt extract, primary, in 2 additions

BREWING NOTES

** You'll never actually see a hydrometer reading for the original gravity of 1.167, as you'll add sugars after fermentation has already started. Aim for a post-boil specific gravity of 1.143. This will increase to an effective original gravity of 1.167 after adding malt extract and demerara sugar during fermentation.*

Mash at 153°F (67°C) for one hour. Boil for 90 minutes. Chill to 67°F (19°C), add oxygen for 60 seconds, and then pitch US-05 at 67°F (19°C).

After 16 hours, add a second dose of oxygen for 60 seconds.

On day 3 of fermentation, pitch 800 billion cells of WLP099.

On day 5 of fermentation, raise the temperature to 68°F (20°C) and add the first 2 lb. (907 g) of dried malt extract (DME).

On day 7 of fermentation, add 1 lb. (454 g) of demerara sugar. On day 9 of fermentation, add the remaining 1 lb. (454 g) of demerara sugar.

On day 11 of fermentation, increase the temperature to 70°F (21°C) and add the remaining 2 lb. (907 g) of DME.

Allow at least 21 total days to complete fermentation and up to 28 days.

On day 28, rack off yeast and into a Corny keg, pressurize, cold crash to 33°F (1°C), and hold for five days.

Store at 50–65°F (10–18°C) under light pressure for several months. When the flavors have started to harmonize, release pressure, add whiskey-soaked charred chips per the instructions in the article, purge with CO_2, and taste every 1–2 weeks. We used Rittenhouse Rye 100-Proof Whiskey. Pressurize to 2.3 vol. (4.6 g/L) in the keg and fill your bottles with a bottling wand. Enjoy some fresh and for years to come.

BARREL ALTERNATIVES

Not everybody wants to wait 18 months for their beer to finish or spend another $100 or more on a barrel for their batch of beer. While nothing perfectly replicates a fresh, full-sized bourbon barrel, there are things that you can do as a homebrewer that professionals cannot, and there are flavors you can achieve that can't actually be done in full-sized barrels.

Char Your Own

My favorite method is the charred wood method. In this method, you take toasted oak and char it with a small torch. You can get Bernzomatic torches from your local hardware store for under $20. Char the oak really well to resemble the inside of a barrel. From there, you'll see a lot of astringency from that char. Boil the charred oak in water for ten minutes, and then remove the oak, place it in a Mason jar or other container, and soak it in the spirit of your choice.

Spirits Selection

When selecting spirits for this, I like to think about spirits that go well in cocktails, as the final barrel-aged beer is far more of a cocktail-type drink than a straight spirit. Summon your inner mixologist and think about what you might reach for when making an old fashioned or Vieux Carré-type drink. Because it can take many years to fully extract oak flavors from a barrel, I prefer younger whiskey barrels for aging stouts, as much more barrel flavor remains in a young, freshly dumped whiskey barrel. Conversely, I prefer soaking my oak in older whiskey, as it has already extracted a lot of oak flavor from its former barrel, and it can lend some added complexity to your charred oak concoction.

Strength in Numbers

Barrel-strength whiskey is usually 100 to 120 proof (50% to 60% ABV). The whiskey that most people drink is usually watered down to 40% to 45% ABV after it is removed from the barrels for bottling. The key here is that the spirit in your barrel is very likely stronger than the average shelf bottle, so you want to hunt for barrel- or cask-strength whiskey, or at least bonded (100 proof) whiskey for the charred oak.

Using Your Charred Oak

You can then use this whiskey-soaked charred oak at your leisure. A little bit goes a long way, but the nice thing is you can add more chips to taste. Taste it every week or two, and once the flavor stops changing and you've extracted all the oak and whiskey that you're going to, you can always add more oak to the beer. You can also add some of the spirits from your charred oak jar. Taste the liquid first to make sure it's not too astringent and add it slowly. One to two ounces per 5 gallons (1.6 to 3.2 mL per liter) is a good starting point, but don't be afraid to increase that to 5 ounces (8 mL per liter) or more over time if you feel it needs more whiskey flavor.

This method can successfully replicate a barrel-aged stout with one significant difference: if you brew a beer and then put the charred oak into the beer after a month of fermenting, and wait another month for full extraction, you're left with a "barrel-aged" stout that is only two months old. If you want to replicate the 12- to 24-month barrel-aged stouts, you have to allow your beer to age as it would in a barrel.

To do this, transfer the beer post-cold crash into a glass container and periodically add a tiny bit of charred oak. After 8 to 12 months, you will have a beer that tastes like it has been aging in a barrel. You don't need to do this, as a fresh stout that has rested in charred, whiskey-soaked oak can be delicious, and it's something professional brewers can't easily do without moving the same beer from one fresh barrel to another for two to three months (cost prohibitive and logistically risky).

01110011 01110100 01101111 01110101 01110100 Stout

Imperial stout

Recipe courtesy of Bottle Logic Brewing.

Bottle Logic's stout uses a long boil to achieve its high gravity. To achieve that high gravity without boiling for several hours, founder and head brewer Wes Parker suggests adding dextrose, D-90 candi syrup, or, for a sweet stout, lactose.

Batch volume: 5 US gal. (18.9 L)
Original gravity: 1.139 (32°P)
Final gravity: 1.061 (15°P)
Efficiency: 65%
Bitterness: 45 IBU
Alcohol: 10.2% by volume (before barrel aging)

MALTS

21 lb. (9.53 kg) Simpson's Best Pale Malt
2.4 lb. (1.09 kg) flaked oats
1.8 lb. (816 g) Crisp Pale Chocolate
1.5 lb. (680 g) Briess Blackprinz
1.2 lb. (544 g) Simpsons Medium Crystal
1.2 lb. (544 g) Simpsons DRC
9.6 oz. (272 g) Briess Dark Chocolate
4.8 oz. (136 g) Simpsons Roasted Barley

HOPS

1.5 oz. (43 g) Magnum, 12% a.a. @ 60 min

YEAST

White Labs WLP007 English Ale Yeast

ADDITIONAL ITEMS

rice hulls, as needed for mash runoff

BREWING NOTES

Mash at 156°F (69°C) for 60 minutes, targeting a pH of 5.4. Boil for 4–6 hours (this recipe has been adjusted for 4 hours of boiling). Ferment at 68°F (20°C) and allow to free rise to 72°F (22°C) after 72 hours.

Try it both ways and see what you prefer or split a batch in two and compare methods on the same beer.

You can do this with other spirits too. Rum barrels are usually used for whiskey first, so take some whiskey-soaked chips and transfer them into another jar that you fill with the rum of your choice. Whenever I use a new spirit, I like to research how that spirit's barrel is actually used and treat that as a baseline for inspiring my replication. You can go outside of the box, too: I once aged a wheatwine in pear brandy-soaked toasted oak. Nontraditional, but delicious.

A final note about barrel alternatives. Many people buy toasted oak and just put that in their beer. You can do that, but it won't have the same charred flavor that you get from aging it in an actual barrel. Other people may just dump some whiskey into their stout. In my experience, you just don't get enough oak flavor by doing this, but you can add whiskey as necessary to boost the flavor of the spirit in the final beer if you feel it's necessary. This is another thing that pro brewers legally cannot do, so it's nice to have it in the homebrewer's toolbox.

FINAL STEPS

Transferring out of the barrel with an appropriate-length transfer tool (I prefer a stainless-steel racking cane) and into a purged Corny keg is a great method for packaging. While these beers have already had oxidation, be careful not to add any more, especially in the big bursts that are found with subpar transferring procedures.

From there, you usually want to drink these out of the keg or force carbonate them into bottles. It's very difficult to achieve proper bottle conditioning with beers that approach and even exceed 13 percent ABV, and very few professionals even attempt that. And while these should be enjoyable for years to come, they are not going to improve drastically over 5 to 10 years as a good English barleywine or lambic often does, so avoid bottle conditioning.

TROUBLESHOOTING

A stuck fermentation is the most common issue with brewing big beers, especially if yeast pitch rates, yeast health, and fermentation temperatures aren't optimal. Here are three ways to fix a stuck fermentation in a big beer.

1. First, check the gravity of the beer. If attenuation has progressed at least 60 percent of the way toward final gravity, bump the temperature to 72 to 75°F (22 to 24°C) and shake the fermenter to rouse your yeast. This solution may not work, since your yeast may have already quit or the cell count is too low, but it's easy to do, with no real downside if it fails.
2. If step 1 fails, make a massive starter of an alcohol-tolerant yeast strain and repitch towards the higher end of the recommended temperature range for that yeast. My choice for stuck fermentations is WLP099 Super High Gravity Ale Yeast, which really rips through wort even in challenging high-ABV environments. You can choose any good alcohol-tolerant ale

Brew This!

Infinite Sequence

Imperial stout

Recipe courtesy of New Image Brewing.

Owner and head brewer Brandon Capp uses Infinite Sequence as one of New Image Brewing's two primary base stout recipes for barrel aging. He's aged this beer over two years before and has used this recipe for both single-barrel vintages and in blends of multiple barrels.

A fun variation is to age this beer with 1/6 lb. (76 g) of whole-bean coffee, 1/6 lb. (76 g) of Ceylon cinnamon, and 1.1 lb. (499 g) of cacao nibs.

Batch volume: 5 US gal. (18.9 L)
Original gravity: 1.149 (34°P)
Final gravity: 1.056 (13.8°P)
Efficiency: 65%
Bitterness: 30 IBU
Alcohol: 12.3% by volume (before barrel aging)

MALTS & ADJUNCTS

22 lb. (9.98 kg) Proximity Base 2 Row
3 lb. (1.36 kg) Weyermann Carafa Special II
1.8 lb. (813 g) Simpsons Crystal 15°L
1.8 lb. (813 g) Simpsons Malted Oats
1.6 lb. (740 g) Simpsons Flaked Oats
1.2 lb. (541 g) Simpsons Black Malt
9.6 oz. (272 g) Weyermann Roasted Barley

HOPS

1 oz. (28 g) Magnum, 12% a.a., first wort

YEAST

44 g (1.55 oz.) Fermentis SafAle US-05

ADDITIONAL ITEMS

rice hulls, as needed for mash runoff

BREWING NOTES

Mash 60 minutes at 150°F (66°C), targeting a mash thickness of 1.125 qt./ lb. (2.3 L/kg) and a pH of 5.2. Boil for 150 minutes or as long as needed to achieve the indicated original gravity.

Ferment at 66°F (19°C) for 5 days, or until specific gravity reaches 1.085. Warm to 70°F (21°C) and ferment until completed. Cool to 60°F (16°C) if you wish to add adjuncts.

Cold crash and condition as close to freezing as you can for 4 days. Package with 2.4 vol. (4.8 g/L) CO_2.

strain that you're comfortable with. One yeast to avoid is Champagne yeast. Since Champagne yeast ferments wine pretty vigorously to a dry result, people tend to think that it will do the same with beer. It is not an especially good fermenter for beer and certainly not a good emergency solution for a stuck fermentation.

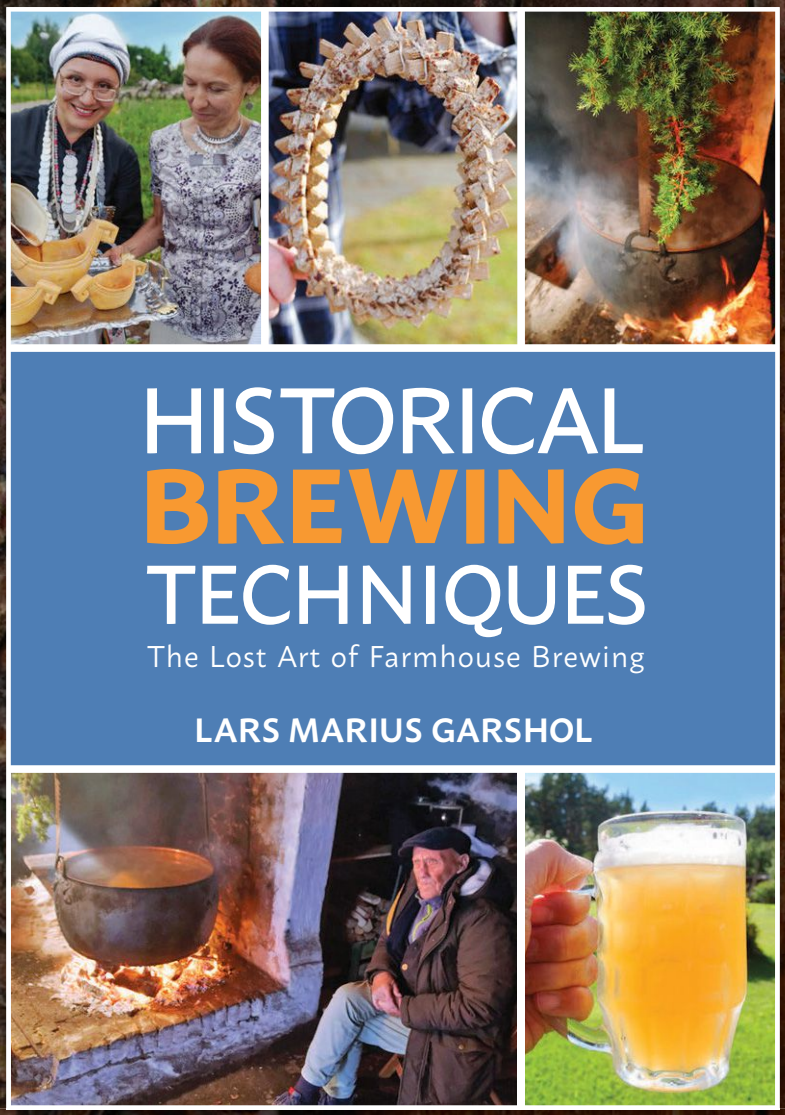
3. Some breweries will hit the beer with a punch of oxygen to fix a stuck fermentation, but these beers will already see exposure to oxygen in the barrel over time, and if you add too much oxygen there is a real risk of losing vibrant flavors of this beer from day one. For that reason, I would only add oxygen if you do not have access to more fresh yeast.

Another common worry for both home and professional brewers of big beers is hitting the target starting gravity. You have to adjust your estimated efficiency downward quite a bit for high-gravity beers, but this is system-dependent and usually takes a few batches to dial in. If you undershoot your desired gravity, it's pretty easy to add dried malt extract (DME) to reach the correct gravity. In fact, if your mash tun can't physically hold enough grain to make the volume of high-gravity wort you want, simply substituting some base malt with pale DME is a great solution. I personally keep DME on hand at all times for these two situations.

When it comes to barrel aging, after filling their barrels, many people like to keep a small amount of beer on the side to top off the beer that is lost to the "angel's share," or evaporation. I don't recommend doing this. I would keep that bung closed until you are ready to package the beer, as the risk of contamination by opening the bung or introducing another liquid to what is already in the barrel is too high. If you have more beer than will fit in the barrel, simply keep the beer to drink—it can be fun to compare it to the barrel-aged version.

Other issues revolve around the beer tasting too bitter, roasted, astringent, sweet, or boozy. My recommendation is to tailor your recipes based on previous results. Using good techniques should resolve most of those issues. It may take two or three tries to really get what you consider to be the perfect stout, but if you follow the advice above, there's no reason why your first attempt can't be delicious.

Ryan Pachmayer is the head brewer at the Yak and Yeti Restaurant and Brewpub in Arvada, Colo. He is also a BJCP Certified beer judge. He can be reached at ryan@puzzah.com.



"IT'S NOT AN EXAGGERATION TO SAY THAT *HISTORICAL BREWING TECHNIQUES* IS THE MOST IMPORTANT BOOK ON BREWING IN AT LEAST TWENTY YEARS."

—JEFF ALWORTH, AUTHOR OF *THE BEER BIBLE*

does your beer say ALOHA?

By Lee Case and John Herreid, with illustrations by John Herreid

The first time I experienced pineapple sage's wonderful scent, I was with my family in the Lake Merritt Sensory Garden in Oakland, Calif. The garden grows dozens of different fragrant, flowering, and texturally interesting plants. It complies with the Americans with Disabilities Act (ADA) and is designed for direct contact, especially for people in wheelchairs and the visually impaired; all visitors are encouraged to touch and smell everything in the garden. →

At the time of our visit, volunteer gardeners were busy trimming many floral and wonderfully smelling plants.

"Here's something for you," one docent said, handing me a green cut stem with tubular red flowers. "Rub the leaves of this plant and then smell your fingers."

I was transported far away as I smelled fresh-cut pineapple, the essence of piña coladas, the tanginess of a pineapple's ripe fruit flesh, all from a simple plant cutting. I imagined hearing distant ukulele music while walking through a Hawaiian rainforest, tropical birds chirping and singing all around. A slight breeze blew through the heavenly magnolia and papaya trees in full bloom…

Then the aroma was gone. "Outstanding aroma! What is this?"

"That's pineapple sage. Isn't it something?"

I had to agree, for I had never experienced such an aroma from a simple woody plant.

According to Wikipedia, "*Salvia elegans* has tubular red flowers and an attractive scent to the leaves that is similar to pineapple. It produces numerous erect leafy stems and flowers in the late autumn." The entry goes on to claim that "the leaves are edible, in fact *Salvia elegans* leaves are used in the treatment of anxiety, and for lowering blood pressure."

In the San Francisco Bay area, you can get pineapple sage locally from many nurseries, including the plant experts at Annie's Annuals and Perennials, an incredible nursery known for their selection of unusual and California-native plants.

BREWING UP AN IDEA

Some years later, I asked my brewing partner John Herreid if he had any ideas for a good *Zymurgy* article. John always has inventive ideas and creative solutions that involve culinary experiments or brewing something delicious, and his response was immediate: "I want to know if it is possible to capture the aroma of pineapple sage *(Salvia elegans)*, which is very fruity and strongly aromatic in the leaf, in a brewed beverage."

I loved this idea, because I had been fond of pineapple sage since I discovered it. John is also captivated by this plant, and to prove it, he has a large pineapple sage plant growing in his garden that attracts bees, butterflies, and hummingbirds.

After some discussion, we came up with several possible approaches:

- Muddle pineapple sage in a small amount of vodka and taste it.
- Brew a batch of beer using *dried* leaves as a late addition.
- Brew a batch of beer using *fresh* leaves as a late addition.
- Use a tincture of *dried* sage leaves soaked in alcohol as a secondary "dry-hop" addition or used at bottling.
- Go wild and brew a batch of beer using mostly pineapple sage stems and leaves for bittering and aroma, treating the sage like a gruit. This "Polynesian island hermit" approach would give us the full experience of pineapple sage aromas and flavors. If our initial brewing experiment worked, we just might be bold enough to do this!

John's initial idea was to make a muddled extract that could be added to a pale ale, summer beer, or beer cocktail, the goal being to extract the fresh pineapple aroma and essence into bitters and then add it to the beer. The classic Berliner weisse relies on a similar method of flavoring by which one adds herbal woodruff or raspberry syrup to this light, refreshing beer.

Pineapple sage's bright red flowers.

Muddling involves using a fresh ingredient (such as mint, lemon verbena, lemon balm, or star anise) to create an instant extract. You crush and swirl the plant ingredients in a neutral flavor, 80-proof-or-higher alcohol (e.g. vodka) with a muddler or a small spoon, which imparts the aroma and flavor of the raw ingredients into the alcohol. Once muddled, let the mixture sit 10 to 15 minutes. This concoction can be imbibed straight or added to a regular cocktail or beer cocktail.

Photos © Getty/anton5146; courtesy of Lee Case; illustrations by John Herreid

Pineapple sage leaves.

When we tried this method, we tasted more of the sage's woody notes, even though we used the plant's leaves. It was good for a cocktail bitters, but there wasn't enough pineapple aroma. We hoped for more success with the beer.

BREWING PINEAPPLE SAGE ALE

Based on our brewing experience, John and I thought using a late sage addition would be best for capturing the aroma of the leaves with less of the bitterness or woodiness that would likely be imparted if they were boiled for longer than 5 to 10 minutes. We wanted to allow the aroma to shine through, so we chose a *very* light blonde ale recipe as our base, with a target ABV of around 5 percent.

We designed the recipe to produce three small batches for comparing the flavor differences. We brewed a 6-gallon (22.7 L) base batch and then, as the boil finished, we divided the wort into three 2-gallon (7.6 L) batches with two extra brew pots. The batches were designed as follows:

1. Base batch with no sage (control group)
2. Batch using fresh-cut pineapple sage leaves in the whirlpool
3. Batch using dried pineapple sage leaves in the whirlpool

We treated the sage leaves like a "fresh hop" addition and added the leaves at flameout in an attempt to retain the overall aromatic qualities. The recipe calls for 2 to 4 ounces (57 to 113 g) of pineapple sage; we conservatively chose two ounces, which

TABLE 1: BCJP-INSPIRED EVALUATION SHEET.

Taster name	Base recipe	Batch with fresh sage	Batch with dried sage
Aroma			
Color			
Body			
Taste (Mouthfeel)			
Overall Score			

TABLE 2: SIMPLIFIED EVALUATION SHEET.

Taster name	Beer A	Beer B	Beer C
Rank in flight (1st, 2nd, or 3rd)			
Comments: What do you notice about each sample (aroma, flavor, body, color, etc.)?			
Would you drink this beer again?			
Is there anything you might change?			

hydrate and feed YOUR YEAST

I remember from my reading that Charlie Papazian, Mitch Steele, and John Palmer all mentioned the importance giving your yeast an initial "snack" before it has to go to work. On brew day, this is the method I use with dry yeast.

If you are as busy as I am, you can easily store a nice variety of high-quality yeast in commercial dry packets. Lallemand, Fermentis, Muntons, and others are excellent, and they remain viable in the refrigerator for a good amount of time. Lallemand has recently released their premium series yeast, and it works rather well.

Hydrate and feed your yeast during the boil—it takes at least an hour for this procedure. First, boil 3 cups of water. In a small bowl, pour about 1 cup of the boiled water, place a small cooking thermometer in the bowl, and cover it with a plate. Because the yeast will come into contact with this water first, you must know the exact temperature before adding the yeast.

At the same time, pour the other 2 cups of boiled water into a medium-sized bowl and add 2–6 Tbsp. of a complex sugar such as honey, molasses, agave syrup, or date syrup. Using a complex sugar rather than common table or brown sugar provides better growth conditions for the yeast. You may also add ¼ tsp. yeast nutrient if you wish. Cover with a plate to discourage wild yeasts from contaminating this solution.

Wait for the 1 cup of water to cool to the correct rehydration temperature—check your yeast package instructions for this—typically 77 to 92°F (25–33°C). Once it hits the target temperature, add the yeast. Let the yeast hydrate for 15 to 20 minutes. Then, add the yeast-and-water solution to the medium-sized bowl that has the sugar solution and cover again; let it sit for at least 30 minutes. This method gives the yeast a snack before they get their main food source, which is of course, wort.

Brew This!

CALI PHONE YA BLONDE ALE

American blonde ale with pineapple sage

Recipe courtesy Lee Case and John Herreid

This recipe makes three 2-gallon (7.6 L) batches of beer. Prepare the wort as a single batch and then divide it into three equal volumes after knockout for different whirlpool treatments. Note that the dry hop addition of 0.3 oz. (8.5 g) should be divided equally among the three batches (i.e., 0.1 oz. each).

Batch volume: 6 US gal. (22.7 L)
Original gravity: 1.062 (15.3°P)
Final gravity: 1.019 (4.8°P)
Bitterness: 30 IBU
Alcohol: 5.7% by volume

MALTS & ADJUNCTS

6 lb.	(2.72 kg) Golden Promise malt	6 oz.	(170 g) Special B malt
5 lb.	(2.27 kg) Maris Otter malt	4 oz.	(113 g) dark Munich malt
6 oz.	(170 g) Biscuit malt	8 oz.	(227 g) rice hulls

HOPS

0.5 oz.	(14 g) Cluster, FWH	0.5 oz.	(14 g) Cluster @ 20 min
0.5 oz.	(14 g) Cascade @ 30 min	0.5 oz.	(14 g) Cascade @ 0 min
0.3 oz.	(8.5 g) Northern Brewer, dry hop on 7th day		

YEAST

1 liter starter — White Labs WLP001 California Ale Yeast (or similar)

ADDITIONAL ITEMS

1 tablet Whirlfloc @ 15 min
1 tsp. yeast nutrient @ 15 min
2–4 oz. (57–113 g) fresh pineapple sage leaves, whirlpool, batch 2
2–4 oz. (57–113 g) dried pineapple sage leaves, whirlpool, batch 3

BREWING NOTES

Mash in grain with 3 gal. (11.4 L) strike water and rest at 155°F (68°C) for 60–75 minutes. Add first wort hops to kettle, lauter, and sparge to a pre-boil volume of 7 gal. (26.5 L). Boil 60 minutes, adding kettle hops, Whirlfloc, and yeast nutrient as indicated.

After knockout, divide wort into three 2-gallon batches, adding sage during whirlpool for batches 2 and 3, and then chill. Transfer to three fermenters. Pitch yeast, taking care to divide the starter evenly between the three batches, and ferment for 7–15 days.

EXTRACT VERSION

Steep dark Munich, Biscuit, and Special B malts in 165°F (74°C) water for 30 or more minutes. Replace Golden Promise and Maris Otter malts with 8 lb. (3.63 kg) of light liquid malt extract, adding 6 lb. (2.72 kg) at the beginning of the boil and 2 lb. (907 g) 15 minutes prior to flame out.

was equal to the amount of hop additions. After adding the late sage additions, we cooled the three batches and transferred each batch of wort into a 2.5-gallon (9.46-L) BrewDemon conical fermenter and then pitched the yeast.

We chose to go light on the hops and used homegrown native California Cluster and Cascade hops with a neutral character. The intent was to showcase the pineapple sage's aromas and flavors. Initially, I thought it would be fun to add tropical hops such as Azacca, Merkur, Polaris, or Sabro, but how could we then determine what aroma and flavor the sage itself imparts? We decided to go with familiar hops, with low to medium beta and alpha acids, and avoided hops that may be earthy or woody, such as Crystal, Galena, and Northern Brewer.

Everything went according to plan; cooling the wort was the only challenge, as we only had one copper wort chiller on hand. We cooled in the following order: non-sage wort, dried-sage wort, then fresh sage wort. I realized after the fact that I had only the three small fermenters. I did not want to transfer each batch to a much larger fermenter with the added headspace and oxidation risk for a secondary fermentation, so I decided to use the built-in feature of the conical fermenter and remove the bottom trub after primary fermentation (7 to 11 days), leaving each batch in their respective primary fermenters for the full fermentation.

TASTER FEEDBACK

We initially planned to use an evaluation method based on the BJCP scoresheet with individual scores for aroma, color, body, taste, and overall impression. However, after John and I conducted our own initial tastings, we threw that idea out. Most beer tasters in the general public are not familiar with the BJCP's scoring system, and more time and explanation might be required during the tasting.

So, for the public taste tests, we went from the more formal BJCP-style approach (see Table 1) to a more general feedback sheet for a blind tasting (see Table 2). We used this card to quickly obtain feedback from several tasters and found it useful for helping large groups of tasters focus on the most important task—tasting the beer.

And what better place to run a blind group tasting than in your office? At the time of the tasting, I worked at a startup software company in downtown San Francisco located in Salesforce Tower, the tallest building west of the Mississippi River. Knowing our company culture and that some of my

co-workers loved beer, I proposed that we conduct a taste test in the office.

I initially invited just a few individuals, but during the tasting, my product manager announced something like, "Hey guys and gals, stop working. We're having a beer tasting in the kitchen right now!" which is how we ended up getting a dozen more tasters in about three minutes.

There is nothing like running a beer tasting and answering rapid-fire questions from the same audience simultaneously. "How did you come up with the idea?" "What is pineapple sage again?" "Can you tell me where you brew and how much you usually make?" "Typically how long does it take before you can drink the beer?" "Can I buy some of this beer right now?"

Great tasters, all—I was so glad I brought enough beer! The results of this tasting (and three other home tastings) were:

- Eight tasters identified the sage-addition beers. They could tell that one beer was not flavored and that the "other two beers tasted similar, and were fruitier, so those two must contain the pineapple sage."
- Six tasters preferred the fresh sage version and claimed it "was definitely more fresh tasting."
- Two tasters preferred the dry sage version
- One taster preferred the regular blonde ale with no sage.
- One taster from Italy liked them all and correctly identified all three batches in less than a minute. Bam!

Everyone said they would definitely drink the beer again. The only suggestion was to increase or intensify the fruity taste and floral notes that came from the beers with the sage.

It was a popular event in the office. The product manager requested a batch for an upcoming event. The chief marketing officer sampled them all, started a new campaign for a company-branded beer, and put me in touch with the marketing VP for planning. The clear message was this: we want more.

CONCLUSION

Adding pineapple sage to the beer was a smashing success, even though the aroma did not strike me strongly as pineapple. Pineapple sage imparts a delicate, floral, tropical aroma, and the next time we brew this, we will definitely use more sage. It strikes me as noteworthy that the batch with the fresh pineapple sage was the crowd favorite, and it turns out, that was the final wort to be cooled. It definitely had extra time to release its aromas into the wort, and that may have factored in its popularity.

Using the extraction tincture might be the next thing we attempt, as that method might lock in even more of the pineapple aroma.

In closing, we both highly recommend using pineapple sage in your next beer, regardless of the style, and experimenting with edible plants that have a strong, floral aroma. Brewing is a malleable practice, and you never know which herb or plant will influence or support the next brewing trend.

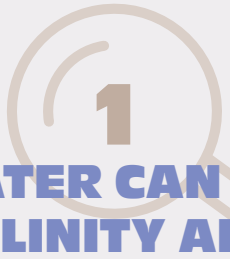
Lee Case works as an API and software technical writer. A homebrewer since the early '90s, he loves to brew classic and historically accurate beers from previous centuries. He and his family live in Northern California, where they grow apples, berries, cherries, hops, and plums. John Herreid has been homebrewing since the early 2000s. A graphic designer and illustrator, one of his favorite parts of homebrewing is label design. After 20 years in California, he recently relocated with his family to Cincinnati, Ohio, where he has been exploring local breweries.

SKEPTICAL BREWING 2

This is the second 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 BREWING WATER CAN BE HARDENED, OR ITS ALKALINITY ADJUSTED, WITH CHALK (CALCIUM CARBONATE)

It is likely that the practice of treating brewing water with chalk started in the 18th century in England. An English brewing book from 1736[1] states that the best-accounted water for brewing is water that percolates through chalk. The author even references that Ailsbury brewers would add "great quantities" of chalk into their wells to treat their brewing water.

Another English book from the 1760s[2] also mentions the "importance" of using chalky water, stating that "if the brewer lives where there is a soft, chalky water, he need not fear success" and later explains a method for treating non-chalky water for brewing.

This practice is certainly still ingrained in the brewing community, and most homebrew shops and brewing industry ingredient suppliers offer chalk for water adjustments.

Modern brewers add salts to alter their source water's mineral profile. Goals of such additions include replicating a water origin, achieving a water profile suitable for the style they are brewing, adjusting mash pH, and achieving a certain organoleptic effect.

Calcium carbonate, also known as limestone or chalk, is the source of scale build-up in plumbing, especially in places that have hard water. Water hardness and alkalinity are measured in terms of their equivalents as calcium carbonate ($CaCO_3$). If a water's alkalinity is higher than its hardness, then this hardness is temporary and will precipitate.

Brewers who wish to increase water hardness or mash pH sometimes add chalk (calcium carbonate) to the water or to the mash. But does it work?

WHAT DOES SCIENCE HAVE TO SAY?

We can't speak about brewing water composition and pH without mentioning Paul Kolbach and A.J. deLange. Kolbach's research in the 1950s[3] showed that mash pH is affected by the water's alkalinity and its calcium and magnesium hardness.

DeLange's work[4] found that regions with higher residual water alkalinity meant local brewers were more likely to brew darker beer styles. He also found that the required quantity of calcium equivalents to neutralize

→

that alkalinity depended on the mash's available phosphates, its pH, and the alkalinity itself—basically, he discovered that it is extremely hard to model and predict.

DeLange has suggested in online forums[5] that brewers resist trying to replicate a specific region's water source due to a number of problems with that approach:

- Source water reports may contain inaccuracies.
- Evidence that local brewers treated their water prior to use may be lacking.
- Water adjustment models and spreadsheets simplify the involved chemistry and can yield inconsistent results.

Instead, deLange suggests a simpler approach focused on adjusting mash pH and minimizing mineral content to avoid adding or causing flavors that the drinker may not like, while ensuring an adequate quantity of minerals that positively affect the beer flavor.

Coming back to the chalk matter, naturally, calcium carbonate dissolves in water—otherwise how would it originally get there?—but the reaction is not instantaneous. For it to happen, water needs to absorb carbon dioxide (creating carbonic acid), and long contact times between the water and the limestone are required. The saturation level of calcium carbonate in water is very low, about 0.04 ounces in 5 gallons (50 ppm or mg/L), which means that little of it can be dissolved under normal conditions, i.e., room temperature and atmospheric pressure.

Figure 1 plots calcium carbonate's solubility. From the graphs, we see that solubility increases at higher-than-normal CO_2

TEST IT YOURSELF!

Keen to swap chalk for another salt that is more effective at increasing mash pH (i.e. baking soda/sodium bicarbonate)? Brew this beer and give it a go!

BREWERS' HANDSHAKE FERNET STOUT

In hospitality circles, Fernet, an Italian amaro widely consumed in Argentina, is known as the "The Bartender's Handshake." Order one at a bar (outside of Argentina where it is enjoyed by pretty much by everyone everywhere), and they will instantly know you're a fellow bartender and treat you well for the rest of the night.

Fernet Export Stout honors this tradition and is the result of a collaboration between Dos Dingos Cerveza Independiente (Argentina) and Black Hops (Australia). This slightly off-dry brew is balanced with the bitter spices from Fernet and a classic dry stout finish.

Batch volume: 5 US gal. (18.9 L)
Original gravity: 1.065 (16°P)
Final gravity: 1.014 (3.5°P)
Color: 47 SRM
Bitterness: low-medium (Fernet also adds some bitterness!)
Alcohol: 6.7% by volume

MALTS

10.1 lb. (4.6 kg) pale ale malt
1.1 lb. (480 g) light Munich malt
13.4 oz. (380 g) wheat malt
10.6 oz. (300 g) Weyermann Carafa Special I malt (huskless)
10.6 oz. (300 g) Ireks black wheat malt
2.1 oz. (60 g) Weyermann Carahell

HOPS

0.9 oz. (24 g) Centennial, 10% a.a. @ 60 min

YEAST

Fermentis SafAle S-04, Wyeast 1098 British Ale, White Labs WLP004 Irish Ale, Omega OYL-005 Irish Ale, Lallemand Nottingham, or other Irish/English-style ale yeast.

WATER

Adjust your water to the following profile using baking soda, not chalk:
Ca 50 ppm, SO_4 50 ppm, Cl 50 ppm, HCO_3 70 ppm

ADDITIONAL INGREDIENTS

0.5 tablet Whirlfloc @ 10 min
½ tsp. (1.5 g) yeast nutrient @ 5 min
3.4 fl. oz. (100 mL) Fernet Branca @ 0 min
3.4 fl. oz. (100 mL) Fernet Branca, end of fermentation
3.5 oz. (100 g) corn sugar, if bottle conditioning, for 2.3 vol. (4.6 g/L) of CO_2

BREWING NOTES

Mash at 65°C (149° F) and adjust pH to 5.4–5.5. Rest for 45 minutes. If sparging, do it at 75–78°C (167–173°F). Collect enough wort in the kettle to yield 5 gal. (18.9 L) in the fermenter.

Boil the wort vigorously for 60 minutes, adding hops, Whirlfloc, and yeast nutrient per the required schedule. After flameout, add first Fernet addition while whirlpooling.

Chill wort and transfer to fermenter. Aerate thoroughly and pitch yeast. Start fermentation at 18°C (65°F) and let it rise to 20–23°C (68–74°F) after day three. Add the second Fernet addition when fermentation has finished.

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. Carbonate to 2.3 vol. (4.6 g/L) of CO_2.

pressure in water (basically in carbonated/sparkling water); however, bubbling CO_2 for a long while to dissolve added chalk would be an inconvenient brewing practice.

Kai Troester (aka Braukaiser) has explored the "chalk issue" in a few different experiments posted on his blog[6]. One of his experimental results indicates that even at high chalk additions in the mash, the mash's pH increase was minor, only about 0.1 to 0.2, showing that the suspended chalk was not dissolved during the mashing process.

VERDICT

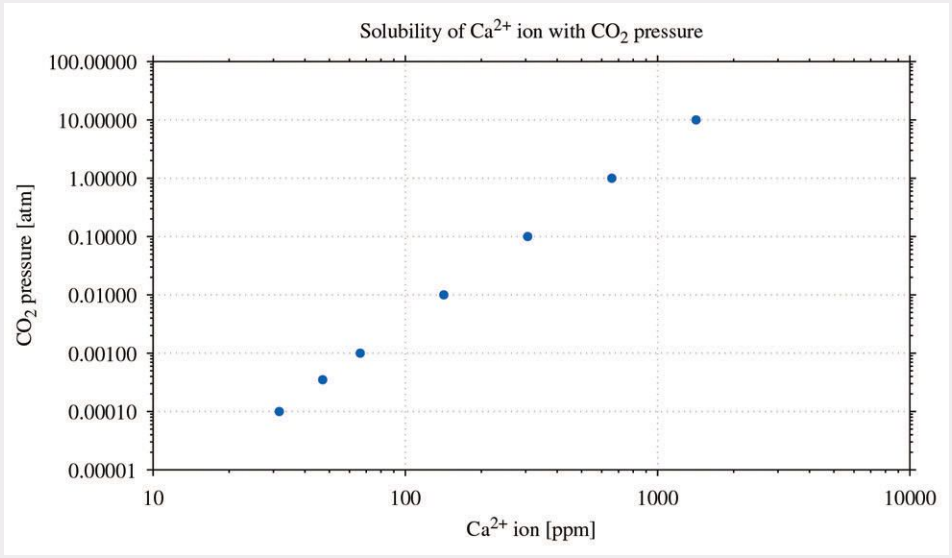
We can't label the assertion that brewing water hardness and alkalinity can be adjusted with chalk an outright myth. However, because a fraction of the available chalk dissolves in the water or in the mash, we can still call it a myth and deduce that chalk additions are inconsistent and ineffective at increasing alkalinity and mash pH.

REFERENCES

1. William Ellis (1736), *The London and Country Brewer.*
2. George Watkins (1760), *The Complete Brewer; or, The Art and Mystery of Brewing Explained*
3. Paul Kolbach (1953), "The influence of the brewing water on the pH of wort and beer," *Berlin Brewing Monthly Magazine*, translated by A. J. DeLange.
4. A.J. deLange (2004), "Alkalinity, Hardness, Residual Alkalinity and Malt Phosphate: Factors in the Establishment of Mash pH," *Cerevesia*
5. Homebrewtalk forum: https://www.homebrewtalk.com/threads/a-brewing-water-chemistry-primer.198460/
6. Kai Troester blog: braukaiser.com

Chalk in water. When chalk (calcium carbonate, $CaCO_3$) is added to water (left) and stirred, it does not dissolve but forms a suspension (center). After some time (a couple of days here) chalk settles at the bottom of a container (right).

FIGURE 1: SOLUBILITY OF CALCIUM CARBONATE.



Data source: en.wikipedia.org/wiki/Calcium_carbonate

2 HIGH LEVELS OF ZINC ARE TOXIC TO YEAST

Zinc is a trace metal, which means that it is normally present in small but still measurable amounts in cells, and it is necessary for yeast's metabolism and physiology.

As unicellular organisms, yeast cells require trace amounts of zinc for

- Enzymatic activity. Zinc plays a key role in more than 100 enzyme reactions occurring in yeast cells.
- Cellular membrane stabilization. Zinc helps the cell membrane scar "heal" after each budding cycle.

Furthermore, zinc plays a crucial role during fermentation, as it:

- Stimulates the uptake of complex wort sugars such as maltose and maltotriose;
- Increases fermentation rate; and
- Promotes yeast flocculation.

Barley wort, especially from a low- or no-adjunct beer, is generally a very complete medium for yeast, having most of the required micronutrients for completing "healthy" fermentations. Zinc, however, is sometimes present at suboptimal concentrations, and supplements are normally recommended to improve fermentation performance, especially for high-gravity worts or for brewers who want to re-pitch yeast. →

Zinc deficiency was not a problem when most breweries used copper kettles. Zinc was present in them as an impurity, and trace quantities ended up being absorbed into wort during the brewing process. Modern brewing equipment is typically made from stainless steel, which means that no zinc can be absorbed from the equipment itself.

Academics suggest a wide range of zinc concentrations in wort:

- Boulton, in the book *Brewing Yeast and Fermentation*[1], says that "The most common nutrient addition is zinc, usually added as a solution of the hydrated sulphate and at a concentration of 0.05 to 0.15 ppm Zn2+"
- In the book *Yeast: The Practical Guide for Beer Fermentation*[2] Chris White and Jamil Zainasheff suggest levels between 0.1 and 0.15 ppm, which they mention can be achieved by adding 0.2 to 0.3 ppm at the end of the boil (as there is a 50% absorption efficiency loss in the trub).
- Bamforth, in his book *Food, Fermentation and Micro-organisms*[3] writes, "Some brewers add zinc (e.g. 0.2 ppm) to promote yeast action."

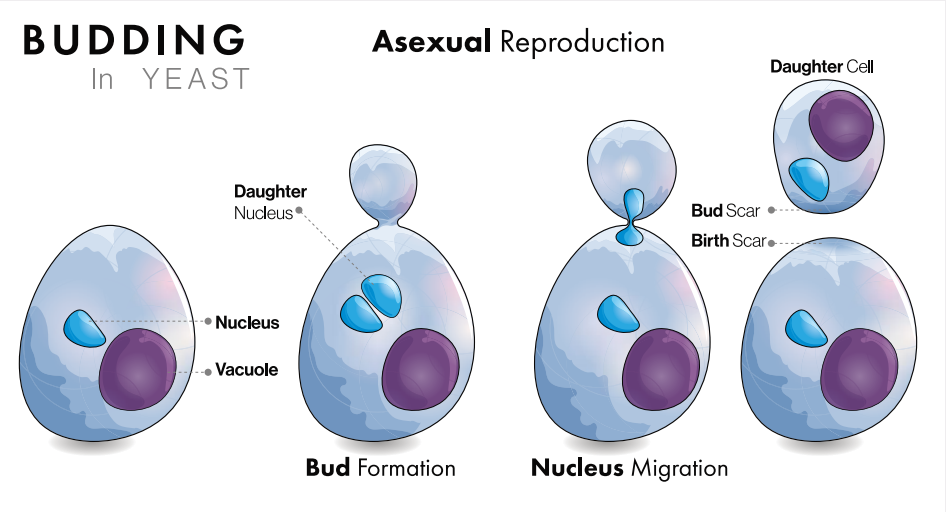
It is known that excessive consumption of trace metals, even for humans, can be toxic. Priest's *Handbook of Brewing*[4] pins the threshold at which zinc inhibits yeast growth at 0.6 ppm, while common talk in brewing forums and online water calculators sets this number to 1 ppm.

WHAT DOES SCIENCE HAVE TO SAY?

Witham[5] first observed in the early 1960s that 450 ppm of zinc in wort would reduce yeast growth and fermentation by half, concluding that zinc may also interfere with levels of enzymes in plants and animals.

A few years later, Molson breweries made several studies[6] on the effect of fermentation speed and total yeast produced by dosing industrial wort with different levels of zinc (from 0 to 1 ppm) over seven generations. The resulting charts show that in the last (seventh) generation, the yeast that had 1 ppm of zinc added into each batch was the best performer, exhibiting the fastest fermentation speed and largest yeast biomass volume.

This paper shows detailed results for four concentration levels ranging from 0 to 1 ppm and mentions that on preliminary trials, they tested additions from 1 to 5 ppm and noted an inhibitory effect above 1 ppm; however, these results were not included in the data. Even though it's not specified in the paper, one might suspect Molson's researchers used an American adjunct lager wort, which would contain low levels of trace minerals.



Asexual reproduction of *Saccharomyces*: yeast bud formation.

Other studies indicate diverse levels of zinc at which fermentation is affected:

- A study from 1983[9] also illustrates the connection between zinc uptake and toxicity in brewer's yeast, showing a steep reduction in cell count as well as viability at concentrations higher than 6.5 ppm.
- Yet, another paper[12] tested concentrations up to 23 ppm and claimed that no toxicity was observed.
- Results from an earlier study done in 1967[7] indicate that zinc levels up to 500 ppm were not toxic and "only slightly impeded fermentation."

All this sounds extremely confusing, as there is such a wide range of results between the different papers, ranging from 1 to 500 ppm.

Luckily, another paper[8] sheds some light, concluding that both the minimum required concentration of a metal for proper yeast growth, as well as the level at which each metal becomes toxic for the yeast, depends not only on the metal itself but also on the concentration of other metals in the wort. Furthermore, it states that levels would differ for each yeast strain.

Other researchers continued exploring this. Another study[11] found that if more than 0.4 ppm of manganese is present, a level of up to 65.5 ppm of zinc could be tolerated by yeast; however, if the wort had a level lower than 0.4 ppm of manganese, only 2 ppm of zinc was tolerated.

Another study[11] also found that extremely high zinc concentrations (more than 1,300 ppm) can be tolerated during the fermentation of high-gravity wort.

All the studies mentioned so far focus on toxicity and measure things like yeast growth, viability, and alcohol measurements. They don't focus on the organoleptic impact that zinc might have on fermentations.

One study from 2011 by DeNicolla and Walker[13] addresses this. Measuring the impact on aromatic compounds they found that only zinc levels of 10 ppm or above appear to have an effect. The result is higher concentrations of higher alcohols (a 6 percent increase), and some esters, namely ethyl caproate, which smells like pineapple (a 25 percent increase), and isoamyl acetate, which smells like banana (a 12 percent increase).

VERDICT

If we define "high levels of zinc" as a concentration of 1 ppm, as indicated in online brewing forums, then the verdict is that toxicity to yeast at this level is an outright myth. The science proves that toxicity thresholds are not only yeast-strain specific, but also dependent on several other factors such as the mineral content in the original brewing wort, which would differ drastically depending on the water profile and grain bill. Most importantly, organoleptic impact is noticeable at levels 10 times higher than said value.

Let's put all this into perspective for a standard 5-gallon homebrew batch to which zinc sulfate heptahydrate salt is added as a zinc source.

- 0.017 grams (17 mg) is needed to reach the target guidelines indicated in the book *Yeast: The Practical Guide for Beer Fermentation* of 0.1 ppm of zinc (for

which 0.2 ppm are to be added late in the boil).
- 0.17 grams (170 mg), 10 times the original value, are needed to reach the "high level" myth value.
- 1.7 grams (1700 mg), 100 times the original value, are needed to reach levels where significant organoleptic impact is detected.

If you are a homebrewer worried about using too much zinc, fearing the toxic effect on yeast, fear no more, as you would have to get it extremely wrong for it to have a negative impact on your brew.

REFERENCES

1. Boulton, C., Quain, D (2006) *Brewing Yeast and Fermentation.* Blackwell Science.
2. C. White and J. Zainasheff (2010) *Yeast, the Practical Guide for Beer Fermentation.* Brewers Publications.
3. Bamforth, C. (2005) *Food, Fermentation and Micro-organisms.* Blackwell Science.
4. F. Priest and G. Sterwart (1996) Handbook of Brewing. Taylor & Francis.
5. I J Witham (1963) "Zinc Toxicity in Brewers Yeast," Nature.
6. H Densky, P Gray & A Buday (1966) "Further Studies on the Determination of Zinc and its Effect on Various Yeasts," ASBC.
7. S Frey, W. DeWitt B Bellomy (1967) "The Effect of Several Trace Metals on Fermentation," ASBC.
8. T. Helin, J Slaughter (1977) "Minimum Requirements for Zinc and Manganese in Brewing." J. Inst Brewing.
9. By J. L. Mowll and G. M. Gadd (1983) "Zinc Uptake and Toxicity in the Yeasts S. roseus and S. cerevisiae." Journal of General Microbiology.
10. R. Jones and P. Greenfield (1984) "A Review of Yeast Ionic Nutrition—Growth and Fermentation Requirements." Process Biochemistry.
11. E Rees, G Stewart (1998) "Strain Specific Response of Brewer's Yeast Strains to Zinc Concentrations in Conventional and High Gravity Worts." J. Inst Brewing.
12. G. Walker et al (2005) "Yeast-metal interactions: impact on brewing and distilling fermentations." Inst Brewing & Distilling Asia Pacific Section 2006 Convention.
13. De Nicola and G. Walker (2011) "Zinc Interactions with Brewing Yeast: Impact on Fermentation Performance." J. Am. Soc. Brew. Chem.

3
BREWING YEASTS HAVE AN AEROBIC PHASE DURING FERMENTATION

While it is not possible to pinpoint a specific moment in time when this idea arose, we believe it has to do with high school biology classes. We all learn about aerobic and anaerobic conditions (presence or absence of oxygen, respectively) in which the energy-yielding reactions of respiration and fermentation (aerobic and anaerobic conditions, respectively) take place, although we are not always taught about the Crabtree effect, which we'll look at below.

Regardless, brewing books, even well-regarded references such as the *Encyclopedia of Brewing*[1], have repeatedly stated that yeast first undergoes an aerobic phase (as oxygen/air is added to the wort prior to pitching) at the beginning of fermentation and then proceeds to an anaerobic phase.

Froth! The Science of Beer[2] is a nice example, as it presents the reasoning for having a respiratory phase prior to fermentation: "In an oxygen-rich environment such as the initial wort that you have assiduously aerated, the yeast cells practice aerobic respiration—which [...] is an efficient method of breaking down the wort sugar to supply the energy that the yeast cells use for reproduction. When the oxygen supply dwindles, the cells switch to anaerobic respiration, which is less efficient but works."

This, the book ascertains, is due to yeast being a facultative anaerobe, which essentially means that the microorganism can both obtain energy via respiration (in the presence of oxygen, and more efficient in terms of energy yield) or fermentation (less efficient but does not require oxygen), and respire when possible due to the gain in efficiency. As an interesting side note, organisms can also be obligate anaerobes (for whom oxygen is harmful) or aerotolerant (which cannot respire but tolerate its presence).

Thus, the reasoning goes, respiration is more efficient than fermentation. The Pasteur effect (inhibition of fermentation in the presence of oxygen) kicks in and yeast respire in the presence of oxygen, so we get an aerobic phase in fermentation when pitching yeast into oxygenated wort.

WHAT DOES SCIENCE HAVE TO SAY?

What has science established in terms of oxygen requirements and use by *Saccharomyces cerevisiae* during brewery fermentations?

Pasteur, in the 1860s, described what came to be known as the Pasteur effect: that fermentation in yeast was inhibited by oxygen. It was observed by an increase in growth and decrease of sugar uptake when yeast was transferred from an anaerobic to an aerobic environment. This is now thought to be a consequence of Pasteur's experimental conditions, as it does not occur within batch growth conditions[3].

In 1929 the Crabtree effect, also known as the "reverse-Pasteur effect," was first documented[4]: respiration was inhibited because of a high sugar concentration in the medium. It was further confirmed in brewing strains in the 1960s[5].

Andreasen & Stier[6,7] established in the early 1950s that under anaerobic conditions (i.e. without oxygen) *Saccharomyces* required both pre-formed sterols and unsaturated fatty acids for growth. This was further confirmed in the 1970s for brewing strains. →

VERDICT

As argued in a paper from the 1980s[8], the evidence basically indicates that *Saccharomyces* yeasts are not true facultative anaerobes, meaning that they can't grow in both the presence or absence of oxygen (i.e. they can't choose to respire or ferment depending on the presence or absence of oxygen), mainly because the Crabtree effect[8] takes precedence. Hence, we must label this belief as an outright myth.

It is worth noting that this is why baker's yeast is grown in a fed-batch process, a procedure where the microorganism is continuously fed under strict substrate control (as opposed to adding the substrate from the beginning) to avoid triggering the Crabtree effect, thereby forcing respiration which results in an increase of biomass; which is what yeast manufacturers want. Unlike brewers, they are not interested in alcohol production from fermentation.

Current research[9] emphasizes that the Crabtree effect should be taken into account when preparing starters, to increase biomass yield and improve fermentation kinetics and wort attenuation when the yeast is used. The authors recommend yeast be propagated in wort supplemented with yeast extract to a 100 carbon-to-nitrogen ratio and diluted to 2°P of fermentable sugars, which could be achieved by diluting wort with deionized distilled water and supplementing with yeast extract. The dosage rate will depend on the product used and an estimation of the free amino nitrogen (FAN) of the wort produced.

It is important to bear in mind that not all microorganisms are Crabtree-positive[5], although most others widely used in brewing are (for example, *Brettanomyces*), yet this is not the case, for example, with *Kluyveromyces*[10], which is now being used for brewing mixed-culture and sour beers[11].

REFERENCES

1. Boulton, C. (2013). *Encyclopedia of Brewing.* John Wiley & Sons.
2. Denny, M. (2009). *Froth! The Science of Beer.* Johns Hopkins University Press+ ORM.
3. Lagunas, R. (1986). "Misconceptions about the energy metabolism of Saccharomyces cerevisiae." Yeast, 2(4), 221-228.
4. Crabtree, H. G. (1929). "Observations on the carbohydrate metabolism of tumours." Biochemical Journal," 23(3), 536.
5. De Deken, R. H. (1966). "The Crabtree effect: a regulatory system in yeast." Microbiology, 44(2), 149-156.
6. Andreasen, A. A., & Stier, T. J. B. (1953). "Anaerobic nutrition of Saccharomyces cerevisiae. I. Ergosterol requirement for growth in a defined medium." Journal of Cellular and Comparative Physiology, 41, 23–36.
7. Andreasen, A. A., & Stier, T. J. B. (1954). "Anaerobic nutrition of Saccharomyces cerevisiae. II. Unsaturated fatty acid requirement for growth in a defined medium." Journal of Cellular and Comparative Physiology, 43, 271–281.
8. Fiechter, A., Fuhrmann, G. F., & Käppeli, O. (1981). "Regulation of glucose metabolism in growing yeast cells." Advances in Microbial Physiology, 22, 123-183.
9. Moutsoglou, M. E., & Dearden, A. C. (2020). "Effect of the respiro-fermentative balance during yeast propagation on fermentation and wort attenuation." Journal of the Institute of Brewing, 126(3), 289-297.
10. Thomson, J. M., Gaucher, E. A., Burgan, M. F., De Kee, D. W., Li, T., Aris, J. P., & Benner, S. A. (2005). "Resurrecting ancestral alcohol dehydrogenases from yeast." Nature Genetics, 37(6), 630-635.
11. Carlito, Eugenio & Monteiro, Carlito. (2020). "Assessing non-traditional yeasts species for the purpose of brewing beer." 10.13140/RG.2.2.30491.90406.

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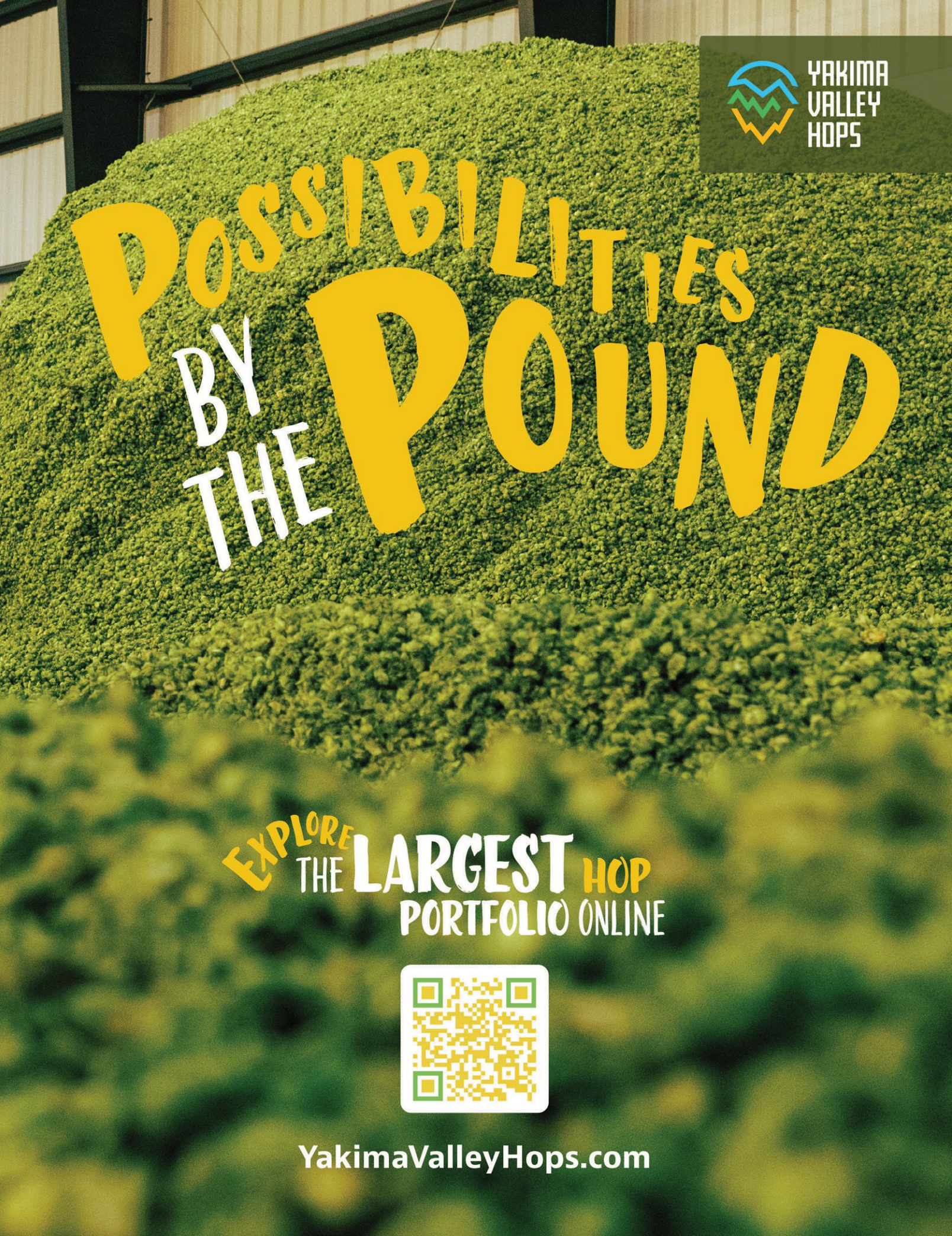
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The Schmidt family.

Grandpa Harry Schmidt (far right) at the bar with coworkers.

MY GRANDFATHER'S CROCK

RESURRECTING A 70-YEAR-OLD FAMILY BREWING TRADITION

By David Schmidt

My grandfather's crock wasn't allowed in the house
So it bubbled away in the garage…

My father still fondly recalls those evenings around the Schmidt family dinner table in the 1960s. Grandma would fill everyone's plates with mashed potatoes and crispy fried chicken. Grandpa read the paper. Dad and his siblings, my Uncle Craig and Aunt Marilyn, ate with gusto. There was always some dinner guest, maybe Dad's friend from Boy Scouts, who would compliment the delicious cooking.

Then the explosions would start.

POW! BANG!

The noises would erupt from the nearby garage. Grandma would scowl at Grandpa.

BOOM!

Dad's friend would stare wide-eyed with concern. "What the heck was that?" This was the age of Cold War duck-and-cover drills, after all. None of the Schmidts were concerned, though. Grandpa would just chuckle and keep on eating his potatoes. "Heh, heh, heh!" He'd smile. "Sounds like we've got a lively one out there!"

Another bottle of homemade beer had exploded.

I grew up hearing tales of Grandpa's legendary homebrew. Dad and his two siblings nostalgically remember the malty smell that permeated their garage any time of the year. Grandpa's fermenter was an eight-and-a-half gallon ceramic crock, the kind that other German families used to ferment sauerkraut. He stored the crock inside a wooden cabinet in the garage, since Grandma never allowed it inside the house, and a fresh batch of wort was always bubbling away.


David Schmidt brewing.

"I've always loved the smell of boiling wort," Uncle Craig told me. "My wife can't stand it when I'm brewing, but that smell just takes me right back to childhood."

Once he hit adolescence, Craig found that having a brewer father came in handy for his social life as well. "I was a little more popular than I should have been in high school, thanks to that homebrew. I'd sneak some to my friends sometimes."

"Did you ever get in trouble for it?" I asked.

"Just once—but only because we threw out one of your Grandpa's good 32-ounce bottles. 'Next time you steal some of my beers,' he told me, 'at least save the bottles. Those darn things are expensive!'"

Word got around to Dad's friends as well. His buddy from Scouts came over one summer afternoon to plan a fishing trip. As they sorted through a tackle box at the dining room table, the friend kept dropping hints about the fabled homebrew. "So your old man makes his own beer, huh?"

"He sure does." Dad decided to keep his friend on the line for a while and tire him out.

"Wow. Brews it right there in the garage?"

"Yep."

As they continued to sort lures in silence, his friend cast glances toward the garage. Finally, Dad set the hook.

"You want to try a bottle?"

"Well… I guess it would be nice on a hot day like this."

My dad popped open a cold one and his friend took a few sips. Unlike Craig's friends, this boy was not a fan, having only ever tried factory-made commercial lagers. He tried to disguise his grimace of disgust. Finally, he sheepishly asked Dad, "Is it OK if I don't finish this?"

Grandpa's beer certainly was an acquired taste. Having heard the stories growing up, I always wondered what that taste was like. Grandpa stopped brewing before I was even born. Although he told me plenty of brewing stories before his death in 2012, I never had the chance to try his beer myself. After years of collecting brews from all over the world and making countless batches of my own, I finally had a novel idea: why couldn't I recreate Grandpa's beer?

I would just need to figure out his technique and get a rough idea of the specific ingredients. Once the idea entered my head, it refused to leave. I had to do it: it was time to resurrect Grandpa's brewing crock.

FROM RUSSIA TO CALIFORNIA: THE TRANSFORMATION OF SCHMIDT FAMILY BREWING

It could hold sauerkraut
for a family of twelve,
But my grandpa, he
dreamed of much more…

I am proud to say that I don't know how far back homebrewing goes in our family—at least two or three hundred years, and probably even further.

Grandpa inherited the knowledge from his ancestors who came over from Russia in the early 20th century. The Schmidts were of Volgadeutsch stock: ethnic Germans who had settled the banks of the Volga River in southwestern Russia long ago. Those self-sufficient farmers learned to ferment whatever they had on hand—rye, wheat, barley, and millet—through many lean years of scarcity in the Volgadeutsch colonies. Once our people started emigrating to Argentina, Brazil, Canada, and the U.S., they augmented those Old Country recipes with newfound abundance.

As one of the first children born in the U.S., Grandpa learned to take advantage of this convenience and commercial prosperity. Rather than brewing all-grain beers as his ancestors had, he bought cans of malt extract at the hardware store. "He would buy it at a store called PlowBoys in Bellflower," Uncle Craig told me. "Man, that place had everything. It was like a hardware store, plus a convenience store, plus… Well, they sold all kinds of shit. Including malt extract, of all things."

Buying his malt extract at a hardware store would have definitely been Grandpa's style. With a toothpick in his mouth and a "buy union" sticker forever on his pickup truck, he was a man of simple, working-class tastes. He was part of that post-War generation that put their faith in everything sterile, automated, and industrialized. This was the time when white bread was considered "the healthiest," with all of its impurities fully bleached out.

Until his last days, Grandpa bought the cheapest lagers he could find: Meister Bräu, MGD, and Natural Light were old favorites. This might offend the sensibilities of modern hipster brewers: how could someone from such a long homebrewing tradition settle for such yellow, industrial swill? For Grandpa, though, drinking cheap beer was an act of loyalty to his roots, to those hard-working farmers who were never known to put on airs.

For years, Grandpa worked the night shift at the factory. He told me about coming home early in the morning and fixing himself a "supper" of bacon and eggs, along with a cold homebrew, before going to bed for the day. My Aunt Marilyn's friend would often come to the house to walk with her to school. She would stare at Grandpa in shock, as he slugged a huge bottle of beer in the early morning. Even in grade school, the child was old enough to know what the acceptable levels of alcoholism were. "Beer with breakfast?" she'd ask. "Isn't it kind of early?"

"Not for me," Grandpa chuckled. "This is my supper!"

Blue Ribbon malt extract.

HOMEBREWING IN THE 1950S: A ROGUE'S ENTERPRISE

There were some who denied
That the brew should bring him pride
And they deemed it illicitly borne…

Not everyone approved of Grandpa's brewing. The genteel next door neighbors looked down on such "backwoods" practices. When my mother first started dating my father in high school, the neighbor girl gave her a stern warning. "Stay away from that hillbilly Schmidt boy. His dad is a moonshiner or something… He has a still in his garage!"

It turns out, she wasn't that far off: homebrewing was technically illegal at the time.

When Prohibition ended in 1933, the production and sale of alcohol was finally legalized. What many don't realize, however, is that homebrewing remained illegal. Ordinary citizens were not allowed to make their own beer for another 46 years. It wasn't until 1978 that the federal government finally legalized it via Public Law 95-458 (H.R. 1337), signed into law by President Carter, which allowed adults to brew beer for personal or family use. To avoid controversy, it was slipped into the body of a transportation bill. Just a few months after it took effect, the American Homebrewers Association was founded.

Since then, California has led the way in expanding homebrewers' rights. Business and Professions Code §23356.2, passed in 2017, allows Californian homebrewers to serve their beer at competitions and tastings, and donate it to nonprofits for fundraising events. Meanwhile, some other states kept their severe restrictions in place well into this century. The last states to legalize homebrewing—Mississippi and Alabama—didn't do so until 2013! At an international level, homebrewing is still illegal in a handful of countries, including Malaysia, Ukraine, and the Faroe Islands. (It's probably why so many dolphins are clubbed to death there.)

Where did Grandpa get his ingredients, then, while homebrewing was still illegal? Enter Pabst Blue Ribbon. Ever since the late 1800s, the Pabst brewery had been selling Blue Ribbon malt extract as a "health tonic." Other brewers followed suit, touting malt syrup as a treatment for indigestion and insomnia and recommending it to nursing mothers. Pabst focused its marketing specifically on immigrants like my ancestors, offering literature in both English and German.

Once Prohibition went into effect, Pabst marketed their extract as a baking product as well. Malt wasn't just for making beer, they said; it could be used to leaven bread and as a substitute for sugar. They published cookbooks listing several recipes that included the extract. During and after Prohibition, though, thousands of people continued to use this malt for its God-given purpose: to make beer.

Of course, not everyone comes from a family like ours, where homebrewing was second nature. What then? How could they learn to brew? According to anecdotal sources, Pabst provided them with instructions—"on the down low," of course.

The cans of Blue Ribbon malt extract contained a mailing address where customers could write to request a recipe book. A full-color booklet would soon arrive in the mail with instructions for baking cookies, cakes, and biscuits, but no mention of homebrewing. Some time later, however, a more unassuming envelope would show up, plain white with no return address. This one contained typed instructions for making your own beer.

If I was going to recreate Grandpa's brew, then, I would need to figure out two things: what was his process, and what ingredients did he use?

RECREATING GRANDPA'S TECHNIQUE

But his crock brought happiness untold
To all who its contents imbibed…

Although my dad never learned to brew, he recalled the basic ingredients involved: malt extract, yeast, and sugar. He described the extract as "cans of this thick syrup that poured out slowly, like honey. He'd boil water in a big pot on the stove, then pour in that syrup."

Grandpa had told me that he never needed to buy hops separately. They were already mixed into the malt extract, which came in light and dark varieties. Craig and Dad confirmed that they never saw him put anything into the pot other than the hopped extract.

After the boil, he transferred it to the ceramic crock and topped it off with more water. The crock went inside a wood cabinet in the garage, with a lid on top and a door on the front. (See diagram.) I asked Uncle Craig if the crock contained any sort of airlock.

"It didn't even have a real lid on it! I mean, the cabinet loosely closed up around it, but that shit was far from 'airtight.' It was 'closed up' enough to keep bugs and mice out of the brew, but it was totally open to the elements."

Possibly the most unique component to Grandpa's technique was "the device." This was a contraption he had invented himself, one that may have inspired his neighbor's "moonshining" rumors. It attached to the cabinet's lid, just above the surface of the wort, and contained a thermometer-sensor, a light bulb, and an electrical connection. When the temperature dropped too low, the bulb turned on to keep it warm. (California temperatures can fluctuate at night, especially in the winter.)

"These days, most brewers just keep their fermenter inside the house," I mentioned to Craig.

"Your Grandma never would have stood for that!" he replied. "Sure, she'd drink the beer once it was finished, but she couldn't

stand the smell while it was brewing. And with the top of the crock wide open, it would have stunk up the whole house. So Grandpa figured out a way to keep the yeast alive, even in the dead of winter."

After fermenting for a week or two in the garage, it was bottling time. Grandpa would pour the beer through a funnel into each 32-ounce glass bottle, add a tablespoon of sugar for carbonation, and then cap the bottle with a lever-operated bottle-capper. He stored them on a shelf that ran along the wall of his garage beneath his workbench, where the beer would condition for two to three weeks.

"Of course," Craig chuckled, "sometimes he'd get 'a lively one' out there. You'd hear a noise like a firecracker in the garage. *Puh-CHEEW!*"

I could relate. I've had my share of bottles explode as well, most notably one particular batch of pumpkin ale. I had combined three different recipes and must have gotten the proportions off; the excess residual pumpkin just kept right on fermenting. One morning, I found the top of a shattered bottle lodged into the ceiling of my closet. A lively one indeed.

Some things never change.

OLD SCHOOL MALT AND HOPS: IN SEARCH OF THE INGREDIENTS

My grandfather bought all his
malt and his hops
From the old merchant's shop
down the road…

As I researched online, I realized that I'm not the first person to try and recreate my Grandpa's 1950s recipe. Someone posted a question on the Adventures in Homebrewing blog in 2013, asking where they could find some of the old Blue Ribbon malt extract.

Ed Kraus, the blog's administrator, explained that while the syrup was widely available in the 1950s and 60s, it is no longer for sale. A new owner took over Pabst in 1985 and, for some time, continued to market the extract under the name Premier Malt. As the homebrewing movement expanded, though, competition increased and Pabst stopped selling extract sometime in the 2000s.

This was disappointing—I wouldn't be able to buy a can of the extract that Grandpa used. However, I could do the next best thing: try and recreate it.

I recalled Grandpa's description: they had sold light and dark varieties of the syrup, and it came pre-hopped. This was repeated by multiple sources whose families homebrewed during the same period. I spoke with the staff of the Historic Pabst Brewery in Milwaukee, Wis., now a bar and gift shop known as Best Place. They confirmed that Pabst had, indeed, offered a hopped version of their malt extract, and they sent me some photos of the vintage cans in their collection (see photos).

Using pre-hopped malt extract is about as automated as you can get when it comes to homebrewing—just the sort of 1950s convenience that Grandpa loved. To recreate it, I would need to start with a basic light malt extract syrup. The next question was, what sort of hops would it have contained?

I wondered which hops had been commercially available at the time and what contemporary varieties would most closely fit their profile. Given all that has changed in the world of hops over the past 70 years, which modern variety would be the closest to the original ingredients? Cascade could be a good option, given its fairly generic taste and bouquet, but it is far too modern for Grandpa to have used. The first commercial use of Cascade wasn't until 1975, when Anchor Brewing Company brewed with it. I would have to dig deeper.

I reached out to Pabst Brewery but received no reply. The first helpful guidance I received came from Michelle Palacios of the Oregon Hop Commission and Hop Research Council. She confirmed that Cluster was one widely grown varietal in the U.S. during the 1950s and 1960s. Michelle then put me in touch with Tiah Edmunson-Morton, of Oregon State University's Hop and Brewing Archives.

Tiah's initial hunch was that Early or Late Clusters and Fuggles would have been quite common at the time. She tempered this statement, however, with the fact that Cluster was affected by disease


The Schmidt crock.

during the late 1940s, according to Peter Kopp's Hoptopia, and other varieties were taking its place: Fuggles, Brewer's Gold, and Bullion. In short, she confessed that there wasn't a clear "smoking gun" answer to the question.

I spoke with my San Diego friend Rob, an experienced brewer in his own right, and he suggested another option: Northern Brewer. This variety was first cultivated in 1934 in the UK, and would have been prominent and commercially available at the time. Its woody, earthy flavor was general and versatile, making it a common substitute for Hallertau.

In the end, I had it narrowed down to three main candidates: Fuggles, Cluster, or Northern Brewer. Short of studying for a master's degree in hop cultivation, this was as close as I could get to an answer.

Thankfully, the question of yeast was a no-brainer. Dad and his siblings all clearly remembered Grandpa brewing with packets of Fleischmann's dry yeast. This made sense, as it was the dominant brand of yeast on the market and the easiest to find on grocery store shelves. Much like Blue Ribbon malt, it was a well-trusted brand that had existed since the 19th century. Also like Pabst, it appears to be here to stay. (During the 2020 lockdown, Fleischmann's actually ran out of its supply of yeast, with so many Americans suddenly baking at home.)

Humble ingredients.

One final question arose: did Grandpa use white table sugar in addition to malt extract? My dad recalls sugar being used, while Uncle Craig remembers only malt, with sugar added only for carbonation during the bottling stage. Many others who brewed in the 1950s told me that white sugar was a common, cheap technique to kick up the alcohol content, while a small amount of malt extract provided the necessary taste.

Whether or not Grandpa used this technique, he certainly wouldn't have disapproved of it. Much like his Volgadeutsch ancestors in those remote colonies in Russia, he was always ready to use whatever cheap ingredients were available to get the job done. As I researched 1950s homebrewing, I kept seeing the same basic formula: 1 quart of malt extract (hops included), 5 pounds of sugar, and Fleischmann's yeast. That was good enough for me.

I called Rob and told him to fire up the brew kettle: it was time to resurrect Grandpa's beer.

BACK UP IN THE CROCK WITH THE RESURRECTION

And those selfsame components could serve now to brew,
Once again, bubblng beer by the load…

My initial plan was to brew in Grandpa's original ceramic crock. Ever since he passed, Craig has been the Keeper of the Crock, and we talked about reviving it from its decades of hibernation.

This proved harder than it sounded. For starters, there was no way to seal the damn thing. Also, we couldn't get Grandpa's heating contraption working, and we would need to if we were to brew in a garage or outdoors. If brewing indoors at Craig's house, the open crock would be quickly contaminated with pet dander.

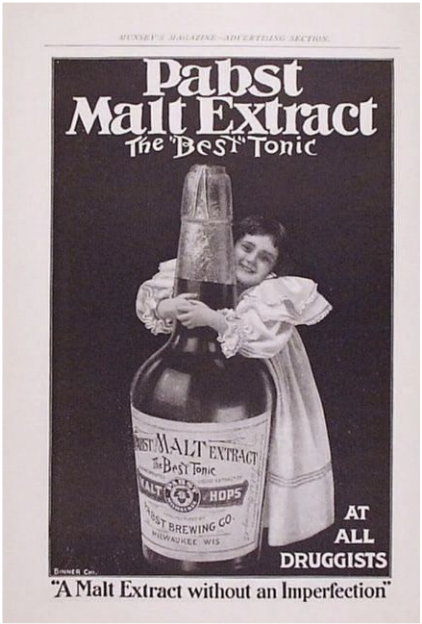
The best reason to hold off on using the crock, however, was the fact that it might still contain a live yeast culture. Grandpa used it frequently enough to saturate its inner surface with yeast cells. If we could propagate them, gradually feeding them a sugar solution, we might be able to identify Grandpa's strain. After all, dormant yeast has been successfully harvested and revitalized from vessels in Chinese tombs after 9,000 years.

It might be nothing more than the old Fleischmann's strain. But then again, the crock could harbor a wild strain as well. For all we knew, some robust yeast may have slipped in, taken to Grandpa's brew, and camped out in the crock for good. As Stephen Harrod Buhner points out in his book Sacred and Herbal Healing Beers, some wild yeasts can be extremely hearty.

I penciled this yeast project in for the near future and decided to leave the crock alone for now in favor of brewing this batch in my normal fermenter. With the list of ingredients in hand, Rob and I headed to San Diego's oldest homebrew mart. This was the same shop where I had bought my supplies for Ethiopian t'ej and t'alla back in 2019. ("Drinking in the Cradle of Humankind," Zymurgy, Sept/Oct 2019.) Back then, the shop's employees were thrilled to hear about my plans. Ethiopian folk brewing hit all the right hipster buttons: obscure recipes, exotic ingredients, esoteric techniques. When I told them about my plans for Grandpa's beer, on the other hand, they looked incredulous.

"You want to make a beer out of light DME and white table sugar?" The cashier stared at me like I'd walked into a high-end guitar shop and asked for a kazoo. "Why would you do that?"

A word of warning to readers who decide to make this 1950s homebrew: you will likely get a similar response from your local homebrew shop. In their defense, they have all the best intentions at heart. When someone devotes their life to artisanal beer and quality ingredients, it can seem downright unethical for them to contribute to a deliberately mediocre brew.



Vintage malt extract ad.

Brew This!

Grandpa's Garage Swill

Batch volume: 5 US gal. (18.9 L)
Original gravity: 1.056 (13.9°P)
Bitterness: 27 IBU

1 qt.	light malt extract (Pilsen light, for instance)
5 lb.	sugar
1 oz.	Northern Brewer hops
3 packs	dry Fleischmann's yeast
5 gal.	water

Prime the yeast with 1 Tbsp. sugar and lukewarm water. Dissolve the sugar before adding malt extract and hops, then boil for 60 minutes. Cool and pitch yeast, and ferment 1–2 weeks. Bottle with priming sugar for carbonation.

Rob and I bought some Northern Brewer hops and the lightest extract available: Briess CBW Pilsen Light. Then we stopped by Smart and Final for white sugar and Fleischmann's dry yeast. Half of our ingredients came from a discount grocery store—Grandpa would have been proud.

To really cinch the deal, I decided to forego distilled water. San Diego's tap water tastes bad enough that you could believe it came straight out of the 1950s, and thus provides some added authenticity. We got the water boiling and put some Waylon Jennings music on to set the mood; the sort of plaintive old honky-tonk songs that are riddled with codependency and casual machismo.

Before brewing, I activated the yeast like any old-fashioned baker would, stirring in all three packets with a tablespoon of sugar and lukewarm water. When the water boiled, we dissolved the white sugar first, then pitched the malt extract and hops for a 60 minute boil. We kept the hops to a one ounce minimum, hoping to replicate the lightly hopped flavor of that original malt extract. It's doubtful that drinkers in the 1950s had much of a taste for anything close to a hoppy IPA. "Dank" was certainly not part of their vocabulary.

Given the high amount of sugar, we realized that this beer would likely be higher-gravity than most. If Grandpa's homebrew had been this strong, it's no wonder my Dad's friend couldn't finish it. (Conversely, this might also explain why Uncle Craig's friends loved it so much.)

"You know what else I realized?" Rob said. "We're almost making a 'reverse steam beer' here." While a traditional San Francisco steam beer is an ale fermented with bottom-fermenting lager yeast, we were brewing a light Pilsner-style beer, fermented with an ale yeast. "Or, to be more precise," I said, "a bakers' yeast."

White sugar, dry bakers' yeast… These were the homebrewer's ingredients of the 1950s. The craft has come a long way since then.

SCHMIDT BREWING IN THE NEW MILLENNIUM

In our age of contentment
We still must ferment
By the time-honored truths of the crock…

For a time, our family's brewing tradition went dormant. Dad and his siblings all married and left home, and Grandpa stopped brewing entirely. I asked him once why he had given it up. Did it have something to do with empty nest syndrome? Did it fill him with melancholy to brew for an empty house? Grandpa's answer was much more mundane and unceremonious. The company once mislabeled a can of malt extract as "light" when it contained dark syrup. Grandpa "rage quit" and never brewed again.

"But I thought you liked both kinds?" I said. "You said you brewed both light and dark."

"Yeah, but that day I felt like making a light one. I was so upset, I swore I'd never buy from them again."

Thus, classic Schmidt stubbornness brought a sudden end to thirty years of homebrewing. As the saying goes, you can always tell a German…but you can't tell him much.

Thankfully, the family tradition didn't die entirely. Years later, Uncle Craig would pick up the brewer's mantle. He got into homebrewing just as the craft beer craze was taking off in the 1990s, when homebrew kits became readily available, and was able to experiment with endless varieties: diverse types of malt and other grains, herbal extracts, fruits and honey. (I tried some of his honey beer after it had sat in the garage for eight years. It had seen better days.)

Is it a betrayal of our family tradition to take advantage of these fancy new ingredients? Just the opposite: it's simply the next natural step in the evolution of Schmidt family brewing. From all-grain brewing in Russia, to simple malt extract in the 1950s, to complex artisanal ingredients today, we are always adapting. Like his father before him, Craig kept the general family tradition alive, even while adapting to new technologies and convenience. I'm happy to be the next link in the chain.

I feel privileged to be brewing at a time when the movement is thriving. California currently has more craft breweries than any state in the country, numbering well over 900, with most Californians living within ten miles of a brewery. My hometown of San Diego continues to lead the way with more than 100 breweries, while my adoptive hometown of Mexico City is seeing its own surge of craft beer culture. It's a good time to be brewing.

And yet, it's also healthy to get back to the basics. It's good for the soul to drink a simple, uncomplicated beer like Grandpa Schmidt made. It helps us connect to those days when a man came home sweaty and tired from a long night shift, and reached for something cold and dependable. Something that just hits right when you're eating supper at eight in the morning, ready to get some shut eye. Cheap homemade beer may not be "full-bodied" or have a "complex bouquet," but it teaches us humility. It reminds us of our connection to the generations that came before us.


Crock electronics.

It also reminds us that some things never change in the brewing process. Despite all our precision, no matter how careful we may be with the recipe and measurements, a bottle still explodes every now and then. When we hear the blast and the subsequent fizzing, we can only chuckle with nostalgia.

"Sounds like we've got a lively one out there!"

Thirty years, always bubbling…
The yeast spores a-doubling…
His crock brought happiness untold
To all who its contents imbibed…
Dedicated to the memory of Harry Wayne Schmidt, 1920-2012. Many thanks to Len and Craig Schmidt for sharing their memories, and to Rob Wyngard for his brewing expertise.

RESOURCES

- homebrewacademy.com/state-federal-homebrewing-laws/
- ncsl.org/research/financial-services-and-commerce/home-manufacture-of-alcohol-state-statutes.aspx
- americanhistory.si.edu/blog/papazian
- law.justia.com/codes/california/2017/code-bpc/division-9/chapter-3/article-3/section-23356.2/
- nyamcenterforhistory.org/2017/03/16/the-best-tonic-pabst-malt-extract-pamphlets-in-the-academy-library/
- blog.homebrewing.org/find-blue-ribbon-malt/
- californiacraftbeer.com/ca-craft-beer/history-craft-beer-ca/

David J. Schmidt is an author, homebrewer, and multilingual translator who splits his time between Mexico City and San Diego, California. Schmidt speaks twelve languages and has spent the past fifteen years traveling throughout rural Mexico, Latin America, and Africa in search of ancient folk brews, making him a veritable Indiana Jones of homebrewing. (Think Harrison Ford with a beer gut.) He can be found on Facebook, YouTube, and Twitter with the handle "Holy Ghost Stories," or via the website HolyGhostStories.com.

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COLOR CALCULATIONS AND MEASUREMENTS

PART 1: EVOLUTION OF MEASUREMENTS

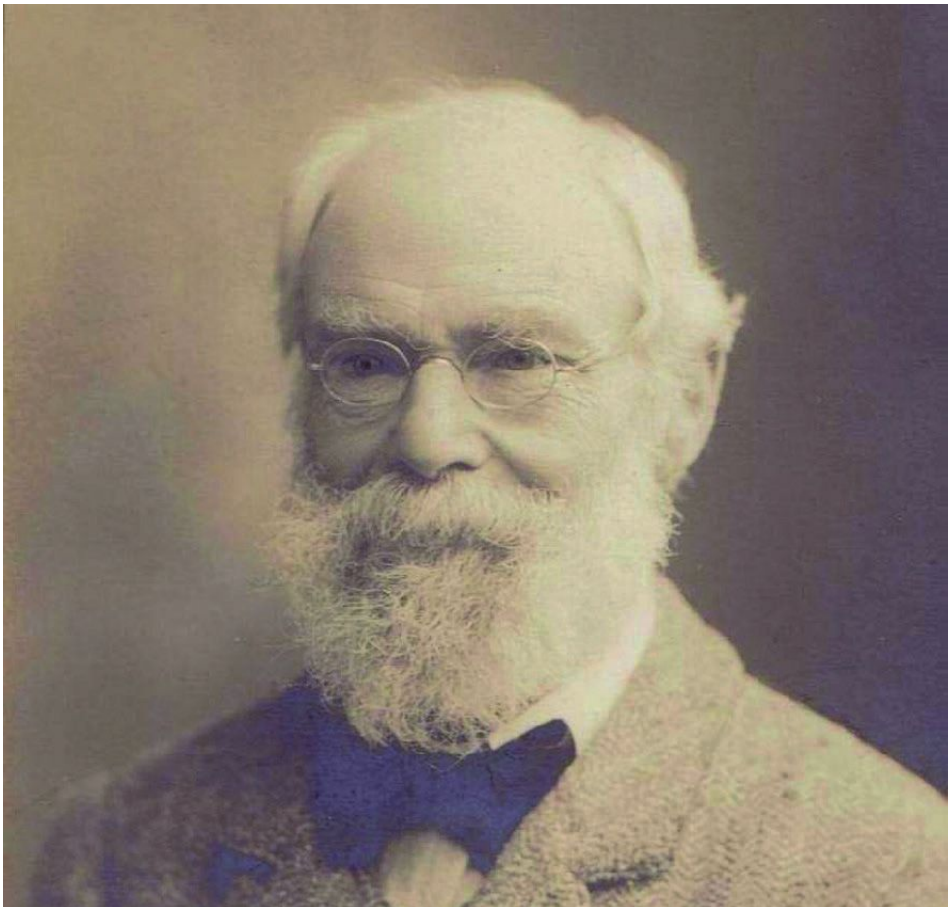
By Thomas Kraus-Weyermann and Horst Dornbusch

MEASURING BEER COLOR.

This is the first in a three-part series of articles about the nature of beer color, as well as the difficulty of accurately quantifying color both at the recipe design stage and in the finished beer. Part 1 explores the nature of color in general and the historical evolution of beer color measurements. Part 2 examines the differences and similarities of the most common equations used by today's brewers around the world for calculating beer color—not after the fact in the laboratory—but in advance during recipe formulation. Finally, part 3 analyzes three test beers brewed specifically for this study. It compares the color predictions for these brews made by the different beer color formulae outlined in part 2 to the actual color measurements of the same brews made in the laboratory. This comparison allows practical brewers to select which equation might be the most advantageous for them to use at the recipe design stage.

A quick glance at the beer style specifications guiding judges at the world's leading beer competitions such as the World Beer Cup®, the Great American Beer Festival®, and the European Beer Star confirms that color values (in degrees Lovibond or EBC units) are an important consideration for ranking different beer entries. Other judging criteria include the beers' sensory characteristics, as well as their adherence to such style-specific parameters as original and final gravities (in degrees Plato or as density), alcohol levels (by weight or by volume), and bittering ranges (in IBU).

For color measurements of a finished beer as opposed to color predictions in advance from malt color values, there is nowadays an international consensus that is codified by both the American Society of Brewing Chemists (ASBC) and the Mitteleuropäische Brautechnische Analysenkommission (Central European Commission for Brewing Analysis or MEBAK®) [1]. However, while the analytical methods for measuring beer color in the laboratory are no longer in dispute, there are wildly differing and even contradictory formulae in use for color predictions. Even though these formulae cannot all be true, the professional literature is silent about which of these formulae is the most accurate. The reasons may be hidden in the very nature of light itself, and in the challenges involved in capturing the perception of light's reflections and refractions by the human eye and the human brain mathematically. Yet, a clarification of this issue is of critical importance to brewers engaged in designing beer recipes. This article series seeks to address this problem.



Joseph Williams Lovibond (1833–1918).
Source: https://images.app.goo.gl/gZZjeA8iqrwh293n8

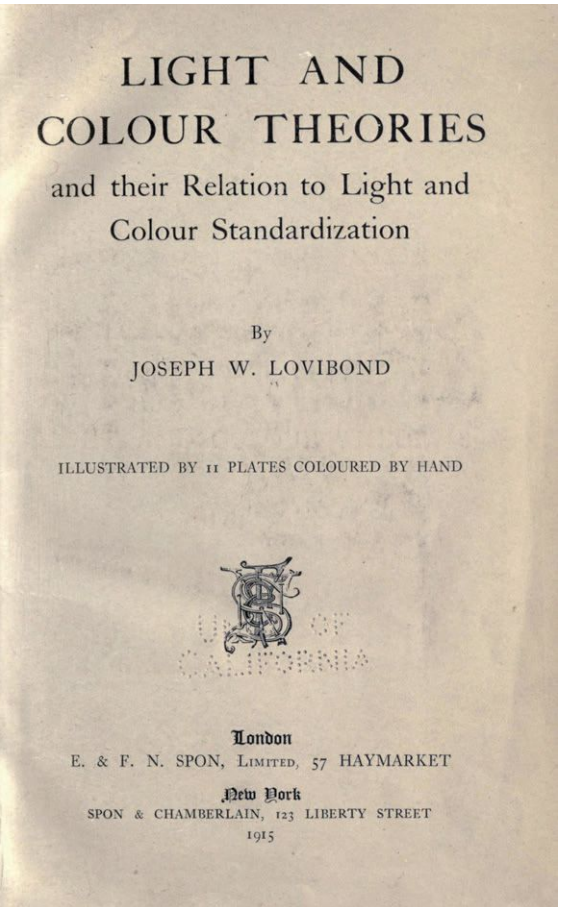
A BRIEF HISTORY OF BEER COLOR MEASUREMENTS

Over the centuries, many prominent thinkers have studied light. These include such scientists as Johannes Kepler, Christiaan Huygens, and Isaac Newton in the 17th century; Hermann von Helmholz in the 19th century; and Max Planck, Albert Einstein, and Werner Heisenberg in the 20th century. It also includes the 17th century philosopher René Descartes and the towering 18th/19th century aesthete and poet Johann Wolfgang von Goethe. All of these luminaries wrote extensively about light and produced various theories about its nature [2, 3]. Some regarded light primarily as particles, some saw it as waves, and others, mostly as energy units (quanta).

In the world of beer, the wave aspect of light has become the chosen vehicle for color measurements. The first person to develop a systematic approach to such measurements was the British brewer Joseph Williams Lovibond, who, in 1885, developed his "colorimetric comparator." This instrument allowed him to systematically assess the color of beer in a glass [4]. The Lovibond method relies on the observed differences and similarities between the absorption rates of ambient light as it passes through a standard set of numbered, differently colored, stained-glass disks, and the absorption rate of the same ambient light by beers of different colors in a standard glass. Lovibond came up with this idea after noticing the effect of light as it passes through a multi-color stained-glass window. The Lovibond scale is expressed in degrees (°L) and may range from 2 °L for the palest of pale lagers to perhaps 70 °L for the darkest of dark stouts [5].

Lovibond completed the design of his equipment in 1892 and named it "Tintometer." Two years later, he described his method in a path-breaking book, *Measurement of Light and Colour Sensations: A New Method of Investigating the Phenomena of Light and Colour by Means of the Selective Absorption in Coloured Glass, Graded Into Scales of Equivalent Colour Value* [6], which was subsequently reprinted in various editions all over the world under the shortened title of *Light and Colour Theories and their Relations to Light and Colour Standardization* (see image). Lovibond's innovation of more than 130 years ago was a giant step toward the systematization of beer color descriptions, and versions of the colorimetric comparator are still being produced today by a company that bears Lovibond's name [7].

The comparative method for the assessment of color by the Lovibond method, unfortunately, still entails a certain degree of subjectivity because, as we all know, different people may perceive colors differently. Varying degrees of red-green blindness, for instance, are not uncommon in humans and may cause different people to assign different colors to the same beer. Also, different environmental factors, such as bright



Standard reference book for beer color measurements by Joseph Williams Lovibond.

sunlight versus dim light from an overcast sky, may affect the association between a particular color disk of Lovibond's Tintometer and the color of a particular beer. Therefore, any determination of a beer's color by the Lovibond method is greatly improved if many individual assessments under different conditions are "crowd-sourced" and then averaged.

Beer Color Measurements in the Modern Age

In 1951, the ASBC replaced Lovibond's colorimetric comparator for beer color measurements with a new and much more objective technology, the spectrophotometer. This is an optical device that measures the intensity of light before and after it has passed through a sample liquid. Spectrophotometry was invented in 1940 by the American chemist Arnold Beckman. It takes measurements independently of human judgments.

Within the brewery context, this new methodology led to the development of a new color scale, which replaced the Lovibond scale. It is called the Standard Reference Method (SRM) [8, 9, 10]. The sample light selected for this method is deep blue. It has a wavelength with a single frequency of 430 nanometers (nm). This places the sample light near the low end of the visible spectrum, which typically has a frequency range from 380 to 700 nm. Prior to this standardization, several other beams of light with different wavelengths were often used for the spectrophotometric procedure, and references to these can still be found in several older publications. In practice, however, the beams with other wavelengths have since fallen into disuse [10].

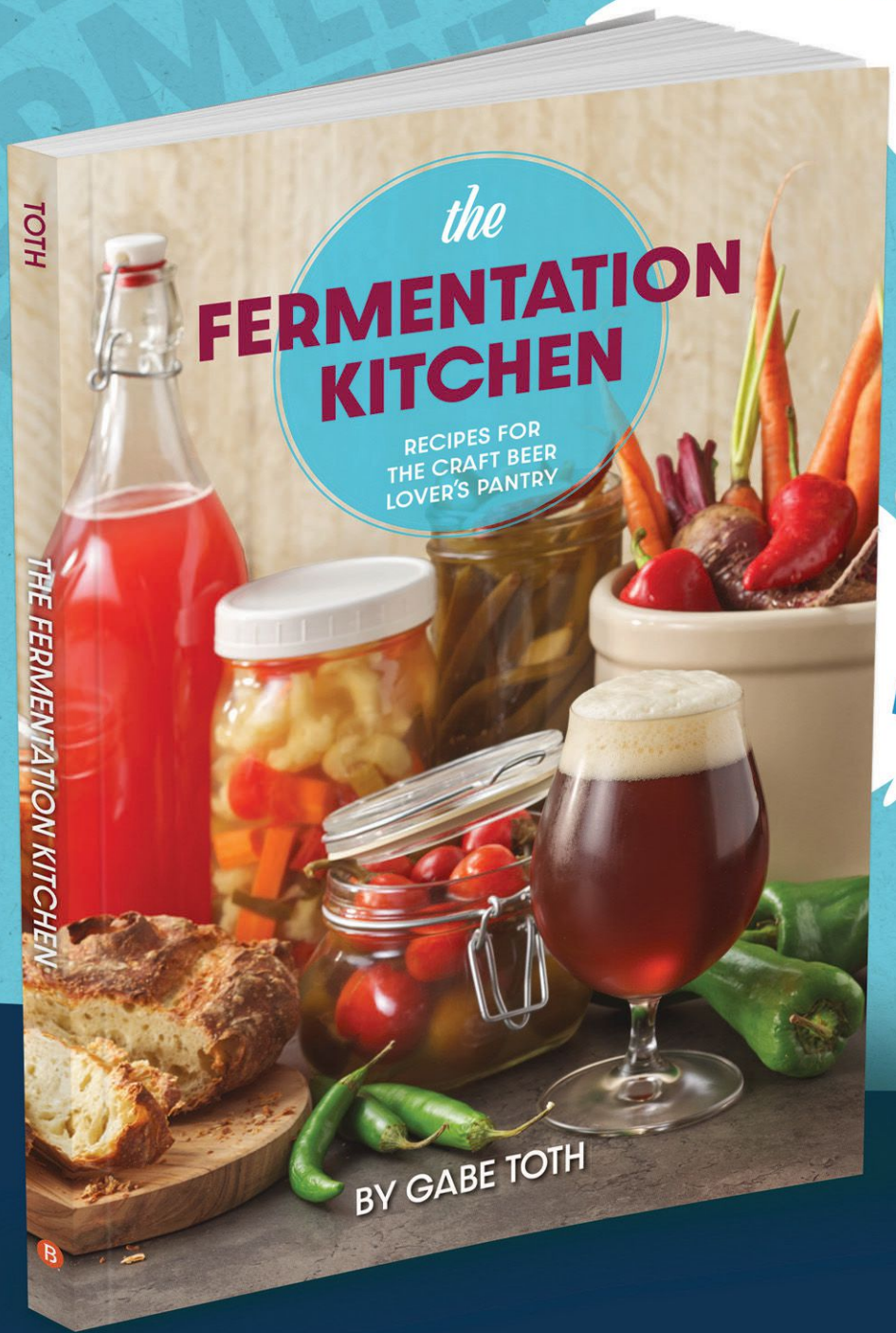
For accurate and uniform color measurements, the 430 nm beam is passed through a standardized 1 cm square (0.3937008-inch-square) cuvette, which is often made of optical-grade quartz. The cuvette is filled with a non-turbid (i.e., filtered!) sample of the wort or beer to be measured. On the scale used for the measurement, 1 SRM unit of color has been defined by the ASBC as 12.7 times the logarithm of the spectrophotometric attenuation (i.e., the reduction in intensity as a result of absorption or deflection) of the sample beam. The multiplication factor of 12.7 was chosen to create a rough (i.e., not exact) equivalence between the old °L scale and the new SRM scale.

This 1951 change in methodology by the ASBC was influenced by a seminal presentation given by I. Stone and M.C. Miller as part of the 1949 ASBC Proceedings, which can now be found online [11]. The title of the presentation was "The Standardization of Methods for the Determination of Color in Beer," in which the authors outlined a precise conversion formula between the old °L and the new SRM units, especially for light-colored beers. Their equations are $SRM = °L + 0.04662 \times (°L)^2$ and, in the reverse, $°L = 0.808 \times SRM - 0.0083 \times SRM^2$. A simplified approximation of these equations for practical brewers, who need to make a quick assessment, are 1 SRM = 1.2992 °L or, in the reverse, 1 °L = 0.77 SRM.

By 1975, the European Brewery Convention (EBC) made a further contribution to the international standardization of beer color measurements by codifying a mash from which a wort is to be drawn for analysis. This method is now known as a Congress Mash. It is a small-scale procedure that has since also been adopted by the ASBC. It is based on a 50-gram sample of milled malt mixed with 200 milliliters of distilled water at 45 °C (113 °F) for a 30-minute rest, followed by a temperature rise of 1 °C (1.8 °F) per minute to 70 °C (158 °F). After the further addition of 100 milliliters of 70 °C distilled water, the mash rests for 1 hour at that temperature and is lautered to obtain 450 grams of cooled and filtered "congress wort," which is now suitable for color measurements by the spectrophotometric method. This wort is also used for the determination of many

Assessment of Color by the Lovibond Method Entails a Certain Degree of Subjectivity.

New Release



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other variables, including gravity, viscosity, beta-glucan content, and the amount of soluble protein [12].

Eventually, on January 1, 1996, the European standard-making body developed a color measurement method similar to the SRM scale of the ASBC [13]. For this, it relied on a light of the same wavelength (430 nm). However, not being "married" to the old Lovibond scale, the EBC selected 25 rather than 12.7 as the multiplier for the spectrophotometric attenuation value. This difference, however, is not problematic because of the complete analogy between the two measuring procedures, which allows us to create a simple conversion formula between SRM and EBC values: 1 EBC = 1 SRM × 1.97. In the reverse, the equation is 1 SRM = 1 EBC/1.97, or 1 SRM = 1 EBC × 0.508. For a very quick rule-of-thumb approximation, an EBC color value is roughly double that of an SRM color value. Empirically, this conversion formula is reasonably reliable for wort and beer samples within a color range of roughly 3.6 to 25.3 EBC (1.8 to 12.8 SRM) [13].

As a liquid gets darker, more of the light passing through the sample cuvette is being absorbed. Consequently, the spectrophotometer sensor, which is calibrated to detect this loss of light, issues progressively higher SRM values. There is a point, however, at roughly 40 to 50 SRM (80 to 100 EBC), when a liquid extracted from very dark malts absorbs so much light that the sensor can no longer produce reliable readings. Roughly 40 SRM (80 EBC) also happens to be the color threshold beyond which most humans can no longer detect any changes in darkness. This means that any beer that is darker than that value appears uniformly black to the human eye.

To compensate for this spectrophotometric detection limitation, very dark worts or beers need to be diluted with a measured volume of distilled water until the now-lighter color of the diluted sample returns to within the accuracy range of the spectrophotometer. The resulting measurement is then put through an equation to compensate for the known dilution. Because the dilution effect on the absorption measurement of light is non-linear, the equation for the calculation of the pre-dilution value extrapolated from the post-dilution value is also non-linear.[14]

Beckman Model DB spectrophotometer (1960).

Because the dilution factors become enormous for very dark roasted malts of, for instance, 1000 EBC (roughly 375 SRM) or more, even small measurement errors could lead to substantial misrepresentations of the actual color values of the malts.

For such malts, therefore, many maltsters still employ the old Lovibond method of colorimetric comparisons (for instance, with the Hellige Komparator) of congress wort colors to normed colored disks. In addition, they also collect comparative color assessments from several individuals in parallel to control as much as possible for any subjective distortions caused by potential idiosyncrasies of different observers.

CONCLUSION

Over the years, the two main standard-making organizations in the brewing industry, the ASBC and the EBC, have gradually modified their color measurement methods and conventions with the goal of minimizing any differences in their approaches. By and large, both organizations now use the same spectrophotometric measurement technology and the same test setups. This makes the measured quantities back-and-forth convertible, albeit expressed in different units of measurement. In the United States, brewers use that country's so-called Customary Units, while brewers elsewhere rely on the decimal-based Système International d'Unités. Thus, as mentioned above, measuring the colors of finished beers is now, indeed, an internationally settled matter.

However, the world of beer color calculations as a prediction during recipe formulation as well as the relationships between any such advance predictions and any after-the-fact empirical color measurements of the same beers is still a different and confusing matter, which will be the subject of parts 2 and 3 of this article series.

REFERENCES

1. Brautechnische Analysenmethoden, Methodensammlung der Mitteleuropäischen Brautechnischen Analysenkommission (MEBAK®), vol. 1, 1984.
2. http://www.people.vcu.edu/~djbromle/color-theory/lecture/4c.htm.
3. http://www.nightlase.com.au/education/optics/light.htm.
4. Kuehni, R. G.; Schwarz, A.: "Color Ordered: A Survey of Color Systems from Antiquity to the Present," 2007.
5. Holliland, C: "The Lovibond," in: Oliver, G.; Dornbusch, H.: "The Oxford Companion to Beer," 2011.
6. Lovibond, J. W.: "Measurement of Light and Colour Sensations: A New Method of Investigating the Phenomena of Light and Colour by Means of the Selective Absorption in Coloured Glass, Graded Into Scales of Equivalent Colour Value." 1894, https://archive.org/details/cu31924003183120.
7. https://www.lovibond.com.
8. https://en.wikipedia.org/wiki/Standard_Reference_Method.
9. http://beersmith.com/blog/2008/04/29/beer-color-understanding-srm-lovibond-and-ebc/#:~:text=MCU%20provides%20a%20good%20estimate,1.4922%20*%20(MCU%20**%200.6859).
10. deLange, A. J.: "The Standard Reference Method of Beer Color Specification as the Basis for a New Method of Beer Color Reporting," Journal of the ASBC, 2008.
11. Stone, I.; Miller, M.C.: "The Standardization of Methods for the Determination of Color in Beer," ASBC Proceedings, 1949; https://www.tandfonline.com/doi/abs/10.1080/00960845.1949.12006275.
12. Bamforth, C. W.: "Congress Mash," in: Oliver, G.; Dornbusch, H.: "The Oxford Companion to Beer," 2011.
13. White, F. H.: "Spectophotometric Determination of Malt Colour"; on behalf of the Analysis Committee of the European Brewery Convention, Journal of the Institute of Brewing, 1995.
14. Krüger, J.: "Strohgelb bis Pechschwarz," Braumagazin, Spring 2019, https://braumagazin.de/article/bierfarbe.

Thomas Kraus-Weyermann is president and CEO of Weyermann Malzfabrik in Bamberg, Germany. Horst Dornbusch is founder and owner of Cerevisia Communications LLC in West Newbury, Mass.

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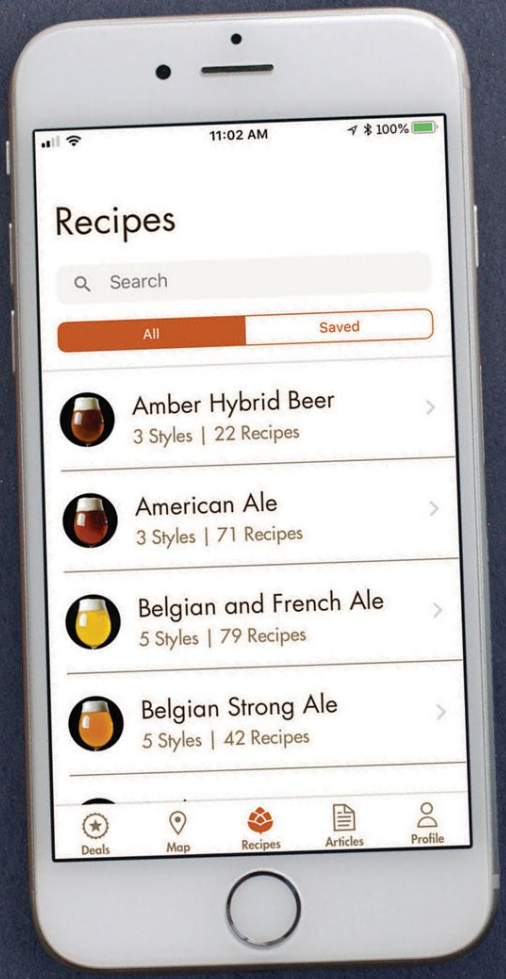

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That mantra rings as true today as it did in 1978 when Charlie Papazian cofounded the American Homebrewers Association with Charlie Matzen. Homebrewing can be as simple or as complex as you want to make it, but the first step is always to relax and not worry.

To aid your relaxation and help you get the most out of *Zymurgy*, here are some standard assumptions and methods for our recipes. Of course, when a recipe says to do something different, follow the recipe. But you can always fall back on these general tips to brew great beer.

ON THE WEB
For more detailed info, head over to HomebrewersAssociation.org and dive into our How to Brew resources.

BREWING WITH *ZYMURGY*

MAKING WORT

Most recipes in *Zymurgy* offer an all-grain version and a malt extract or partial-mash alternative. Pick the procedure you prefer and prepare some wort! Some recipes might include a water profile. If you can't (or don't want to) deal with water chemistry, don't worry about it: just go ahead and brew! Extract brewers needn't add minerals to water.

Malt Extract Recipes
Making wort from malt extract is easy.

- Crush specialty grains, if any.
- Place milled grains in a mesh bag and tie it off.
- Steep bag of grains in 150–160°F (66–71°C) water for 30 min. in your brew pot.
- Remove bag of grains from the pot.
- Fully dissolve extract in the hot, grain-infused water (if there are no specialty grains in the recipe, you can skip directly to this step).
- Top up with water to your desired boil volume. (Leave some room for foam!)

All-Grain and Partial-Mash Recipes
Unless otherwise specified, all-grain brewers can conduct a single-temperature infusion mash with these parameters:

- Water/grain ratio: 1.25 qt./lb. (2.6 L/kg)
- Mash efficiency: 70%
- Mash temperature: 150–153°F (66.7–67.2°C)
- Mash duration: 60 minutes

Partial-mash recipes make the same assumptions but use a smaller amount of grain and augment the wort with malt extract.

BOILING

No matter how you get here, everyone loves adding hops.

- Boil time is 60 minutes unless otherwise stated.
- Boils are assumed to be the full batch volume, but you can also boil a concentrated wort and top up with water in the fermenter.
- Hop additions are given in minutes before the end of the boil.

Brew Lingo

Every field has specialized language, and homebrewing is no different. Here are a some of the key terms, abbreviations, and acronyms you'll find throughout *Zymurgy*.

AA – alpha acid

ABV – alcohol by volume

AHA – American Homebrewers Association

BBL – US beer barrel (31 US gal or 117.3 L)

BIAB – brew in a bag

BJCP – Beer Judge Certification Program

Chico – American ale yeast, AKA Wyeast 1056, WLP001, SafAle US-05, and others

CTZ – Columbus, Tomahawk, and Zeus: interchangeable high-alpha-acid hops

DME – dry malt extract

DMS – dimethyl sulfide, an off flavor similar to canned corn or cooked vegetables

DO – dissolved oxygen

EBC – European Brewing Convention (beer color)

FG – final gravity

FWH – first wort hops, added to the boil kettle as it fills with sweet wort after mashing

HERMS – heat exchange recirculating mash system

HLT – hot liquor tank

IBU – international bittering unit

LHBS – local homebrew shop

°L – degrees Lovibond (malt color)

LME – liquid malt extract

LTHD – Learn to Homebrew Day

MLT – mash-lauter tun

NHC – National Homebrew Competition

OG – original gravity

°P – degrees Plato (wort/beer density)

RIMS – recirculating infusion mash system

RO – reverse osmosis, a water purification process that removes most dissolved ions

SG – specific gravity (wort/beer density)

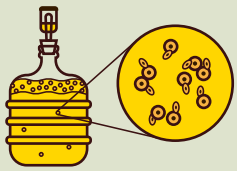
SMaSH – single malt and single hop

SMM – S-methyl methionine, precursor to dimethyl sulfide (DMS)

SRM – Standard Reference Method (beer color)

FERMENTING & CONDITIONING

Pitch yeast into chilled, aerated or oxygenated wort.



- Use twice as much yeast for lagers as you do for ales.
- Ales ferment at 60–70°F (15–20°C). Lagers ferment at 45–55°F (7–13°C).
- Condition ales at room temperature or colder for a week or two.
- Condition lagers at close to freezing for several weeks if you can (traditional but not required).

BOTTLING & KEGGING

If you bottle,

- Use 1 oz. of dextrose (corn sugar) per gallon of beer (7.5 g/L) for a good, all-purpose level of CO_2.
- Use less sugar for less fizz.
- Take care with higher carbonation levels—many single-use beer bottles aren't designed for high pressure.

If you force carbonate in a keg,

- Use the chart to dial in the gauge pressure on the regulator.
- Add 0.5 psi (35 mbar) for every 1,000 feet (300 meters) you live above sea level.
- To convert psi pressures to mbar, multiply by 69.
- To convert volumes of CO_2 to g/L, multiply by 2.

REGULATOR PRESSURES (PSI) FOR VARIOUS CARBONATION LEVELS AND SERVING TEMPERATURES

TEMP. (°F)	VOL. CO_2										
	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1
33	5.0	6.0	6.9	7.9	8.8	9.8	10.7	11.7	12.6	13.6	14.5
34	5.2	6.2	7.2	8.1	9.1	10.1	11.1	12.0	13.0	14.0	15.0
35	5.6	6.6	7.6	8.6	9.7	10.7	11.7	12.7	13.7	14.8	15.8
36	6.1	7.1	8.2	9.2	10.2	11.3	12.3	13.4	14.4	15.5	16.5
37	6.6	7.6	8.7	9.8	10.8	11.9	12.9	14.0	15.1	16.1	17.2
38	7.0	8.1	9.2	10.3	11.3	12.4	13.5	14.5	15.6	16.7	17.8
39	7.6	8.7	9.8	10.8	11.9	13.0	14.1	15.2	16.3	17.4	18.5
40	8.0	9.1	10.2	11.3	12.4	13.5	14.6	15.7	16.8	17.9	19.0
41	8.3	9.4	10.6	11.7	12.8	13.9	15.1	16.2	17.3	18.4	19.5
42	8.8	9.9	11.0	12.2	13.3	14.4	15.6	16.7	17.8	19.0	20.1

■ = PSI

Source: Brewers Association Draught Beer Quality for Retailers

Brewing Local IN BROOKLYN

By John LaPolla

As any homebrew shop owner will tell you, owning a homebrew shop can have unexpected benefits. As our shop is located in Brooklyn, we're close to a lot of interesting places that offer us some really unique opportunities—like the chance to collaborate with the Brooklyn Botanic Garden!

Brooklyn Botanic Garden raw barley.

Douglas Amport of Bitter & Esters threshing barley.

Malted barley with chit.

The Brooklyn Botanic Garden (BBG) is one of my favorite places, and I have been fortunate to both live and work near this amazing oasis from the chaos that is New York City. Many years ago, by chance, I happened to meet Maeve Turner (who is the head of the Herb Garden at the BBG), because she came in to buy homebrewing supplies. Over the years, we've grown to be friends, and I learned that she has been growing Nugget hops at the garden. She has generously shared some of the crop over the years so that we can brew with them at the shop.

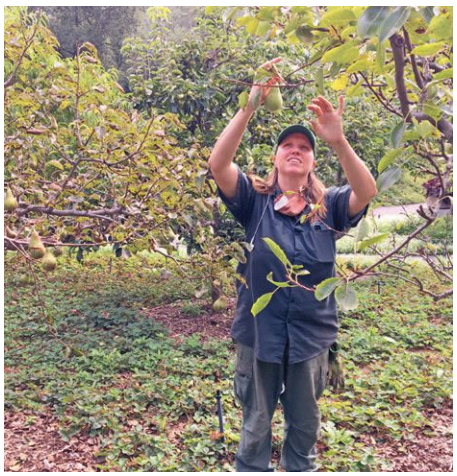
This year, she grew some six-row spring barley for the first time and asked if I would like to have it. Of course I would! The funny thing was that she gave me the whole barley plants, stalks and all. My business partner Douglas and I had to hand thresh the barley to remove the seeds from the rest of the plant. This involved rubbing the stalks to remove the seeds and then blowing on them to remove any chaff. The big grain producers have machines that do this, but we had fun doing it by hand. After several chaff-covered hours, we ended up with a pound and a half of barley.

We weren't sure if we should simply roast the barley to use in a larger batch of a dark beer, or if we should attempt to malt it. Malting barley involves germinating the kernels to create the enzymes that will convert starch to sugar during the mash. We sell plenty of malt at our shop, but we had never attempted to malt anything ourselves. We're always up for a challenge and the opportunity to learn, so we decided to try our hand at malting instead of roasting.

Following a *Zymurgy* article on home malting ("Introduction to Home Malting" by George de Piro, *Zymurgy* Jan/Feb 2001), I spent seven days soaking, sprouting, drying, kilning, and cleaning the seeds, but in the end, we had a pound and a half of malted barley ready for brewing. Such a small amount of barley would only yield about six bottles of beer at about 4% ABV. Coincidentally, it was harvest time for hops as well, so we were able to use barley and hops from the Brooklyn Botanic Garden to make our beer.

The last thing we needed was yeast. As a homebrewer, you purchase a specific strain of yeast that's been cultured by a lab and build it up to an amount sufficient to ferment a batch of beer. Given that we were already using barley and hops from the BBG, we thought it would

Maeve Turner of Brooklyn Botanic Garden picking pears.



Brooklyn Botanic Garden hops.

Brooklyn Botanic Garden pear starters.

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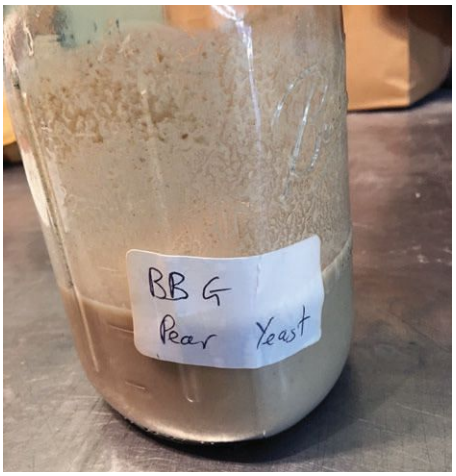
Pears in starters.



Pear yeast slurry.

Brooklyn Botanic Garden hops and malted barley.

be prudent to source our yeast from there as well.

Yeast can be found almost anywhere, but you generally have a better chance of finding a good brewing strain on fruit. Maeve had given us a few pears from the garden to use as yeast sources. We cut them up and added them to three low-gravity starters of around 1.025 specific gravity. Many other microbes like to live on fruit besides yeast, so there was no guarantee we would get a yeast strain suitable for brewing.

We added a little bit of hops to the starters to help discourage wild *Lactobacillus* bacteria growth. Of the three starters, one grew mold (which was not unexpected) but two of them cultivated yeast.

Easy indicators that we had yeast were the smell (which was pleasant) and the remarkably similar appearance to commercially available yeasts we've used thousands of times. It's too bad we don't have a microscope, but that would be a good choice if you're looking for that extra level of verification.

Finally, we measured the pH to make sure it had dropped to at least 4.5 so that no pathogens were living in the starter. I built these starters up by adding them to progressively larger starters until I had a healthy slurry of wild yeast. This was thrilling! We were going to make an all-Brooklyn Botanic Garden-ingredient beer. As far as anyone knew, this had never happened in the garden's more than 100 years of existence.

With the help of our employee Jack, we then proceeded to make the beer. This would be the test to see if we had malted the barley correctly. We double-milled the malt and mashed it at 155°F (68°C). After an hour, I took a refractometer reading—had we not malted it correctly, there would have been no sugar. Drum roll please… and success! Our gravity readings indicated that starch conversion had happened. We had sweet, delicious wort.

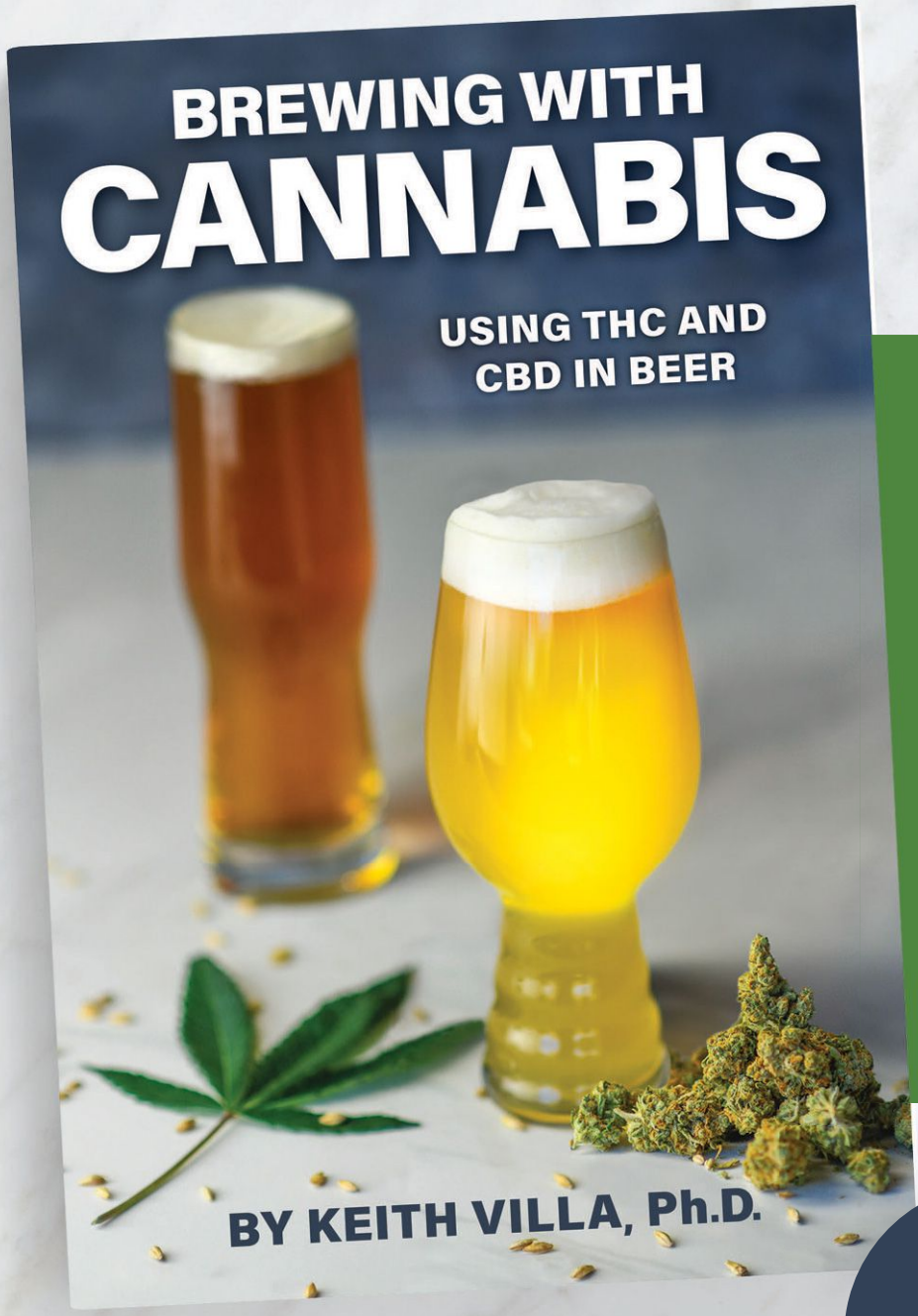
We then boiled the wort as we would with any other beer. We added the Nugget hops twice during the boil: at 60 minutes and at flameout. Not knowing the alpha acid levels of the hops, we had to make an educated guess. We had previously made a test beer with Rahr 6-row to try out the hops and see how much we would need for the final beer. Using the information we gleaned from the test beer, we were able to determine that we'd need a lot more hops than we'd anticipated for our new batch. Additionally, we wanted to make sure the yeast made a good beer—it did.

The mash.

Maeve Turner adding hops to the boil.

John LaPolla of Bitter & Esters and Maeve Turner of Brooklyn Botanic Garden.

Photos © courtesy of



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Keith Villa, Ph.D., is brewmaster and co-founder of Colorado-based CERIA Brewing Company, a trailblazer in the rapidly growing market of non-alcoholic, cannabis-infused beers. After earning his Ph.D. in brewing from the University of Brussels in Belgium, Keith began his 32-year career as founder and head brewmaster at Blue Moon Brewing Company, an operating unit of MillerCoors. Since then, this beer doctor has gone on to brew several award-winning beers and continues to set new standards and push the boundaries of flavor, styles, and ingredients. Keith also is co-founder and head brewer of family business Donavon Brewing Company based in Arvada, Colorado.

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Brooklyn Botanic Garden beer fermenting.

Bottling Brooklyn Botanic Garden beer.

Brooklyn Botanic Garden beer with label.

We fermented our gallon of beer for two weeks. The test batch developed some sulfur aroma during fermentation, which is not uncommon with wild yeasts. We wrapped a heat belt around the fermenter for the last three days to help dissipate that aroma. This yeast is a fast fermenter and very attenuative. The original gravity was 1.040, and the final gravity was 1.004, yielding an estimated alcohol content of 4.7% by volume. Once fermentation had finished, we transferred the beer into bottles with a little bit of corn sugar.

The wait was worth it! We ended up with six bottles of a golden wild ale. The color was sparkling hay and the taste reminiscent of a fine saison, crisp and dry. The aroma included peppery phenols, and, dare I say, a hint of pear? The hops balanced the yeast and malt flavors perfectly.

But don't take my word for it. Maeve was kind enough to set up a meeting for us with Adrian Benepe, president of the Brooklyn Botanic Garden. We sat outside on their fragrance garden terrace on a warm fall day and enjoyed this delicious beer. Both Adrian and Maeve were impressed by the final product and asked if we'd like to do it again next year. Yes, yes we would!

We liked this beer so much that we sent a sample of the BBG yeast to Bootleg Biology for them to isolate. Hopefully, in a few months, we will have this yeast for sale at the shop!

We had been documenting this experience on Instagram, and of course everybody wanted to try the beer, but we only had three bottles left after the tasting at the garden. So we held a raffle, and four lucky winners got to come to the shop for a private tasting. We ended up raising $300 for the garden and had a great time. And yes, everyone loved the beer.

All in all, this was a wonderful learning experience and a way for us to make something truly local. Thank you to Maeve, Adrian, and the Brooklyn Botanic Garden for their help and for providing the ingredients.

John LaPolla is co-owner of Bitter & Esters homebrew shop in Brooklyn, N.Y. Bitter & Esters has been in business for 10 years, is New York City's only homebrew supply shop, and won the AHA's Homebrew Shop of the Year Award in 2019.

Tasting with (left to right) Maeve Turner, Botanic Garden president Adrian Benepe, and John LaPolla.

Photos courtesy of Michael Stewart, courtesy of Brooklyn Botanic Garden (beer with label & tasting)

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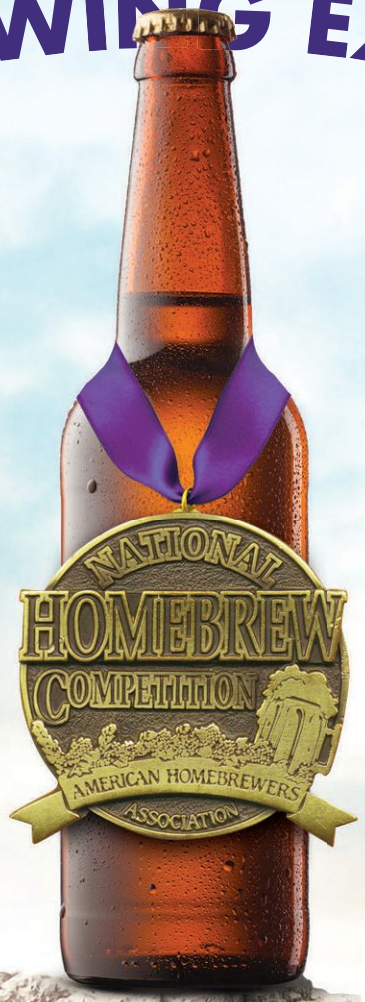

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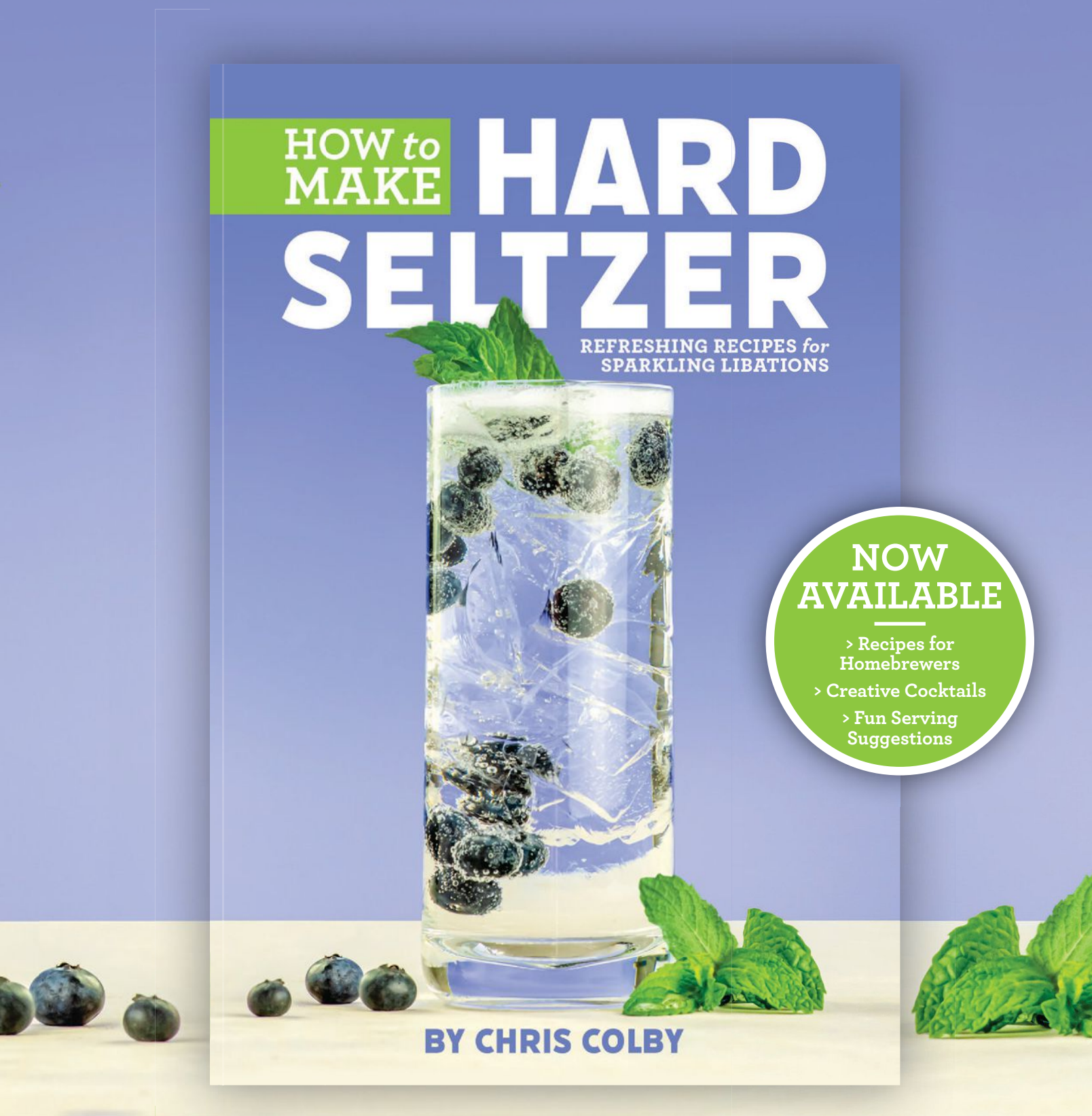

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LAST Drop

BY ERIC J. WAHLBERG

The Joy of Being

I tried making beer in the late 1970s. I was working at my town's wastewater treatment plant at the time and had access to our local drinking water quality reports. I remember only four things about that brew: Epsom salt additions, aromas of skunk and cabbage, a terrible hangover, and a complete lack of interest in ever duplicating the experience.

Fast forward to the first year of COVID-19. We'd barely made it back home to Vermont in mid-March after delivering six weeks of water-treatment training on the West Coast before the entire world isolated and socially distanced.

Living in the middle of 130 acres of northern Vermont woods provides, by definition, plenty of isolation and social distancing. We're off grid, but not entirely. The phone line buried in our mile-long driveway is our one and only hard connection to the outside world And at an upload speed of only 0.85 Mbps, it's not a strong connection by any stretch of the imagination. I count the two trips per year the propane truck makes up our driveway as our one soft connection. We have two water supplies: a developed spring up the hill, which gravity feeds to the house, and a well drilled deep into underlying granite only 75 feet from the house, which requires pumping and both anionic and cationic exchange.

That first fall season after COVID hit, after the kaleidoscope of autumn colors fell to the ground and my second vintage hard cider was fermenting down in the basement—a much larger and more carefully crafted batch than the previous year's—I thought, *I've waited over 40 years. What better time than a COVID winter to revisit brewing?* So I did.

In the time it takes to get a full byte down our phone line, I had located the digital edition of John Palmer's *How To Brew* and pored over it for hours on end. On the cover was a quote attributed to his history teacher: "It's only boring until you learn something about it. Knowledge makes things interesting." By December, I had a batch of Port O'Palmer bubbling furiously; by year's end, I had 18 1-liter bottles filled and aging. Two weeks into January, I popped open a bottle and gently poured the brew into a chilled Pilsner glass. After a few awestruck moments, overwhelmed with anticipation, I took my first sip. Like a fly on flypaper, I was hooked for life.

Every spring, it never ceases to confound me that I can collect and boil 40 gallons of maple tree sap to make a gallon of maple syrup. Now, I am just as confounded that I can make beer from sprouted and dried barley. Yikes! Who figured this out?

I haven't yet graduated to all-grain brewing, but I do partial mashes. As an engineer nerd, I use a spreadsheet to estimate original gravity. I brew with our pristine spring water, but I am intrigued by the possibility of bettering my brews with water-chemistry adjustments.

Yes, I'm in the phase of the homebrewing arc John describes as "consistency." The seven beers I'm striving to brew consistently well are Anne Fulton's Porter, Brindle Bean Brown Ale, Clearing What Ales You, Emerald Isle Red Ale, Green Mountain Scottish Ale, Jimmie Jam Not-So-Pale Ale, and Little Teapot Shorthand Stout. My journey through that arc, which John describes so well, has made my COVID isolation not only bearable, but joyful.

From my experience, it boils down to this: if you drink beer, you should be brewing beer. With minimal expense for equipment and ingredients, you can't afford not to brew your own, and it's good.

It is said about getting a PhD that you learn more and more about less and less until you finally know everything about nothing. Little did I know back in the 70s how much there was to know about brewing beer and how fun it can be. And then you get to drink it! If wine, as Galileo mused, is sunlight held together by water, then beer is Mother Earth and her people held together by the joy of being.

I'm writing to give heartfelt thanks to the entire brewing community—brewers (amateur and professional), farmers, maltsters, researchers, you name it—who have come before me. Thank you for easing me, and I'm sure others, through this COVID isolation.

It takes a village…of homebrewers.

Eric Wahlberg lives in Cabot, Vt., with his wife Patti and their two dogs.

Photos courtesy of Eric J. Wahlberg

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