FOR THE HOMEBREWER & BEER LOVER

14 RECIPES YOU CAN FERMENT

zymurgy®

home brew tech

INVENTIONS, INNOVATIONS, AND RESOURCES

VOL 47 · №4
JULY/AUGUST 2024

THE MAGAZINE OF THE AMERICAN HOMEBREWERS ASSOCIATION®
HomebrewersAssociation.org

Maltose Falcons

ESTD. 1974

AMERICA'S OLDEST HOMEBREW CLUB

CONGRATULATIONS ON 50 YEARS!

The impact that the Maltose Falcons have had on the American beer industry cannot be overstated. Today's diverse beer landscape can largely be traced back to the lobbying efforts to legalize homebrewing in the US by early Maltose Falcons members in the mid-1970s. Their devotion and dedication laid the groundwork for the craft beer revolution almost half a century later.

Throughout the last fifty years, the Maltose Falcons have continued to inspire thousands of hobbyists to pick up a mash paddle, while also having a positive social impact on their local community through countless philanthropic efforts.

In recognition of their unwavering commitment to the craft, Rahr Malting Co.® extends a heartfelt salute to the Maltose Falcons for serving as an inspiration to all.

Cheers to your members, past and present, as we celebrate your 50th anniversary!

- FROM YOUR FRIENDS AT -

1847

RAHR MALTING CO.®

ZYMURGY Staff

Follow the AHA @homebrewassoc

THE MAGAZINE OF THE AMERICAN HOMEBREWERS ASSOCIATION®

Publisher | Brewers Association℠

Editor-in-Chief | Amahl Turczyn

Copy Editor | Adriana Terron

Art Director | Jason Smith

Production Graphic Designer | Kelli Gomez

Marketing & Communications Director | Ann Obenchain
ann@brewersassociation.org

Sales Director | Kevin Doidge
kevin@brewersassociation.org

Sr. Manager, Business Development | Kari Harrington
kari@brewersassociation.org

Sales Activation Managers | Kim Derr
Hans Tishmack

Senior Marketing Manager | Rachel Staats

Marketing Manager | Jeb Foster

Operations Manager | Dan Goloback

AMERICAN HOMEBREWERS ASSOCIATION

Executive Director | Julia Herz
ahaed@brewersassociation.org

Educational Project Manager | Duncan Bryant

Competition Director | Chris Williams

AHA COMMITTEE MEMBERS

Matt Bolling, Sandy Cockerham, Shawna Cormier*, Chris Hummert, Jill Marilley, Amy Martin, Melissa McCann, Doug Piper, Roxanne Westendorf.
**Indicates representative to the BA Board of Directors.*

OUR MISSION

Zymurgy celebrates AHA members and educates those who want to brew and ferment.

POSTMASTER

Send address changes to:
***Zymurgy*, 1327 Spruce Street**
Boulder, CO 80302

Printed in the USA.

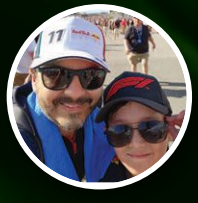
Published by the American Homebrewers Association, a division of the Brewers Association℠. The purpose of the Brewers Association is to promote and protect small and independent American brewers, their craft beers, and the community of brewing enthusiasts. The Brewers Association is a not-for-profit trade Association under Section 501(c)(6) of the Internal Revenue Code. Offices are located at 1327 Spruce Street, Boulder, CO 80302 USA. Membership is open to everyone. ***Zymurgy*** (ISSN 0196-5921, USPS 018-212) is the bi-monthly journal of the American Homebrewers Association and is published six times per year. Periodicals Postage Paid at Boulder, CO and additional mailing offices. Canada Post Agreement Number 41197537. Annual memberships are $49 U.S. and $63 international and include a subscription to ***Zymurgy***.

Changing your address? Let us know in writing or e-mail your address changes to info@brewersassociation.org.

Zymurgy*®** welcomes letters, opinions, ideas, article queries and information in general from its readers. Correspondence and advertising inquiries should be directed to ***Zymurgy, PO Box 1679, Boulder, CO 80306-1679, (303) 447-0816, zymurgy@brewersassociation.org, www.HomebrewersAssociation.org.

The opinions and views expressed in articles are not necessarily those of the American Homebrewers Association and its magazine, ***Zymurgy***.

CONTRIBUTORS



AURELIO GONZALEZ is a Microsoft architect who focuses on low-code, no-code technologies. He loves sharing his high-tech homebrews with his club, the North Urban Brewing Society (NUBS) of Lake County, Ill.

LUIS MARIANO HERNANDEZ MARTINEZ is an experienced brewer, consultant, and beer sommelier. He attended Doemens Academy, and completed the master brewer program at Siebel.

ANDY TIPLER has been homebrewing for more than 50 years and is a certified beer, mead, and cider judge. He is a member of the Underground Brewers of Connecticut, the second oldest homebrew club in the USA.

PIERRE MARGRAFF was born and raised on Tafelbier in Belgium. He moved to the States, then learned to homebrew shortly after tasting his first American beer some 25 years ago.

RYAN PACHMAYER is the marketing and events director at New Image Brewing in Wheat Ridge and Arvada, Colo., and former head brewer at Yak and Yeti Restaurant and Brewpub in Arvada.


October 10-12, 2024
GABF
GREAT AMERICAN
BEER FESTIVAL®
DENVER | COLORADO CONVENTION CENTER
Official Sponsors
IKON PASS
KBCO 97.3 FM
M★
Southwest
V8 PLUS
Get Tickets!
GreatAmericanBeerFestival.com

EDITOR'S Desk

BY AMAHL TURCZYN

The Marinara Cycle

Nothing really goes better with homebrew than pizza. Whether it's sourdough New York-style with cream ale, Detroit-style with brick cheese and a hoppy American amber, 00-flour Neapolitan thin crust with Italian Pilsner, or Chicago deep dish with Vienna lager, it's always a combination of flavors and textures that are hard to beat. Get yourself a dedicated pizza oven, learn how to ferment a good high-hydration pizza dough, with a sourdough culture as a delicious option, and maybe even learn cheesemaking. Personally, I'm most focused on the sauce.

This issue we'll look at homebrew technology—inventions and innovations past and present that help shape the way we've evolved as brewers, and continue to streamline our process and ingredients. But we'll also look at making best use of the limited resources we have, and while I'm no inventor, I like putting what's available to best use. Marinara was, according to some food historians, originally a fish-based tomato sauce (*mare* meaning "sea" in Italian), but now has become a catch-all term for an all-purpose tomato-based sauce. It can be used on everything from arrabbiata to pizza, lasagna to parmigiana, manicotti to puttanesca, calzone to ratatouille.

The recipe I use is fairly simple, and is made up of four ingredients: homegrown tomatoes, garlic, and basil, plus olive oil. It's an annual process that starts in early March, when tomato seeds from last year's harvest are sprouted indoors under grow lights. As these plants mature indoors, outdoor compost bins break down leaves and grass from the yard, jump-started with spent grain from the brewhouse, eggshells, and other waste from the kitchen, helped along by a hungry troop of worms in their worm composter, and the microbes in *bokashi* spent-barley grains dried with sourdough cultures. Once broken down, this fertile soil goes on to feed the tomato plants when it's warm enough outside to tuck them into raised beds in the back yard. Thanks to homebrewing, these are grain-fed tomatoes.

Come September, with Colorado's short growing season, it's harvest time. Black, red, yellow, purple, orange stripe and pink varieties are picked, sorted, and roasted to about half their original moisture, processed through a fine-plate food mill to remove skin and seeds, canned in jars, and stored at 37°F (3°C) in chest fridges along with Corny kegs of homebrew. When needed, these jars of tomato puree are then blended with garlic and basil, and further reduced to a thick sauce to be used for various dishes throughout the rest of the year. The biggest, most flavorful specimens of each tomato variety are chosen for seed; you just squeeze the gelatinous seed pulp into small jars, add water, and allow ambient microbes to ferment the goo to a tart liquid. Fermentation is the sincerest form of flattery! The now-clean seeds are then dried, labeled and stored, and the cycle continues.

It's a slow-food, low-tech approach that puts quality nourishment on the table, not unlike my slow-food, low-tech brew system. But everyone has their own approach to fermentation, and there are brilliant homebrewers pushing the boundaries of what modern technology has to offer. Microsoft architect Aurelio Gonzalez loves coding almost as much as he loves brewing beer, and in Homebrewing with AI and IoT, he demonstrates how the use of machine learning and Internet of Things tools can optimize process efficiency in the brewhouse.

Master brewer Luis Hernandez Martinez unearths another innovative approach to brewing beer, this one from 5,000 years ago, and how an ancient invention by the ancestors of those early brewers led to a revolution—quite literally—in malting technology.

Pierre Margraff and Andy Tipler complete the third and final installment of their article series on brewing without the need for tanked CO_2. Sure, you can purchase and fill a tank at your local supply store, as easily as you can buy a jar of marinara at the supermarket. But one of the joys of homebrewing is that DIY spirit that shuns the easy way of doing things in favor of seeking out our own path, no matter how convoluted. KegSack follows Margraff and Tipler on their journey to dispense delicious, perfectly conditioned real ale using a home-built bag-in-a-keg (BIAK) system of their own ingenious design.

Longtime contributor Ryan Pachmayer follows the humble beginnings of another innovative craft brewery that's come so far and achieved such popularity that Giesinger Brau is now the seventh official brewery in Munich, and may be destined to pour the brewery's delicious lagers in the sacred tents of Oktoberfest.

I hope you enjoy this issue's look at brewing invention and innovation, past and present, and putting what's available to you to best use. And even if you don't have the space to grow your own grain-fed tomatoes, I hope you'll at least try this simple marinara recipe.

GRAIN-FED MARINARA

Recipe by Amahl Turczyn
Makes about 2 quarts.

This recipe works best with garden-fresh ingredients and a fragrant, high-quality extra virgin olive oil.

Ingredients

1 gal.	(3.79 L) tomato sauce
4 Tbs.	extra virgin olive oil
4–6 cloves	fresh garlic, peeled and sliced as thinly as possible
3–4	large basil leaves

Add olive oil and garlic to a large kettle or saucepan. Heat just until garlic starts to sizzle—you don't want it to take on any color—then add tomato sauce. Simmer, reducing by one half to one third the original volume depending upon desired thickness. During the last 15 minutes of cooking, add basil leaves and allow them to wilt in the sauce. Jar and seal.

Amahl Turczyn is editor-in-chief of Zymurgy.

Features

Columns

Departments

Recipe Guide

Cover Illustration
© Carlo Cadenas

Vol 47 • No. 4
July/August 2024

zymurgy®

(zī'm ɚr 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

NOW ON Tap

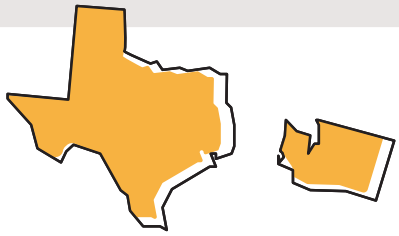
Beer & Sweat Keg-Only Competition

AUGUST 10, CINCINNATI, OHIO

Join your fellow homebrewing community at the 36th Annual 'Beer & Sweat' on August 10 in Cincinnati, Ohio. This keg-only competition features a homebrew party for judges and competitors in attendance that's about as close to the beloved AHA Club Night as you can get. There will be raffles, camaraderie, and hundreds of homebrews to sample. Compete against passionate brewers, receive feedback from experienced judges, and immerse yourself in a day dedicated to the love of beer. This event is not just a competition; it's also a platform for showcasing your brewing artistry with every entry on tap ready for sampling. Offering the chance to connect with fellow homebrewers and share your unique creations, Beer & Sweat stands out as a must-attend for anyone serious about the homebrewing community. Register your entries at beerawardsplatform.com/36th-annual-beer-sweat and mark your calendar for an unforgettable experience that highlights the spirit of homebrewing.

Government Affairs

HOBBYISTS ORGANIZE TO CHANGE FEDERAL BAN ON HOME DISTILLATION



The Hobby Distillers Association of Tarrant County, Texas has engaged in efforts to make home distilling just as legal as homebrewing. Federal law now allows home beer and wine makers to produce up to 100 gallons per year of their lower-strength beverages without taxation. Opponents of home distilling maintain that distilled spirits are potentially dangerous if incorrectly produced (as little as 10 mL of methanol can cause permanent blindness, as the body metabolizes it into formic acid), and flammable spirits near a heating source can easily cause fires or explosions. Supporters of home distilling say these dangers are exaggerated, and that the home production of spirits is safe when the proper precautions are taken. Federal agents have demonstrated a willingness to continue to enforce federal law by arresting alleged moonshiners, though hobby distillers claim that like homebrewers, they only want the legal right to produce spirits for themselves, their friends, and family—they have no intention of selling the liquor they produce.

The Hobby Distillers Association continues to engage members of Congress and hopes to find a member of the House or Senate who will sponsor a Bill and get it passed. It sued the Tax and Trade Bureau (TTB) in 2023, claiming the prohibition of home distilling was unconstitutional. The government claims that at-home distilling interferes with taxation. But according to a recent article in Law360.com, the Association said home distilling would not create a revenue loss, despite congressional efforts to regulate interstate spirit sales to preserve tax revenue.

Meanwhile, in West Virginia, the Republican-led legislature passed a distilled spirits bill this year that allows for individual home distillers over the age of 21 to produce up to five gallons per year; couples are allowed 10 gallons. Supporters say this "moonshine bill" honors Appalachian heritage. The bill's language specifies that the distilling is for personal and family use only. It remains to be seen if and how the TTB will enforce federal laws prohibiting home distillation now that it is allowed on a state level.

Logo courtesy of Beer & Sweat

Cass River Homebrew Club

The Cass River Homebrew Club has been a beacon of homebrewing excellence for 35 years. It was founded in 1988 in Frankenmuth, Mich. by the Cass River Brewing Company brewers Fred Scheer and Fred Schumacher, and homebrewers Bill Eisenhauer, Jeff Hervert, and Scott Wenzel. The club currently boasts approximately 40 active members and meets at Tri-City Brewing Company in Bay City, Mich.

The club holds a significant place in the history of homebrewing. They are reported to be the second-oldest club in the state of Michigan and one of the longest-standing clubs in the U.S. The club is committed to public education on homebrewing, the value of entering homebrewing competitions, training future beer judges, hosting numerous public and charitable events, and supporting its members in their brewing endeavors.

Club members have garnered acclaim for medal-winning homebrew from esteemed competitions, including the American Homebrewers Association (AHA) National Homebrew Competition (NHC), the Michigan State Fair, and the Michigan Beer Cup. Club members are also engaged in efforts beyond Michigan to make their AHA-sanctioned club one of the world's most robust brewing communities.

They show responsibility by having a club code of conduct and participating in the AHA Insurance Program. The AHA recognizes the Cass River Homebrew Club for its lengthy tenure, leadership in education, and contributions to the art of homebrewing.

We commend the Cass River Homebrew Club for its dedication to the hobby of fermentation and its celebration of 35 years of cultivating community over homebrew. We also raise a glass to club president Lori Kula and her fellow club officers for showing what volunteer leadership in homebrewing is all about. Cheers to 35 amazing years of the Cass River Homebrew Club, and many more to come. (Check out a video on the club at HomebrewersAssociation.org/ja24).

AHA Happenings

- Don't miss the **AHA at the GABF**, October 10–12, 2024.A link to the full schedule is available at HomebrewersAssociation.org/ja24
  Tickets go on sale July 16 at GreatAmericanBeerFestival.com
- **Home Fermentation Day** is August 3, 2024. Lots of recipe ideas for the event at HomebrewersAssociation.org/aha-events/home-fermentation-day

BEER QUIZ

Which off-flavor are you most likely to encounter if a draft system has not been properly cleaned?

A. Buttery
B. Skunky
C. Papery
D. Astringent
E. Hot

Photo courtesy of Cass River Homebrew Club | Beer Quiz Answer: A

Brew Over

The Big Brew Day Competition 2023 coverage in Now on Tap, May/June *Zymurgy* neglected to mention the third-place winning homebrew club, as well as the announcement of the 2024 Big Brew Day Competition. Apologies for the omissions and hats off to the Mesilla Valley Homebrewers for their victory!

3RD PLACE
Mesilla Valley Homebrew Club
Las Cruces, New Mexico
Charity: David Allan Brewer's and Distiller's Scholarship

The Mesilla Valley Homebrewers Club was established in 2015. The club represents the Southern New Mexico homebrew community by hosting BJCP competitions and collaborating with local breweries for homebrew contests. Yearly collaborative homebrew contests allow the club to raise funds for the David Allan Brewer's and Distiller's Scholarship, which in turn supports aspiring brewers and distillers at New Mexico State University. MVHC membership is diverse and full of personality. Members enjoy coming together as a homebrew community to celebrate and support the craft.

Learn more at: mvhomebrew.weebly.com/about

BIG BREW DAY COMPETITION 2024

The Weiz Guys Homebrew Club hosts Big Brew Day Competition 2024. This year the competition is open to all AHA-sanctioned homebrew clubs within the United States. The schedule of events is:

- 05/04/2024: Big Brew Day / competition entry window opens
- 06/15/2024: competition entry window closes
- 06/24/2024: all entries must be received
- 06/29/2024: BBDC first round
- 07/13/2024: BBDC final round / best of show

More information is available at: weizguys.com/bigbrew

Photo courtesy of Mesilla Valley Homebrew Club

MONTHLY
INTERACTIVE WEBCAST

AHA MEMBER EXCLUSIVE!

zymurgy® LIVE

Where Fresh Ideas Are Brewed

- Homebrewing Techniques
- Insights from Brewing Luminaries
- Fun-Filled Adventures in Fermentation

Learn from experts like Sarah Flora, Ken Grossman and Amy Martin.

BROWSE THE SCHEDULE AND REGISTER:

HomebrewersAssociation.org/zymurgy-live

Catch episodes in real time or watch the recordings at your convenience.

DIRECTOR'S *Cut*

BY JULIA HERZ

Hose Clamp Rings, Geocaching and Road Trips

AHA Member Connections and Amazing Beer

I recently traveled, toured, brewed, presented, judged, and gained valuable insight from several hundred American Homebrewers Association (AHA) members, craft brewers and homebrew supply shop owners on a whirlwind, multi-state journey. The goal was sharing the value of AHA membership and learning what is on the minds of homebrewers. Where I ended up was determined by two AHA members who each found one of my geocached hose clamp rings (see sidebar). Each member who finds a ring gets a chance to brew with me. Even the following run-on sentence can't do the trip justice, but I'll try.

I flew into Detroit, toured Schramm Meadery with meadmaker and author Ken Schramm in Ferndale, Mich., stayed with AHA and Motor City Masher member Laura Higle in Ypsilanti, Mich., judged the ever-competitive and top-of-class Michigan Mead Cup at Brewery Becker in Brighton, Mich., was MC for the awards (stream available on this issue's online links page at HomebrewersAssociation.org/ja24), presented to MEGA homebrew club at Crooked Ewe Brewery & Ale House in South Bend, Ind. and stayed with AHA →

and MEGA club members Ross and Holly Filipek in Granger, Ind.

On one fine sunny day of this week-plus trip I got to brew with Andrew Ackers and his wife Mary in Ft. Wayne, Ind. They found one of the rings on the Indiana State Fairgrounds. I'd stashed it while judging the Indy Brewers Cup, organized by AHA Committee member and Beer Judge Certification Program (BJCP) president Sandy Cockerham. The Ackers chose to brew a Belgian tripel. Andrew elected to add rhubarb, raspberries and blueberries. The rhubarb came from Mary's grandma's garden. So special.

Then on to Lafayette, Ind. to visit homebrewing pioneer and engineer extraordinaire John Blichmann. Also while in Lafayette, I presented to Tippy Homebrewers at Lafayette Brewing Company with AHA member Todd Cogswell as my lead contact. Somewhere along the way I stopped into famed retail supplier Great Fermentations in Indianapolis, Ind. A visit to Buckeye BrewCraft in Columbus, Ohio was also a memorable highlight.

Then on to Pennsylvania with a homebrew shop tour of Brew Your Own Beer in Havertown, Pa. I also was invited to present to the Band of Media Brewers (the B.O.M.B.) at Sterling Pig Brewery in Media, Pa. Check out the recording of that presentation on our links page. It was after this visit that I brewed with Adam Ritter. Adam and I connected when he found another one of my geocached hose clamp rings in Denver, Colo. hidden during the Great American Beer Festival (GABF) in 2022.

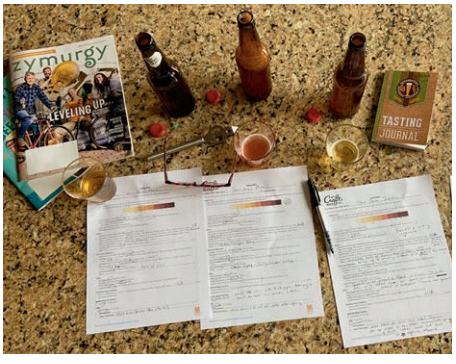
We made a "Philly Sour" saison and split the batch (see recipe). In secondary, Adam added plums to one fermenter and jasmine tea (my contribution) to another. He also had a base beer with no additions.

You know how homebrewers like to tinker. We like to figure things out and navigate with a problem-solving mindset. Well, the collaboration brew days with Andrew, Mary, and Adam come to mind as perfect examples.

So many gems and bonus learnings from the trip. Speaking of examples, Adam's wife Maria shared an incredible loaf of sourdough bread while we brewed, and she was kind enough to give me the recipe. The links page includes a video on how to make the bread. (Note: Adam says the recipe is not adjusted for altitude.)

Want the chance to find one of my hose clamp rings and collaborate on brewing something? Come to Denver, October 10–12 to join us and other AHA members at GABF®. You can follow me @immaculatefermentation for clues on where and when I've stashed a ring. You can also request a virtual or in-person speaker presentation with the link at HomebrewersAssociation.org/ja24.

Julia Herz is executive director of the American Homebrewers Association. You can follow Julia's homebrew talks and travels on Instagram @ImmaculateFermentation or contact her at ahaed@brewersassociation.org.



Clockwise from top left:
Andrew Ackers brewing in Ft. Wayne, Ind.; Philly sour fermenting; Adam Ritter brewing in Media, Pa.; Julia Herz tasting the Saison in Lyons, Colo.; tasting notes of all three versions.

Photos courtesy of Julia Herz

@IMMACULATEFERMENTATION is the dedicated Instagram account where I document my homebrewing, judging, and travel adventures. It's also where photos will be shared of the latest hose clamp ring I've geocached. The winner will be invited to collaborate with me and brew a beer together. Please consider following along with @homebrewassoc for the latest from the AHA.

Brew This!

Philly Sour Saison *25.B Saison*

Recipe by Adam Ritter. Brewed in collaboration with Julia Herz.

This recipe was created as a collaboration with Julia Herz. Philly Sour yeast (discovered very close to Ritter's home in Pennsylvania) and Belle Saison yeast were pitched together to provide complexity, then plum and jasmine tea were added after primary, in separate secondary fermenters.

Batch volume: 5.5 gallons (20.82 L)
Original gravity: 1.053 (13°P)
Final gravity: 1.006 (1.5°P)
Efficiency: 70%
Color: 4.9 SRM
Bitterness: 20 IBU
Alcohol: 6.2% by volume

FERMENTABLES

8.75 lb. (3.97 kg) Pilsner malt
1.5 lb. (0.68 kg) dextrin malt
8 oz. (227 g) Victory malt
8 oz. (227 g) white wheat malt

HOPS

0.5 oz. (14 g) Magnum pellets, 12% a.a. @ 60 min

YEAST

Lallemand Philly Sour
Lallemand Belle Saison (pitch 3 days after Philly Sour)

OTHER INGREDIENTS

0.5 tsp. (1.5 g) yeast nutrient @ 15 min
2 lb. per gallon (0.2 kg/l) black plums, halved, pitted, in secondary
jasmine tea in secondary, as needed (see notes)

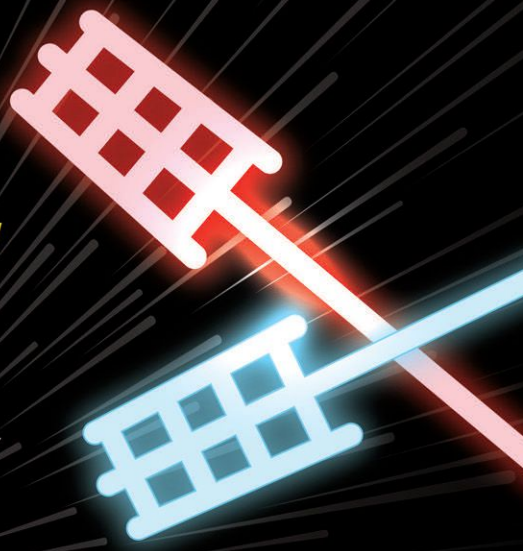
BREWING NOTES

Mash at 149°F (65°C) for 60 minutes. Sparge at 168°F (76°C) until boil volume is reached. Boil 60 minutes adding hops at specified times. Chill to 72°F (22°C) and pitch Philly Sour yeast. Ferment, allowing temperature to slowly free rise to 76°F (24°C). On day three of fermentation, pitch Belle Saison yeast. Continue fermentation at 76°F (24°C). Rack in equal amounts to three secondary fermenters, adding fruit to one, tea tincture (to taste) to another, and keep a third as the base beer. Ferment in secondary fermenters for 10 days, then package.

To make the jasmine tea tincture, add 1 tsp. jasmine tea to 6 oz. boiling water (~2 g in 177 ml).

BIG BREW 2024

FOR NATIONAL HOMEBREW DAY



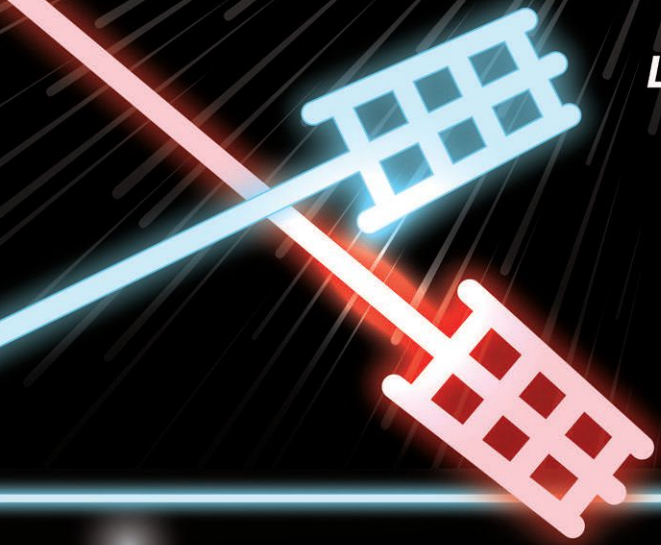
THANK YOU TO OUR SPONSORS:

LALLEMAND

LALLEMAND BREWING

1847

RAHR MALTING CO.



FIND THE RECIPES AT
HomebrewersAssociation.org/BigBrew

AMERICAN HOMEBREWERS ASSOCIATION

May/June Hits All the Wickets

***Dear* Zymurgy,**
I just want to thank you for the best issue of the magazine that I've experienced so far in my roughly 10 years of membership. Congratulations on such an achievement. You did it! You should be proud. The May/June installment was the first issue that I read from cover to cover, enthralled with every contribution. Usually I pick and choose, jump around, and come back to it later for things I skipped. The best part was a small thing overall, but something I've wanted to see in many past issues—captions for the photos in articles that describe the location and help tell the story. Often, I was left guessing which location was in the photo, or who was there holding a beer, or making a beer. This issue hit all the wickets. Great job, folks. Thanks, and cheers.

Matt Bellaver

Editor-in-chief Amahl Turczyn responds:
Hi Matt, thanks so much for the positive feedback! Our team and contributors worked hard on that issue, and it's gratifying to know our efforts are appreciated. Thanks for supporting the AHA over the past 10 years.

BIERGARTEN BLISS

***Dear* Zymurgy,**
I am a new member to AHA. *Zymurgy* has become my go-to brew day reading material. I really enjoyed the Mar/Apr issue feature on Biergartens. The pictures, history, and atmosphere really painted a picture and gave me a newfound respect for biergarten culture. The May/June feature on beer hiking in Bavaria had the same effect! Please keep printing these types of articles.

Aaron Burt

Editor-in-chief Amahl Turczyn responds:
Thanks Aaron for your feedback! So glad you are enjoying content in Zymurgy. *I'll agree that Franz D. Hofer's writing is inspiring... makes me want to drop everything and catch a flight to Bavaria in search of the perfect pint.*

BUILDING BETTER BREZN

***Dear* Zymurgy,**

My apologies to Amahl Turczyn up front for the critique, but I was really disappointed in his article Brezn, because the detail and recipe in no way resembled a Bavarian pretzel. The recipe he provided was for milk pretzels, which are ok, but Brezn are water pretzels. Instead of milk, the sugars in the recipe come from malt extract, which helps provide the caramelized color that Brezn are known for. Also, you can certainly use a baking soda bath, but a lye bath is such a significant difference that you should just explain how to do a lye bath safely; wear latex or nitrile gloves and safety goggles, as these are important and easily handled steps to safely use food grade lye.

Here's a recipe that would do your readers a greater service when baking genuine Brezn.

BETTER BREZN

Recipe by Robert Hartung

INGREDIENTS

1 Tbs.	(21 g) malt extract syrup
2 cups	(473 mL) warm water
2 Tbs.	(18 g) bread yeast
2 Tbs.	(28 g) butter, at room temp
6 cups	(720 g) all-purpose flour
3.5 tsp.	(21 g) kosher salt
pretzel salt to top	

LYE BATH

1 qt.	(0.95 l) water
40 g	food grade lye

DIRECTIONS

1. In a bowl, mix hot water with malt syrup and then let cool to lukewarm, 100–110°F (38–43°C).
2. Add bread yeast and whisk together. Allow yeast to bloom, approximately five minutes.
3. In a mixing bowl, mix three cups of the flour, the salt, and the butter on low speed.
4. Add the yeast mixture and continue to combine.
5. Add 1/2 cup of flour at a time until the last remaining 1/2 cup.
6. Turn dough out onto the counter and knead in the last remaining 1/2 cup of flour. Knead dough for approximately five minutes.
7. Place the dough into a bowl, cover with a towel, and let rest for 45 minutes.
8. Preheat oven to 425°F (218°C).
9. In a glass bowl, add 1 qt. of water, carefully sprinkle the lye into the water, and mix solution. This will create a 4% lye bath solution. Be very careful to wear latex gloves and eye protection.
10. Take the dough out and cut into eight equal pieces, approximately 6 oz. (170 g) each; or for 12 smaller pretzels, four oz. (113 g) each. Roll into a ball, and then with a rolling pin, flatten out into a small circle. Roll up the circle into a short length and then continue to roll into a long rope, leaving the center thicker than the ends. Take each of the ends, looping back to the center, twisting the ends to each other. Then drape the ends back to the outer loops.
11. Place formed pretzels on to a baking sheet lined with a silicone mat. Don't crowd them. Parchment paper does not work well and the pretzels will stick.
12. Wearing gloves, take each pretzel, dip it into the lye bath for 15 seconds, and then place it back on the baking sheet. Sprinkle each with pretzel salt.
13. Bake for 12–15 minutes, or to your preference.

When done, grab one of these pretzels, some butter or mustard, and a good Bavarian lager, and enjoy!

Sincerely,
Robert Hartung

Editor-in-chief Amahl Turczyn responds:
Robert,

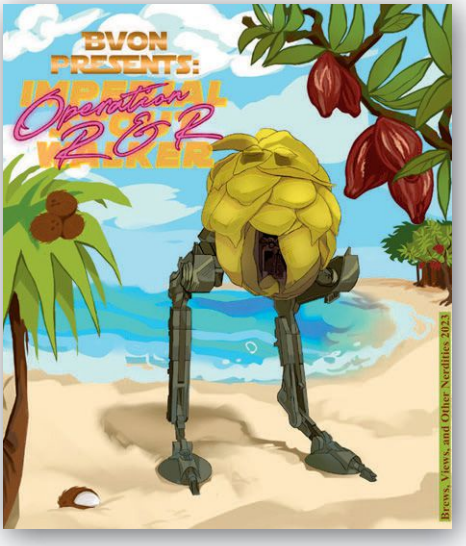
No apology necessary, I am always far more appreciative of criticism when someone takes the time to show me how to make something better…that's integral to the collaborative spirit of brewing and fermentation, and that's how we learn and improve. Thanks so much for including the detailed recipe and the photo (those are gorgeous, and absolutely put mine to shame)! I did mention in my piece that lye works better than soda, and that I was using the latter mainly due to safety concerns, but since you took the time and trouble to explain the more effective lye method, along with taking appropriate safety measures, I think our readers deserve to see your recipe. Can't wait to try baking this version with malt extract and no dairy!

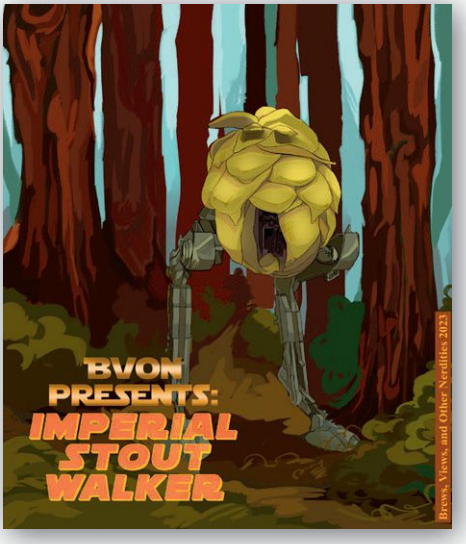
Photo courtesy of Robert Hartung

DEAR *ZYMURGY*

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

YOUR HOMEBREW LABELS





BVON's latest offering is a double dose parody of our favorite space opera. Imperial Stout Walker is an Imperial Stout (obviously) while Operation RnR is that same base stout aged with cacao nibs, and both raw and toasted coconut. Cheers! (Homebrewer two years, AHA member two years)

Leonard Martinez
Monterey Park, Calif.

Emberwood smoked porter with scorpion peppers was my first completely original-recipe beer, my first time bottling, and my first label.

It was a big hit, and will most likely be brewed yearly. (Homebrewer six years, AHA member two years)

Jeff Market
Ohio Valley Homebrewers Association
Evansville, Ind.

SUBMIT YOUR LABEL

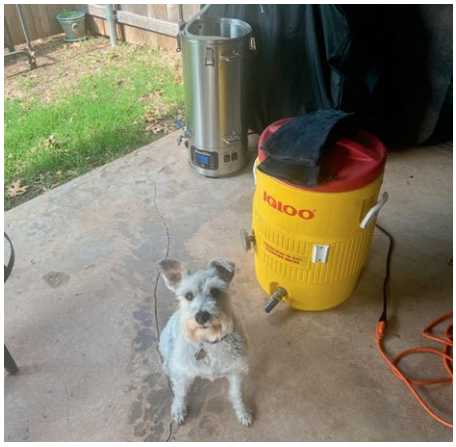
Do you make custom labels for your homebrew? Want it featured here in the pages of *Zymurgy* for all to see your work? Upload your label to **HomebrewersAssociation.org/your-homebrew-experience** and we will take it into consideration!

SCAN ME

YOUR HOMEBREW EXPERIENCE

Show us your labels, 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 loyal brewing assistant.
Scott Hammerstedt
(Homebrewer 16 years, AHA member 10 years)
Norman, Okla.

Our chickens love brew days. In less than 24 hours, they'll eat all the spent grain.
Mitch Springer
(Homebrewer 11 years, AHA member eight years)
Sullivan, Wis.

Bottled 10 gallons recently. Bench capper attaches to a plastic cutting board with mirror clips. A small bucket is screwed to the board, another sits inside to hold the Beer Gun between fills while capping a just-filled bottle. The CO_2 platform holds the tank and has valves for the keg and Gun lines.
Steve Kranz
(Homebrewer 31 years, AHA member 29 years)
Midnight Homebrewers' League
Westminster, Md.

Our daughter Eva, helping me brew my annual Three Kings Kölsch for the BURP Oktoberfest. And our dog, Abbey (short for Abbey Ale), on her first brewday as a puppy—also brewing my Kölsch.
Mike Reinitz
(Homebrewer 15 years)
BURP (Brewers United for Real Potables)
Silver Spring, Md.

Brewing Juno's favorite cream ale with all her pals. What a great Friday!
Dylan Bruney
(Homebrewer six years, AHA member four years)
Nash Street Homebrew
Carrboro, N.C.

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 look 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

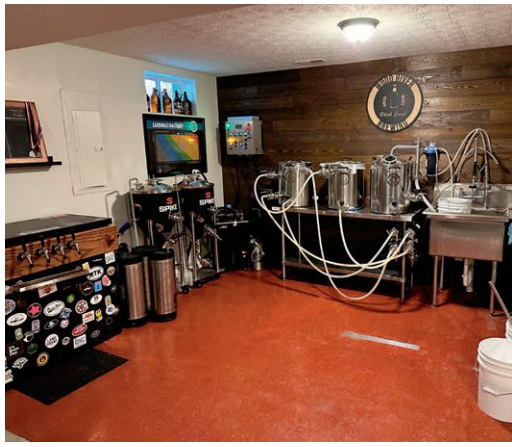
YOUR HOMEBREW EXPERIENCE

Hop harvest day in New Hampshire (2023).

Tim Hanson
(Homebrewer seven years, AHA member six years)
Upper Valley H.O.P.S.
Charlestown, N.H.

Not sure if it was the apples under my tree or the Wee Heavy I was brewing. But these two young deer were having a good time.

Kevin Simons
(Homebrewer 25 years, AHA member five years)
Hampden, Mass.

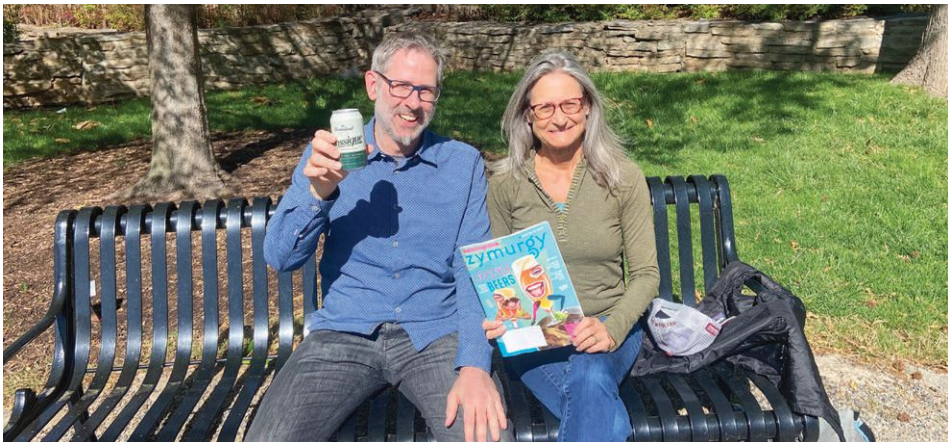


From the stovetop, to the garage, and now an all-electric brewery in the basement.

David Corr
(Homebrewer 10 years, AHA member five years)
Centerville, Ohio

My brew kitty Gaudi performing quality control on brew day. Her reports indicate I'm leaving too much sugar in the mash.

Gino Clement
(Homebrewer 10 years, AHA member six years)
Rat City Homebrew Club
Seattle, Wash.



Franz D. Hofer (AHA member and *Zymurgy* writer) and Julia Herz (AHA Executive Director) together in Stillwater, Okla. during the OSU Craft Beer Forum.

Stillwater Brewers' League (Franz)
Hop Barley and the Alers (Julia)

Bonnie the Brew Boss is supervising today. She wants to make sure that her spent-grain doggie biscuits are made properly.

Steve Hiller
(Homebrewer 11 years, AHA member two years)
Miami Area Society of Homebrewers, PC Mashers, Covert Hops
Roswell, Ga.
(NOTE: DO NOT use grains that have been in contact with hops. Hops have been shown to be toxic to dogs.)

Close up of *Aspergillus oryzae*, a filamentous fungus or mold that is used in the production of such foods as *amazake*, *miso*, and *shoyu* (soy sauce).

Accelerated Aging of Beef with Koji Kin

By Amahl Turczyn

The spores of the mold *Aspergillus oryzae*, known as *koji kin*, are an incredibly versatile ingredient in the preparation of many Japanese foods, including sake, *amazake*, *miso*, and *shoyu* (soy sauce). They have a unique ability to convert starches into sugars, so when steamed rice is inoculated with koji kin and held in a temperature- and humidity-controlled environment, the spores grow, coating the rice with a powdery mold. Once this process is complete, the *kome koji*, as it's now called, can be used for all sorts of culinary purposes, including the saccharification of additional rice to make amazake (a sweet rice beverage) or, when fermented, "rice wine" or sake. But koji kin does more →

Two grams of koji per pound of beef is plenty.

Blend koji spores with about 10x by weight of rice flour.

Dry age beef in fridge 3–12 days, turning daily.

than just break down starch—it also breaks down proteins into free amino acids called glutamates, which, in addition to being the most abundant neurotransmitter in our brains, are also the basis for those wonderful savory flavors known collectively as *umami*. When koji kin meets cooked soybeans, the resulting fermentation can produce miso, an umami-rich bean paste used in all kinds of Japanese soups, sauces, and marinades, or it can produce shoyu and *tamari*, two umami-rich seasoning liquids. But other proteins can be inoculated and broken down in this way, which is what we're going to look with quick-aging beef.

Dry-aging beef is a popular chef's trick. Naturally occurring enzymes in beef slowly break down the connective tissues and proteins in the meat, usually over the course of four weeks to several months. The beef should have plenty of air circulation while this happens and should be kept at the proper temperature (generally speaking, 33 to 40°F, or 0 to 4°C) and humidity (75 to 80%). In fancy restaurants, beef cuts are usually hung in special meat lockers and monitored carefully as the dry aging progresses. The beef develops a nutty, savory, concentrated flavor after about a month, and as it decomposes—which is what dry aging essentially is—the moisture level in the beef drops, umami flavors intensify, and the beef goes from tough and sinewy to melt-in-your-mouth tender. You can also expect to pay big bucks for this treatment when your 45-day dry-aged steak finally hits the restaurant grill.

Luckily, dry aging also works at home. Your average refrigerator can maintain the correct temperature range, and although humidity isn't typically as easy to achieve, you can still dry age beef cuts for a week or two to experience the benefits of the process. If we add koji, however, we can speed things up considerably, with the mold adding its glutamate-enhancing powers to those of the natural beef enzymes. Applying the koji spores to the beef is as easy as sprinkling it on, placing the beef on a wire rack in the fridge, and flipping it every couple of days until it starts to dry out and take on nutty, savory, and even sweet, miso-like aromas.

To apply the koji, some people simply sprinkle the spores directly on. No harm in this, but you only need a gram or two per pound of beef for them to do their job, so direct application can be overkill. To better conserve your koji-kin, you can mix the spores with rice flour in about a 1:10 ratio, then drop the beef into a bag with the powder mix and shake it up, evenly coating the surface with spores. Others buy the kome-koji pre-inoculated rice and pulverize it in a blender, and apply it to the beef in much the same way. Also, there's nothing that says the cut of beef must be large. Slicing the beef into cubes before applying the koji powder will allow the spores to break down the beef even faster, as there's more surface area contact.

Aging will happen in a matter of days rather than weeks, and the great thing about this method is that the cut of beef doesn't need to be fancy. Sure, 10-day koji dry-aged bone-in rib roast is incredibly good, but you can also transform an inexpensive chuck roast into something that tastes much pricier, especially when you use a slow-and-low cooking method in conjunction with the dry aging.

And for that matter, the aging doesn't have to be dry for the koji to work its magic—wet aging in a zip bag with or without seasoning is perfectly legitimate as well and will allow you to retain a lot of the moisture otherwise lost to air exposure in the fridge. In general, without the use of koji spores, the difference between wet-aged and dry-aged beef comes down

London broil after three days aging at 37°F (3°C).

Smaller chunks of koji-coated beef age faster.

Sear the koji-aged beef to brown before braising.

Photos courtesy of Amahl Turczyn

Wet-aged braised teriyaki beef.

Barbacoa-style tacos with homemade red corn tortillas.

to strength of flavor and consistency: wet-aged cuts tend to be a bit milder in flavor and retain more moisture, whereas dry-aged cuts take on a more nutty, intense, savory character, and have a firmer texture due to moisture loss. Leaner cuts are therefore a better choice for wet aging, and fattier cuts do better with dry aging. But of course, when using koji to accelerate the aging, wet or dry, these differences become less apparent.

As with any fermentation, monitor progress carefully, and if at any point you detect ammonia, rancid or rotten aromas, throw it out and start over. You only want one kind of mold growing, and that's koji.

Ferment This!

Koji-Aged Braised Beef Tacos, Barbacoa-Style

Recipe by Amahl Turczyn

This is one of my favorite ways to make tacos, and while traditional *barbacoa* involves digging a pit and slow-roasting the meat wrapped in banana leaves, a slow-cooker braise at a low temperature for four to six hours achieves meltingly tender results without the shovel work. I do recommend preparing a sauce paste called *adobo* in advance; the one I prefer is made from dried New Mexico red chilies, which can be purchased from Latin foods markets in a range of heat levels. Look for soft, flexible pods—that usually means they haven't been sitting on the shelf for very long and will have a fresh, vibrant aroma and flavor. Adobo is quite a versatile seasoning paste, and it keeps in the fridge for months. That and a good, rich, gelatinous stock makes up the bulk of the braising liquid, and lends a rich, complex chile flavor to the koji-aged taco beef.

INGREDIENTS FOR ADOBO

Makes about 1 quart

2	5-oz. packages dried red New Mexico chilies
1 head	fresh garlic, peeled
2 tsp.	(6 g) Mexican oregano
2 tsp.	(6 g) whole black peppercorns
2 tsp.	(6 g) whole cumin seed
2 tsp.	(6 g) whole coriander seed
½ tsp.	(3 g) salt, or to taste
1 tsp.	(3 g) whole allspice berries
1 cup	(237 ml) cider vinegar
1	small can chipotle chilies in adobo sauce (optional)

INGREDIENTS FOR TACOS

2 lb.	(0.9 kg) well-marbled chuck, cut into 2-inch cubes
2 g.	Koji kin blended into 20 g rice flour
OR 20 g.	kome koji, processed into a fine powder in a spice grinder or blender
6 oz.	(170 g) unsalted Mexican seasoning blend (optional)
16 fl. oz.	(474 ml) unsalted, gelatinous stock (beef or chicken)
8 fl. oz.	(237 ml) prepared adobo sauce
2 tsp.	(6 g) Mexican oregano
4–6	cloves fresh garlic, peeled and roughly chopped
3–4	bay leaves
½	large onion, peeled and roughly chopped

Avocado oil as needed to brown the meat

Salt to taste

DIRECTIONS FOR ADOBO

Prepare the adobo well in advance of making the tacos. Toast the whole spices (pepper, cumin, coriander, allspice) in a skillet until they just begin to release their fragrance, then pulverize them in a spice grinder or mortar and pestle. Set aside and allow to cool. Stem and seed the whole dried chilies. Get the skillet very hot and press each chile against the hot pan with a spatula just until it begins to blister on each side—don't let them burn. (This is good to do outdoors, as you may generate some spicy smoke!) This toasting enhances the chile flavor and prevents bitterness. Place the toasted chilies in a large jar and cover with boiling water. Make sure all the chilies are submerged and allow them to soak in the liquid for two to three hours (this long soak also keeps the adobo from being bitter). Remove chilies, reserving soaking water. Process in a blender with the remaining ingredients, adding just enough soaking water to keep the blades spinning. You want the sauce thick, about the same consistency as ketchup. Press mixture through a fine-plate ricer or food mill to remove chile skin and any remaining seeds, or alternatively, press it through a large sieve with a spatula, discarding the remaining chaff. Stir in salt—about a half teaspoon per quart should be plenty. Jar up the smooth paste in small jars and refrigerate. I usually heat each jar in the microwave until the adobo begins to bubble, then screw on the lids tightly. This way, the jars will seal well and keep much longer in the fridge.

DIRECTIONS FOR TACOS

Slice the well-marbled chuck into two-inch cubes. Shake the cubes in a bag with koji powder until meat is evenly coated. Place the coated cubes on a rack in the coldest section of the fridge for five to seven days to dry age. One day prior to cooking, add the Mexican seasoning (the bulk blend from Sprouts Farmers Market works well) in a bag, shake to coat, and refrigerate overnight. About six hours prior to serving finished tacos, heat a large carbon steel or cast-iron skillet until smoking. Add a few tablespoons of avocado oil followed by the beef. Work in batches if possible, as you want the beef to sear, not simmer. Cubes do not have to be cooked through, just browned on the outside. Add browned meat, onion, bay leaves, garlic cloves and Mexican oregano to a slow cooker, then add the adobo. Deglaze the skillet with the stock, then add that to the slow cooker to cover the meat about halfway. Cover and cook on low for five to six hours, or until the beef is tender. Serve with fresh corn tortillas, pico de gallo, guacamole, and fermented hot sauce (or your preferred taco toppings).

It is generally recommended to keep home aging to a week or less and always at or under 40°F (life begins at 40!) or lower; longer aging will contribute stronger flavors, but they may not necessarily be better. A sticky exterior will form after several days, which can be washed off with cold water if desired. The meat will turn a brownish, greyish color as it ages, which is perfectly fine, but you are welcome to trim off any discoloration as it suits you. Then, add whatever seasoning you choose, cook to your desired level of doneness, and enjoy. Here are some recipe ideas for using your aged beef cuts.

***Amahl Turczyn is editor-in-chief of* Zymurgy.**

Ferment This!

Koji-Aged Braised Teriyaki Beef

Recipe by Amahl Turczyn. Teriyaki marinade recipe courtesy of Momiyo Chikasawa.

This recipe also combines koji aging and slow cooking, but also involves a marinade.

INGREDIENTS FOR TERIYAKI MARINADE

1 lb.	(454 g) sugar
16 oz.	(454 g) soy sauce
4 oz.	(113 g) grated or finely chopped fresh ginger root

INGREDIENTS FOR BEEF

2 lb.	(0.9 kg) London broil or lean chuck, cut into 2-inch cubes
2 g.	koji kin blended into 20 g rice flour
OR	
20 g. kome koji	processed into a fine powder in a spice grinder or blender
4–6 cloves	fresh garlic, peeled and roughly chopped
3–4	bay leaves
½	large onion, peeled and roughly chopped
16 fl. oz.	(474 ml) unsalted, gelatinous stock (beef or chicken)
6	hot red *takanotsume* chilies (or equivalent), optional
1 tsp.	sesame oil
Black pepper to taste	

To make the teriyaki marinade, combine equal parts white sugar and soy sauce (Kikkoman low-sodium works well) in a heavy saucepan. Stir to dissolve and bring to a simmer, but watch carefully as the mixture approaches boiling. (Stovetop boil-overs of teriyaki sauce are about as much fun to clean up as homebrew boil-overs.) Add the chopped ginger. Simmer the mixture for 20 minutes, then strain and jar for later use. I usually heat each jar in the microwave until it begins to bubble, then screw on the lids tightly. This way, the jars will seal well and keep much longer in the fridge.

To make the teriyaki beef, shake the cubed beef in a bag with the koji powder until meat is evenly coated. Seal bag and place in the coldest section of the fridge for five to seven days to wet-age. One day before cooking, add the sesame oil, black pepper, and chopped garlic to the bag and shake to coat. Then seal the cubes in the bag with eight ounces of cold teriyaki marinade, making sure to squeeze out any air bubbles to maximize contact. (For a Korean spin on this recipe, you can substitute home-fermented *gochujang* for the teriyaki marinade.) About six hours prior to cooking, remove the beef and discard the marinade. It is not necessary to sear the meat (it will burn with all that sugar anyway). Place drained cubes in a slow cooker with the onion and red chilies (if using). Pour in enough stock to cover the meat about halfway. Cook on low for five to six hours or until meat is tender. Serve over rice and garnish with scallion and sesame seeds, or preferred toppings.

Ferment This!

Koji-Aged Dry-Rub Tri-Tip Roast

Recipe by Amahl Turczyn

This is a super-simple recipe for roast beef that incorporates a dry rub and dry cooking as opposed to braising in a slow cooker. The koji aging enhances the flavors of the beef, and along with slow-and-low roasting, plus careful slicing across the grain when serving, encourages a delicious and tender result. Start with a three-pound (1.36-kg) tri tip. It's a fairly well-marbled, relatively inexpensive triangular cut that usually comes bagged, and with a thick fat cap. You'll need to trim off this cap (or have your butcher do it), as you don't want the fat or silver skin. Once trimmed, sprinkle or shake on your koji until the surface of the meat is evenly coated on all sides. Let the meat rest and absorb the koji powder while you make up the dry rub.

INGREDIENTS

1 3-lb.	(1.36-kg) tri tip, trimmed
1 Tbs.	(6 g) whole black peppercorns
1 Tbs.	(6 g) whole coriander seed
1 Tbs.	(6 g) smoked paprika
1 Tbs.	(6 g) paprika
1 Tbs.	(6 g) onion powder
1 Tbs.	(10 g) salt
1 Tbs.	(10 g) sugar
3	cloves garlic, peeled
1	(about 10 g) large sprig fresh rosemary, leaves only
Cayenne pepper to taste (optional)	

For the dry rub, toast the whole spices in a skillet until they begin to release their fragrance, then pulverize them in a spice grinder or mortar and pestle with the garlic and fresh rosemary leaves. Blend in remaining seasonings. Add to a large bag along with the tri tip, which should be sticky enough by now to take the rub. Shake to coat. Meat should have a thick layer of dry rub. Place on a rack in the fridge for five to seven days to dry age. When ready to cook, bring meat up to room temperature and then place on a baking pan. Bake at 225°F (110°C) until the internal temperature at the center of the roast is 130°F (54°C) for medium rare. Remove the roast from the oven, cover with foil, and allow it to rest for 20 or 30 minutes before slicing across the grain and serving. Any leftovers make great sandwiches!

home FERMENTATION DAY

AUGUST 3, 2024

Home Fermentation Day is a time to revel in the joys of fermentation, from familiar homebrewer favorites, like beer, mead, and cider, to the great beyond of fermented drinks and fermented foods.

Get involved!
Get Inspired!

HomebrewersAssociation.org/aha-events/home-fermentation-day

SESSION BEER

TIPS AND TRICKS

Photos © Getty/Rawpixel

By Chris Colby

Session beers are low-gravity, low-alcohol beers. They are beers to have "when you're having more than one," to paraphrase the old Schaefer beer ads. The dividing line between session beers and regular-strength beers is debatable. Often, any beers under 5% alcohol by volume are thought of as session beers—or at least "sessionable." In this article, I mostly focus on beers with 3.2–4.6% ABV. →

Just because session beers are smaller than other beers doesn't mean that they require less attention during brewing. In fact, some alterations to your usual homebrewing procedures are likely to result in better beer. Here are some suggestions.

LIMIT WORT COLLECTION

Session beers are brewed with less grain than stronger beers. As such, the volume of sparge water used to rinse the grain bed should be correspondingly limited to avoid extracting tannins from the grain. Excess tannins cause astringency in the beer. In some cases, the final amount of wort a brewer yields from running off the mash will be less than the desired batch size volume.

If you fly sparge, monitor the runnings and quit collecting wort when the pH has risen to 5.8 or the specific gravity (SG) has fallen to 1.008 (2°P). If you batch sparge, you should yield around 0.65 gallons of wort per pound of grain (5.4 L/kg).

For beers below an original gravity (OG) of 1.045, you will have less pre-boil wort than is usual for an average-strength beer. For example, for a five-gallon (19-L) batch at OG 1.045, you will likely only have 5.25 gallons (19.8 L) of pre-boil wort. If you employ a standard 60- to 90-minute boil, you will likely end up with only 3.75–4.25 gallons (14.2–16.1 L) of wort. For a five-gallon (19-L) batch at OG 1.034, you will likely only have four gallons (15 L) of pre-boil wort. (The "likely" in all these sentences indicates that there are variables that will influence your results, and your volumes and gravities may differ slightly from these figures.)

There are three possible ways to deal with this, two of which are much better options than the third. First, if you have room in your kettle, simply add water before the boil. Top off until you have enough pre-boil wort to yield your intended post-boil batch volume. Typically, homebrewers boil 6–6.5 gallons (23–25 L) of wort for 60–90 minutes, yielding five gallons (19 L) of post-boil wort.

> "Just because session beers are smaller than other beers doesn't mean that they require less attention during brewing.

Secondly, you can boil the wort at its reduced volume and then add water afterwards. For example, if you yield 4.5 gallons (17 L) of post-boil wort, add 0.5 gallons (1.9 L) of water to make five gallons (19 L). A side benefit of this approach is that the top-off water can be chilled to help cool the wort down faster. The top-off water can be added to the post-boil wort in the kettle or to the cast wort in the fermenter.

The third possible way of dealing with this is to make the wort and ferment the beer at the diminished volume, then add water at packaging. This is a hassle because you should use de-aerated water or else you are priming your beer to spoil more quickly. You can de-aerate water by boiling it, then rapidly cooling it without splashing. Still, if your limiting factor is fermenter space and you plan to consume the beer quickly, it's an option.

NO-SPARGE WORT COLLECTION

The wort for session beers can be produced using the so-called no-sparge method. This method is less time consuming than fly sparging or batch sparging, but results in slightly lower extract efficiency. It is impractical for larger beers because the mash tun needs to be able to hold the full pre-boil wort volume plus the grain solids, but for smaller beers it can make sense.

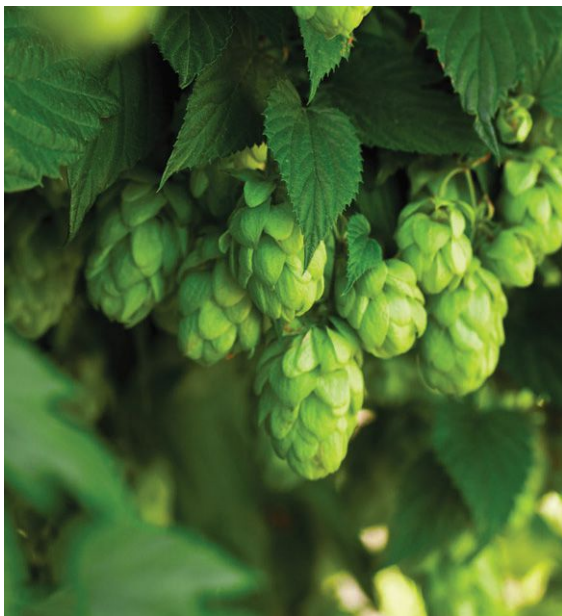
In no-sparge brewing, the grist is mashed at the usual mash thickness. Then, prior to running the wort off, a volume of water is added to the mash. (For some reason, this water is not called sparge water.) This water addition can be heated so that it also mashes out the grain bed—in other words, raises the mash temperature to around 170°F (77 °C). Then, after the mash settles and is recirculated, the wort is all run off quickly.

To do this properly, the brewer needs to know three things: target pre-boil wort volume, how much water will be absorbed by the grain, and how much strike water was used. Usually, the grains will absorb around 0.5 qt. of water per pound of grain (one L/kg). So, the amount of water to add to your mash tun, after mashing, is:

"not sparge" water volume = intended pre-boil wort volume - strike water volume + volume of water absorbed by grain

EXTRACT BREWING

For extract brewers—and especially for those interested in trying all-grain brewing—performing a partial mash is a good idea. Line a two- or three-gallon (7.6–11 L) beverage cooler, the kind with a spigot, with a nylon grain bag to make a small mashing vessel. From it, you can yield 2.6–3.9 gallons (9.8–15 L) of wort (from the two- or three-gallon coolers, respectively) at about SG 1.042. This wort diluted to five gallons (19 L) makes a wort



of SG 1.022–1.033—most of what you would need for many session beers. Just add malt extract to hit your target OG.

Partial mashing is another good idea for certain session beers because some low-gravity English ales call for malts such as amber and brown. These malts need to be mashed, not just steeped, so partial mashing is a good way to incorporate them into your beer while keeping the brewing process on your stovetop.

LOWER YOUR PITCHING RATE

These days, homebrewers can buy packages of yeast with very high cell counts. This is great for most beers, but might be excessive for a session beer. Elevated pitching rates can lead to higher rates of attenuation—something that isn't desired in many session beers, where higher-than-average residual carbohydrate content can provide heft and balance.

The best way to deal with this takes a bit of effort. Use your favorite online pitching calculator and determine the yeast starter size required to propagate this amount of yeast. Pitch a small amount of yeast, not the entire pack, to a starter of that size, and let it ferment. Keep in mind that aiming a little low on your pitching rate can be a good thing, as it limits attenuation.

An easier way to do this is to see how many yeast cells the package contains, and add only a portion of the package. This is fairly easy with dried yeast, but more difficult with liquid yeast, as you need to ensure the culture is relatively homogenous—in order words, that you aren't pouring clear wort off clumps of settled yeast.

LOWER CARBONATION LEVELS

High levels of carbonation detract from the perceived body of a beer. Carbonating these beers to a lower level will help them taste more full-bodied. Low carbonation levels are also typical of many traditional session beer styles. For example, British pub ales often contain about 2.2 volumes of carbon dioxide (CO_2), compared to the usual 2.6 volumes for a typical craft beer or American Pilsner. If you want to further enhance body and mouthfeel, and happen to have a stout faucet on your dispense system, pushing the beer with a mixture of nitrogen and CO_2 can give low-gravity session beers a creamy mouthfeel.

Almost every article on brewing session beers gives instructions on how to make them more flavorful and have more body. However, if you are formulating your own beer, you should ask yourself, "How much flavor and body does this beer really need?"

Sprinter's Stout

Recipe by Chris Colby

This is a dry stout reminiscent of Murphy's. The recipe is designed to yield 6.7 gallons (25 L) of beer, but is brewed as a five-gallon (19-L) batch—on a normal five-gallon (19-L) homebrew setup. It is brewed using a 45-minute mash, the no-sparge method of wort collection, and a 60-minute boil, so it makes for a relatively short brew day. This dry stout is meant to be, you know, dry—hence the low mash temperature, restrained use of crystal malt, presence of sugar (as an adjunct), and relatively high level of carbonation.

Batch volume:	6.7 U.S. gallons (25 L)
Original gravity:	1.052 (12.75°P) before dilution 1.038 (9.5°P) after dilution
Final gravity:	1.007 (1.75°P)
Efficiency:	75%
Color:	44 SRM
Bitterness:	34 IBU
Alcohol:	4% by volume

FERMENTABLES

6 lb. 4 oz.	(2.8 kg) English pale ale malt
1 lb.	(0.45 kg) cane sugar
15 oz.	(425 g) roasted barley (500 °L)
5.5 oz.	(156 g) chocolate malt
2.5 oz.	(71 g) dark crystal malt (90 °L)

HOPS

1.2 oz.	(34 g) Target or other English hops, 10% a.a (34 IBU) @ 60 min

YEAST

White Labs WLP007 (Dry English Ale) yeast
A 1.3-qt. (1.2-L) yeast starter is recommended.

WATER

Ca 80 ppm, Mg 20 ppm HCO_3, 180 ppm.
You'll need about 8 gallons (30 L) for the strike water and the "no sparge" sparge water.

OTHER INGREDIENTS

0.33 tsp.	(1 g) yeast nutrient
6.7 oz.	(190 g) corn sugar (to prime bottles to 2.6 vol. CO_2)

BREWING NOTES

Make the yeast starter two days before brewing. Mash grains at 150°F (66°C) in 12 quarts (11 L) of water for 45 minutes. Add 16 qt. (15 L) of water at 185°F (85°C) to mash out at around 168°F (76°C). Stir the mash and let settle. Recirculate the wort, then run it off. Boil the wort for 60 minutes, adding hops at the beginning of the boil. Stir in sugar and yeast nutrient during the final 15 minutes of the boil. At this point, you should have five gallons (19 L) of wort at around SG 1.052 (12.75°P). Add 6.8 qt. (6.4 L) of cool water to the kettle, to make 6.7 gallons (25 L) of wort. Chill the wort and rack 3.33 gallons (12.5 L) of wort to each of two five-gallon fermenters. Aerate well, pitch yeast (half to each fermenter), and ferment at 70°F (21°C). Keg or bottle condition. You can keg this beer and push it with nitrogen if you like, but I think it tastes better with CO_2. Note that the amount of corn sugar called for is to prime 6.7 gallons (25 L) of beer, not five gallons (19 L).

MALT EXTRACT OPTION

Reduce the amount of English pale ale malt to 4 lb. (1.8 kg) and add 2 lb. (0.91 kg) of light liquid malt extract. Partial-mash the pale ale malt in a 2-gallon (~8-L) beverage cooler. Collect 2.6 gallons (9.8 L) of wort from this mash. Add water to make five gallons (19 L). Steep the crystal malt and dark grains in your wort as you heat it to a boil. Stir in malt extract near the end of the boil.

The "volume" of flavor in food isn't correlated to its quality. Potatoes and baked white fish are two examples of foods people love, but that aren't necessarily bursting with flavor.

Likewise, in the beer world, helles is a crisp, refreshing beer. It doesn't knock you over with flavor or give the impression it is full-bodied, but it is nonetheless an excellent beer style. So when considering ways to decrease fermentability, decrease attenuation, and increase mouthfeel, also consider whether doing so will actually make your beer better. Session beers aren't meant to be sipped like barleywine, after all. It's OK if their overall flavor profile and body make them more "quaffable."

MORE BEER, SAME EFFORT

The biggest "trick" when brewing session beers is to make a greater volume of beer than usual, while putting in roughly the same amount of effort. For example, if you usually brew five-gallon (19-L) batches, you can do the following. Start with a grain bed that, when fully sparged, yields 6–6.5 gallons (23–25 L) of wort. This will require 9.2–10 lb. (4.2–4.5 kg) of malt. Boiling 60–90 minutes will yield five gallons (19 L) of wort at an OG of 1.051–1.056 (12.75–13.75°P). Then, dilute the chilled wort down to session-beer strength and transfer it to your fermenter or fermenters. Or, transfer the stronger wort to one or more fermenters and add water. Now you have yielded more than five gallons (19 L) of beer for roughly the same amount of work it takes to make five gallons. All you need is extra fermenter space.

Note that blending with water not only decreases the OG of the wort, it lowers the international bitterness units (IBUs). Plan for that during recipe formulation. The easy way to do it is to formulate your recipe in a beer recipe calculator at your intended finished volume. Then, brew it as if it were a five-gallon (19-L) recipe until after the boil when you add water (see accompanying recipe).

A twist on this trick is to make varying strengths of beer via different dilutions of one wort. For example, let's say you make five gallons (19 L) of wort at an OG of 1.051 (12.1°P). You can split it by adding 2.5 gallons (9.5 L) of wort to two different carboys. To the first carboy, you could add 0.5 gallons (1.9 L) of water, and to the second you could add 0.75 gallons (2.8 L). This would yield worts with specific gravities of 1.043 (10.72°P) and 1.039 (9.75°P). And your total volume would be 6.25 gallons (23.7 L).

British bitters exist in several strengths. So do Scottish ales. You can brew multiple beers of this sort by making a strong wort and diluting portions of it to different original gravities.

SESSION RECALIBRATIONS

Brewing the best session beer requires an understanding of how to handle a smaller amount of grain and wort, and how to pitch less yeast. Limit the volume of sparge water to correspond with the less-weighty grain bill. Limit the pitching rate to account for the lower original gravity. After fermentation, carbonate, or nitrogenate, to a degree that brings out the best in the beer.

Chris Colby has been a homebrewer since the early '90s, when he studied molecular evolutionary genetics at Boston University. After receiving his PhD in 1997, he briefly worked in educational publishing before becoming a beer writer and editor. He is the author of Methods of Modern Homebrewing *(2017),* Home Brew Recipe Bible *(2016), and the Brewers Publications® title* How to Make Hard Seltzer: Refreshing Recipes for Sparkling Libations *(September 2020). He lives in Bastrop, Texas, with his wife and many cats.*

HOMEBREWING with IoT and AI

PRECISION AND CONSISTENCY

BY AURELIO GONZALEZ

Illustration © Getty/olga_hnelevska

My journey into the world of brewing beer didn't start in some fancy brewery—it all kicked off with a bit of luck and a whole lot of fun after catching a Chicago Bulls game with my mom and brother. You can just imagine my mom cheering the team on, sporting a Benny the Bull mask, and my brother and I, fueled by stadium beers, craving some grub at Lucky's Sandwich spot in Wrigleyville. And that's where we stumbled upon a brew called Anti Hero—an IPA that blew our minds.

I soon found myself eyeing a Mr. Beer Kit, dreaming of brewing up my own magic at the same time my brother pursued larger brewing ambitions—he announced he'd be diving into the craft beer industry back in Mexico City. With his knack for design and branding, he quickly found success, and before we knew it, his operations in Querétaro started to bloom into a craft beer business. Although it was a team effort to make it work, we decided to close it after running into some local snags. It was disheartening after such a promising start.

Instead of quitting, my brother tried again. Persistence runs in our family. I backed up his decision to focus his ideas and business acumen into making Cerveceria Fausto in Monterrey, Mexico one of the best craft breweries in town.

Meanwhile, I found my groove as a homebrewer. Armed with a passion for tinkering and a dash of information technology experience, I began whipping up quality beers on an amateur scale. My local homebrew shop Perfect Brewing Supply fueled my obsession, and North Urban Brewing Society (NUBS), the coolest brewing club around, offered incomparable support.

I'd found my tribe. I was juggling tech jobs by day and brewing up legendary liquids by night. Between coding and concocting suds, I saw an opportunity to automate the brewing process with cutting-edge information technology. Such an approach might one day be beneficial to my brother's brewing operations at Cerveceria Fausto, but I needed to hone my process first.

EMBRACING IOT IN THE BREWING PROCESS

My decision to incorporate Internet of Things (IoT) devices into my brewing stemmed from a desire for automation in two fundamental aspects of the process: consistency and precision. Recognizing the significant impact even minor fluctuations in temperature or specific gravity could have on the final product, I sought IoT solutions to monitor and regulate these and other crucial parameters. After experimenting with various devices, including one that counted bubbles from an airlock (which proved imprecise due to potential leaks), I found Tilt to be the most effective.

The Tilt hydrometer stands as an indispensable tool tailored specifically to the homebrewing community, providing a seamless experience to monitor a brew's specific gravity and temperature. Compatible with a wide array of devices, including Apple iPhones/iPads, Android smartphones/tablets, and the Tilt Pi, it harnesses the power of Bluetooth 4.0+ technology to deliver real-time data directly to a brewer's fingertips (see Figure 1).

One of its most notable advantages is facilitating the brewing process without the need for frequent intervention, specifically its ability to remotely monitor fermentation. This not only ensures the integrity of the brew, but also streamlines the brewing workflow, making it more consistent and manageable.

I recognized IoT devices such as Tilt could potentially revolutionize my brewing experience, but I knew I could continue making improvements and extend Tilt's usefulness even more. For example, I developed an automated alert system that notifies me of deviations in temperature or specific gravity, enabling swift intervention. IoT devices excel at generating valuable data, which serves as the foundation for my automation system and provides invaluable insights for forecasting future outcomes and optimizing processes.

ADAPTING THE TILT 2 PRO DEVICE FOR BETTER BREWING

A big moment for me as a brewer was finding a way to make the Tilt 2 Pro device send its data directly to the Microsoft Dataverse using Power Automate, with just a bit of tinkering instead of heavy coding. This change made it much easier to get all the data into a place where I could thoroughly analyze it and take action quickly if needed. With this setup, I could spend more time being creative with my brewing,

Figure 1: Tilt Pro Wireless Hydrometer and Thermometer.

```
function callAPI(parameters) {
  // Define the API endpoint URL
  var apiUrl = "{YOUR POWER AUTOMATE FLOW URL}";


  // Convert parameters to JSON string
  var payload = JSON.stringify(parameters);

  // Make the API call
  var options = {
    "method": "post",
    "contentType": "application/json",
    "payload": payload
  };

  var response = UrlFetchApp.fetch(apiUrl, options);
  var responseData = JSON.parse(response.getContentText());

  // Log the response
  Logger.log(responseData);
}
```

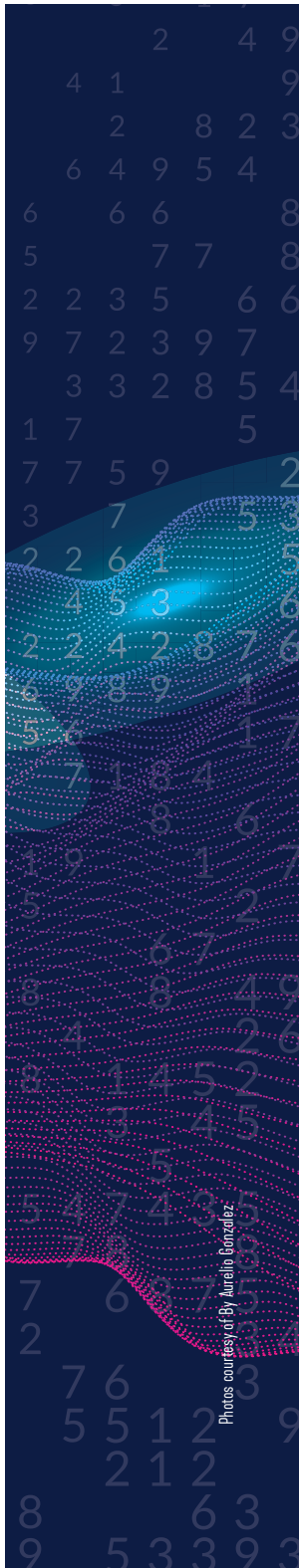
Figure 2: ChatGPT-generated Google app script.

knowing that the tech side was under control. Even though I know a bit about coding, the tools I used are made for people who aren't tech wizards but still want an automated system.

Power Automate is a tool that helps you automate tasks and processes without needing to write a lot of code. It's like having a digital assistant that can handle repetitive tasks for you, freeing up your time for more important things, like perfecting your brew.

Dataverse, on the other hand, is a user-friendly database service. It's designed to help you create and manage robust data solutions without needing advanced technical skills. Think of it as a virtual filing cabinet for all your data, making it easy to organize, analyze, and use in your projects.

Normally, the Tilt system uses a Google app to handle reports and data. But it's flexible enough to let you connect it to other systems, or even create your own solutions if you understand the nature of how Tilt works.



Photos courtesy of By Aurelio Gonzalez

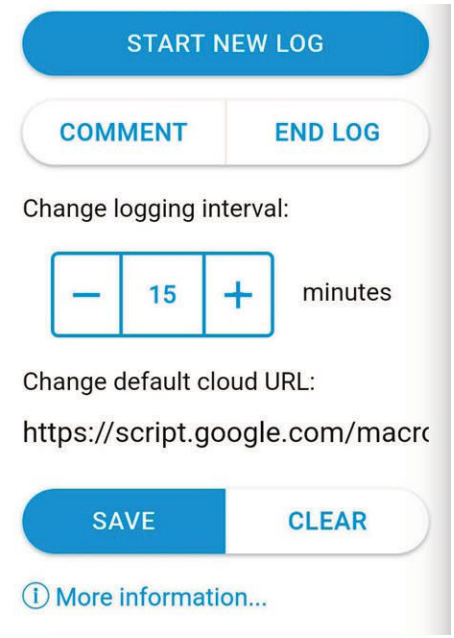


Figure 3: You can connect Tilt directly to tools like Power Automate Flow.

There are two ways to do this customization. The first way involves tweaking the Google app script provided by Tilt by adding a function. This function then sets off a Power Automate Flow, which takes care of putting the data into another database, like Dataverse. Since I don't know how to write Google app script, I used ChatGPT to help me generate the code I needed. Once I had it, I just copied and pasted it, gave it a test run, and it worked perfectly (see Figure 2).

The second way skips the Google app script and uses Tilt's ability to connect with other apps. By just pasting in the URL of the Power Automate Flow, you get the same results without having to change any code (see Figure 3).

Power Automate itself is a handy tool that lets you create automated processes without needing to do a ton of coding. It starts by getting data from the Tilt device, such as the name of the beer, the specific gravity (SG), the date it was brewed, fermentation temperatures, and any extra notes. Then, you set up rules to decide when to send alerts: for example, if the SG drops too low, if the temperature gets too hot or cold, or if the SG stays the same for too long. This setup is really flexible, letting you customize things like connecting with other smart devices to adjust the temperature automatically, or rousing the beer to help the yeast do its job. There are tons of possibilities, letting you tailor how you monitor and control things based on your brewing needs. See Figure 4 for an example of the Power Automate user interface (UI).

MACHINE LEARNING FOR BREWING OPTIMIZATION

Machine learning (ML) is a type of technology that allows computers to learn from data and make predictions or decisions without being explicitly programmed to do so. ML has the potential to optimize how we brew beer, even those of us who aren't tech wizards. Essentially, it's like teaching a computer to recognize patterns and make decisions based on those patterns. When we make beer, things like temperature, yeast type, sugar levels, and how long we ferment all affect the final product. Using ML helps us understand and improve this process in a big way.

You start by connecting your brewing equipment to smart devices that collect data on everything that happens during mashing, lautering, fermenting, lagering, and conditioning. ML then analyzes this data to predict how your beer will turn out and helps you adjust in real time. This means you can make beer more consistently and improve your understanding of each brewing process by changing one variable at a time and allowing ML to forecast how this change will affect the quality of the final beer.

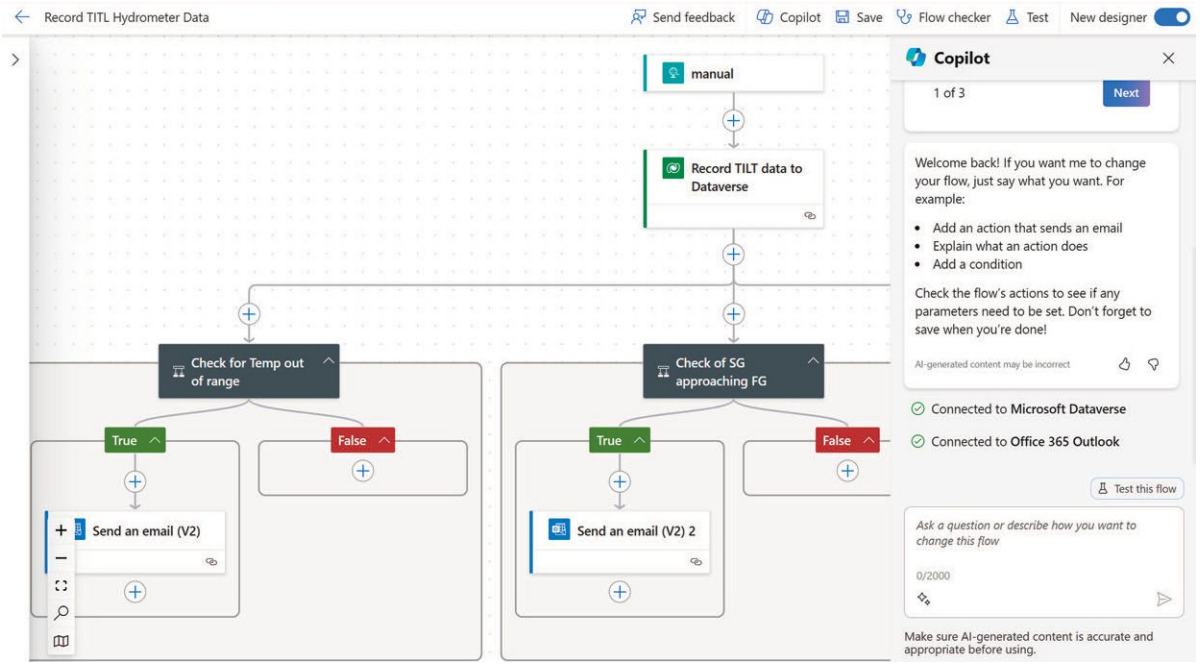


Figure 4: Power Automate user interface.

Whether you are a homebrewer, or particularly if you are a craft brewer, ML tools are game changers. Here are a few reasons why.

- ***Predicting How Your Beer Will Turn Out***: ML can create models that tell you things like how strong your beer will be, or what flavors it will have, based on the initial recipe. This helps you use your resources more efficiently and make better beer.
- ***Finding the Perfect Conditions***: ML can figure out the ideal range of factors such as temperature and acidity during mashing, sparging, boiling and fermentation that results in the exact beer qualities you want. This means you waste less time and use fewer ingredients figuring it out yourself.
- ***Spotting Problems Early***: ML notices if something weird is happening during fermentation—for example, if the temperature suddenly drops or spikes. Catching these issues early can prevent you from potentially ruining a batch of beer.
- ***Making Beers People Will Love***: ML can analyze people's beer preferences by looking at reviews and sales data. What styles are people enjoying in a certain region of the world? What are the latest trends and fads? While this is particularly important for craft brewers trying to compete for sales in a crowded, maturing market, homebrewers can also benefit from ML feedback to know what beers are currently popular or might place highest in competitions.
- ***Being Smart with Ingredients***: ML can help you track how much of each brewing ingredient you need. This helps reduce waste, lower your carbon footprint, and brew more sustainably. For both craft brewers and homebrewers, ML can tap into the current supply chains for hops, malt, CO_2, and more to predict what's available and where future supply bottlenecks might crop up.
- ***Brewing Greener***: ML can help you monitor water and energy use necessary for the brewing process, and even predict how much brewery waste (e.g. wastewater, spent grains, spent hops and trub, CO_2, and sulfur dioxide) your process is generating. Taking steps to reduce or repurpose this waste is good for the planet and saves money. If you're a larger-scale craft brewer, it's also good for maintaining compliance with city and state laws and maintaining a respectable reputation.

One of the things I'm interested in doing at my brother's brewery back in Monterrey is making the operation more sustainable. But to do that I need to learn from my home brewery first. I would start by collecting data from several batches of beer, recording everything from initial ingredient quantities to minute-by-minute temperature and pH levels during fermentation.

Using this data, an ML model would be trained to understand how these variables affect energy and water usage. The goal is to discover patterns and optimal conditions that consistently produce the highest quality beer with the lowest environmental impact.

For instance, the model might find that lowering the fermentation temperature at a specific stage reduces the amount of time the cooling systems are needed, thereby saving energy. Similarly, it might identify that certain yeast strains are more efficient at converting

Clockwise from top left: yeast starters; Cervecería Fausto in Monterrey, Mexico; Perfect Brewing Supply in Libertyville, Ill.; the North Urban Brewing Society (NUBS) at Big Brew.

sugars into alcohol at specific temperature or pH ranges, which could reduce the length of the fermentation cycle and thus, the overall energy and water required.

After identifying the best conditions, I could then incorporate them into the brewing process. The ML model continuously enhances its predictions with new data, thereby consistently boosting efficiency (see Figure 5). Once successfully trained, the model can then be used to ensure consistent beer quality rather than relying on manual adjustments throughout the brewing process for a specific style. It can then be expanded to various other beer styles and applied across different brewing sites with different brew system parameters.

The catch is, to make all this happen, we need good data, and lots of it. The more details we have about how we brew and what we end up with, the better ML can help us brew beer like never before.

LESSONS LEARNED

This journey of integrating technology into the brewing process has been filled with learning and discovery. The most significant lesson has been the importance of balance: balancing tradition with innovation, art with science, and intuition with data. Embracing IoT and artificial intelligence (AI) has not replaced the artisanal spirit of brewing; rather, it has augmented it, allowing for greater precision and consistency.

Another key takeaway has been the value of adaptability. In a field as dynamic as brewing, being open to new methods and technologies can lead to unexpected and rewarding outcomes. Finally, this journey has reaffirmed the importance of community. Sharing insights, challenges, and successes with fellow brewers has enriched my experience and contributed to a collective advancement of the craft.

As I continue to explore the intersection of brewing and technology, I am excited about the future possibilities. The fusion of IoT and AI with traditional brewing techniques is not just enhancing the quality of beer, but also paving the way for innovations yet to be imagined.

Aurelio Gonzalez is a Microsoft architect who focuses on low- and no-code technologies. He loves using technology in the brewing process and is always looking to experiment with new recipes and barrel aging—so he can share the results with his brew club, the North Urban Brewing Society (NUBS) of Lake County, Ill.

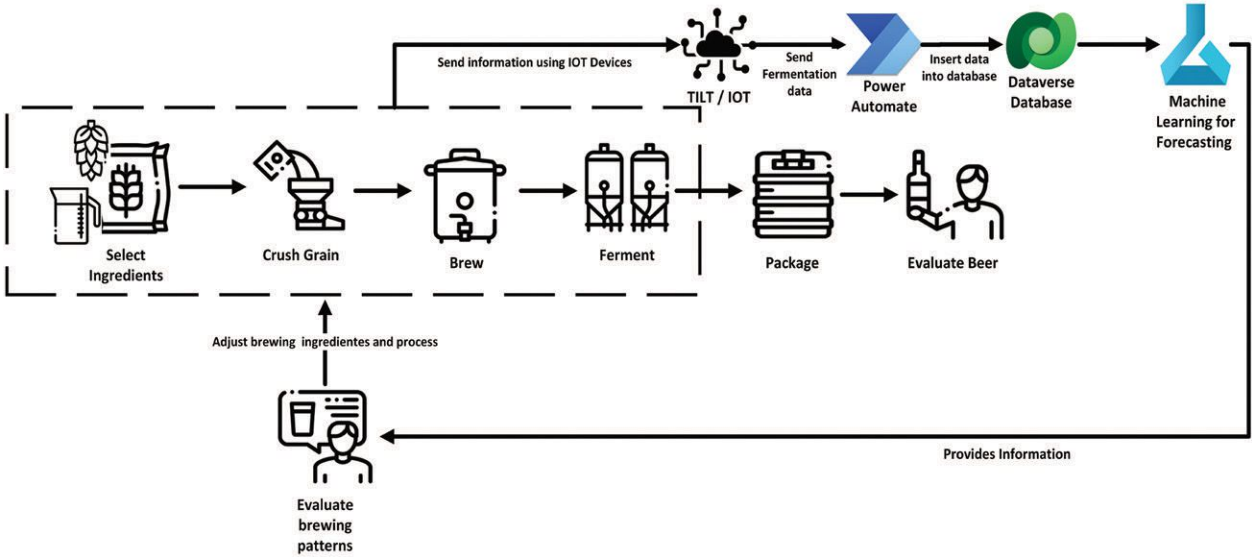
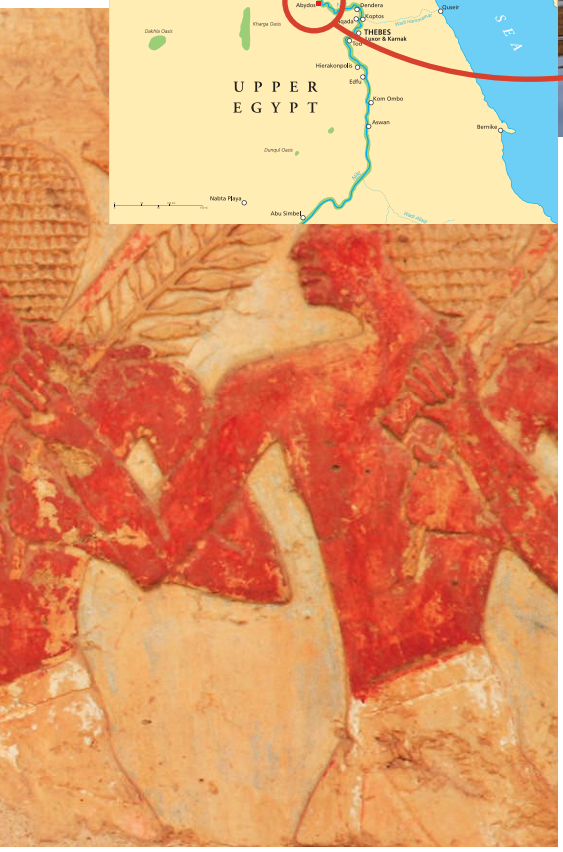


Figure 5: Machine learning models depend on good data, and lots of it.


Abydos, Egypt



Photos © iStock/roverof forever (hieroglyphics); PeterHermesFurian (map); isanchez_bcn (Abydos)

EGYPTIAN DRUM ROASTING

An Invention that Changed Brewing History

By Luis M. Hernandez

The importance of beer in Egyptian culture is no mystery. The ancient cultures of Egypt and Mesopotamia were credited with being among the first to brew beer. Mesopotamian and Sumerian peoples are recognized as the true inventors of the process, but the Egyptians are thought to have made alterations and improvements to create a smoother, lighter beer, and archaeological digs suggest they were the first to produce beer on a large scale. The oldest known brewery in the world was unearthed at an old cemetery site by American and Egyptian archaeologists in February, 2021, in Abydos, Egypt. The brewery is believed to be more than 5,000 years old, and to have had an impressive production capacity of up to 5,900 gallons (22,400 liters) at a time. This brewery goes back to King Narmer's era, around 3,150 BC. →

EGYPTIAN BEER

Beer was the most popular drink in ancient Egypt. It was not only used for special occasions and royal rituals, it was also consumed by people of all ages and social classes. This liquid bread was a major part of Egyptian festivals, such as the *Tekh* Festival, roughly translated as the Festival of Drunkenness. Beer's invention was attributed to Egyptian god Osiris, and as a staple food of the culture, beer was also used as compensation for workers. The first documented strike in history occurred in the 12th century BC during the reign of Ramses III, when the builders of his tomb decided to stop their work due to a delay in their pay, which included beer. It is also documented that the laborers who built the pyramids of Giza were given a daily ration of beer.

The Egyptian love for beer did not go unnoticed, and many classical Greek writers erroneously credited the Egyptians with its invention—they called Egyptian barley beer *Zythos*, which referred to its tendency to foam.

Modern homebrewers might have a difficult time recognizing this ancient beverage as beer, however—while the brewing process probably bore some similarities to modern practice, the end result was somewhat different from today's beer. Egyptian brewers used emmer barley (also known as farro), an ancient grain native to the Fertile Crescent, along with wheat, dates, and flavorings such as rose petals. But Egyptian beer lacked hops and was not boiled. The fermenting vessels used were fired clay jars, and it's thought that their porous interiors harbored wild microbes for fermentation. Because the liquid within these jars permeated through to the jars' exterior surface, some evaporation likely took place during fermentation. This allowed the vessel's internal temperature to stay cooler than the ambient temperature of the brewery, which provided some control of fermentation temperatures in the hot and arid climate.

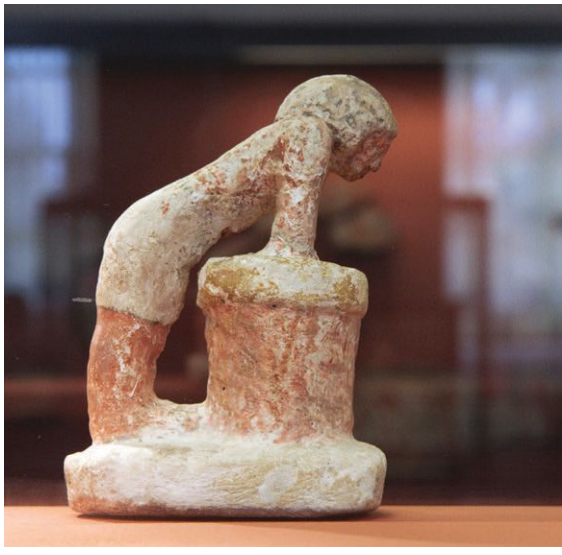
Information gleaned on ancient Egyptian brewing techniques has been greatly dependent upon wall paintings and statuettes. According to Samuel Delwen, a researcher at King's College in London, one feature of the ancient Egyptian brewing method was the use of a two-part mash for each batch. The first part was done with malted grains held at ambient temperatures to allow for starch conversion by malt enzymes. A second mash conducted simultaneously contained ground, unmalted grains, and was held at much higher temperatures to gelatinize starches. The two mashes were then mixed together, in the way modern brewers would conduct a cereal mash. The mash was then sparged with warm water, and once the hot liquid was allowed to cool, it was strained through cloth into the unglazed pottery jars. These fermentation vessels were then covered with muslin cloth, and both resident and ambient microbes did the rest. Without a boil, enzymes remained active during fermentation, so starch conversion continued as yeast and bacteria worked to convert the sugars, allowing for maximum alcohol content. This "parallel fermentation" is not unlike the method used for Japanese sake, which, as a result, can reach 20% alcohol by volume (ABV).

The beer was probably somewhat tart, dark and bready, and most would be consumed fresh, directly from the clay jars, while it was still actively fermenting. Egyptians used long straws made of clay or perhaps papyrus reeds to drink in communal fashion from the large fermentation jars.

A 2018 recreation of this ancient Egyptian beer by brewer Michaela

Ancient Egyptians attributed the invention of beer to the god Osiris.

Illustration © Getty/MalyshFalko (Osiris); Photo Creative Commons/Rama (statuette)



Statuette of a beer brewer, 2,200 BC, Old Kingdom of Egypt.

Brew This!

Monday Lager

Coffee Lager

Contributed by Pollito Cervecero for *Zymurgy* Magazine

Batch volume: 5 U.S. gallons (18.9 L)
Original gravity: 1.048 (12°P)
Final gravity: 1.010 (2.5°P)
Color: 7 SRM
Bitterness: 19 IBU
Alcohol: 5% by volume

MALTS

7.28 lb. (3.3 kg) Pilsner malt
18 oz. (500 g) Munich malt
9 oz. (250 g) Vienna malt
7 oz. (200 g) flaked barley

HOPS

0.3 oz. (10 g) Magnum, 13% a.a @ 60 min

YEAST

Any neutral lager yeast

ADDITIONAL INGREDIENTS

0.9–1.2 oz. (25–35 g) Oaxacan or Mexican dark coffee, cold brewed

BREWING NOTES

Mash in at 122°F (50°C). Raise to 143°F (62°C) and hold 45 minutes. Raise to 158°F (70°C) and hold 30 minutes. Lauter, boil, chill, and aerate. Ferment at lager temperatures according to selected yeast, usually 48–54°F (9–12°C). When fermentation is complete, rack to secondary. Prepare a cold brew by steeping the ground coffee in cold water for 18–24 hours. Strain out solids and add liquid to secondary according to your preferred strength. Condition at near freezing temperatures for two to six weeks, then package.

Charles from Beerblefish Brewing Company, food historian Tasha Marks, and beer and wine consultant Susan Boyle, in collaboration with the British Museum, concluded that Egyptian brewers created a crisp, refreshing beer without the need for hops, a brew kettle, hydrometers, thermometers, or yeast labs. The process was fast, highly efficient, and resulted in massive volumes of strong beer to satisfy the populace. We can imagine that since the fermentation vessels were too heavy to move or even decant, breweries became gathering places for people to socialize, sip beer, and unwind from the day's work.

The closest thing to ancient Egyptian beer that exists today is called *bouza*. This homebrewed beverage follows ancient, traditional methods, and has a typical strength of 7–10% ABV. One recipe for this beer, written in Greek, sums up the process. It involves malting grains, grinding them into flour, and then making loaves of bread that are only partially baked. Still-active enzymes continue to break down the starches, and when the loaves begin to expand from the fermentation, they are shredded, dissolved in water, and the liquid is strained off into a vessel to complete fermentation. Bouza is often associated with the working class, and is seen as a cheap alternative to commercial beer.

DISCOVERING COFFEE

Egypt has another contribution to the brewing world, however, which goes back to the 16th century. At that time in history, another beverage was brewing up a sensation: coffee. It is said that a group of students from Al-Azhar witnessed people from Yemen drinking a dark liquid before a religious gathering. The students grew curious and asked to try it. The drink quickly became popular in Egypt at religious festivals, and soon coffee shops began to open everywhere, making coffee accessible to the masses. Like the ancient breweries, these cafés became social gathering places where people would meet for coffee (*qahwah* in Arabic) and conversation.

As with craft beer and homebrew, however, some authorities saw the new beverage as dangerous, and even seditious. Some Egyptian monarchs viewed it as being connected to revolution. In 1572, Sheikh Ali Ahmed Sonbati decided coffee was intoxicating and banned it. But despite attempts to cease coffee shop activity, cafés remained popular in Egypt and the Middle East. Such was the popularity of coffee in Egypt that innovations in the art of its preparation were inevitable.

EVOLUTION OF ROASTING

Early methods for roasting were rudimentary. Green coffee beans were placed in a shallow pan, heated directly over a fire, and stirred. Unless skillfully done, this often resulted in an unevenly roasted end product.

Around the 17th century in Cairo, the first revolving cylinder coffee roaster was invented. By means of a crank, the perforated metal cylinder could be rotated with the beans inside, so that they were evenly exposed to heat. The design also made roasting more comfortable for the roaster, since the heat could be better controlled.

In the following years, this design spread rapidly through England to France and the Netherlands, before reaching the European colonies. It underwent some minor improvements along the way, but the main concept remained the same.

Back to the world of beer. In England, circa 1816, it became illegal to add coloring agents to beers, including molasses, which was a popular cost-saving method widely used in the production of porter. Not only did molasses lend porter its dark appearance and flavor, brewers also considered it crucial to bolster the strength of the beer to compensate for the poor-quality, unevenly kilned brown malt available at that time.

The decree represented a massive challenge for brewers, since pale, amber, and brown malts were produced by maltsters using a standard, direct-fire kiln that, much like the rudimentary coffee roasting pan, tended to heat malts and grains

Photo © Getty/Kanawa_Studio

Coffee bean roasting in a clay roasting pan.

Brew This!

Mexa Stout

American Stout with Coffee

Contributed by Benito Brewing Company for *Zymurgy* Magazine

Batch volume: 5 U.S. gallons (18.9 L)
Original gravity: 1.050 (12.5°P)
Final gravity: 1.011 (2.8°P)
Color: 40 SRM
Bitterness: 33 IBU
Alcohol: 5.25% by volume

MALTS

6.9 lb. (3.15 kg) Pilsner malt
11 oz. (300 g) Munich malt
11 oz. (300 g) black malt
11 oz. (300 g) flaked oats
7 oz. (200 g) 60°L crystal malt

HOPS

0.3 oz. (8.5 g) Sabro, 18 IBU, 12% a.a @ 60 min
1.6 oz. (45 g) Sabro, 15 IBU, 12% a.a, whirlpool

YEAST

SafAle US 05

ADDITIONAL INGREDIENTS

0.7 oz. (20 g) lactose, in whirlpool
Yeast nutrient, in whirlpool
Whirlfloc, in whirlpool
0.7 oz. (20 g) coffee, cold brewed
0.5 oz. (14 g) cacao nibs, cold brewed

BREWING NOTES

Mash in at 153°F (67°C) and hold for 60 minutes. Mash out at 158°F (70°C) for 10 minutes. Lauter and boil. Add the lactose during whirlpool. Chill and aerate. Ferment at ale temperatures to completion. Rack beer to secondary. Prepare a cold brew by steeping the ground coffee and cacao nibs in cold water for 18–24 hours. Strain out solids and add liquid to secondary according to your preferred strength. Condition for at least three to four days, then package.

unevenly. Brown malts were often under-kilned, sometimes darker than usual, occasionally burnt, and would frequently force brewers to use extra malt to hit their target gravity. And since brewers were taxed based on the quantity of malt they used, this legislative change threatened to prove very costly for beer producers. Maltsters needed a better solution for kilning grain.

Enter Daniel Wheeler, a British engineer and inventor. He saw how coffee was roasted in one of the Egyptian-designed cylinder roasters, and had the brilliant idea of adapting this coffee technology to the brewing industry. Patented on March 28, 1817, under British patent number

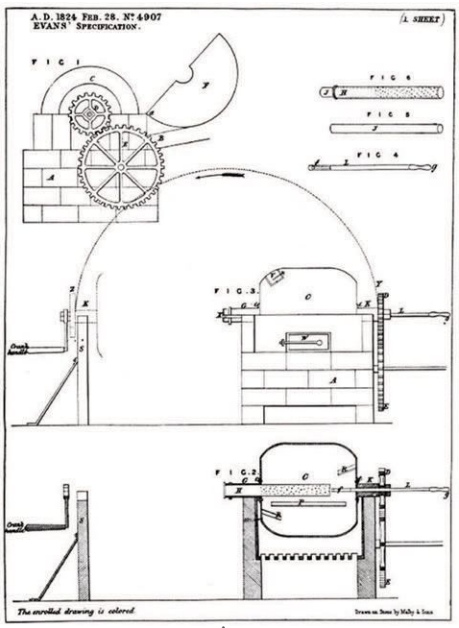
Homebrew-scale rotisserie gas grill drum roasters can be used for kilning, smoking or roasting malt, as well as coffee.

A.D. 1817, March 28.—No. 4112.

WHEELER, DANIEL.—"Drying and preparing malt," so that "the greater part of the saccharine and amylaceous "principles of the grain become changed into a substance "resembling gum, and extractive matter of a deep brown "colour, readily soluble in hot or cold water."—The apparatus may be variously constructed, but must "be capable "of allowing the grain to be sufficiently heated." One way is a cylindrical iron machine or vessel, similar in its construction to that now commonly used with a revolving motion for roasting of coffee. "During the process the machine should be "kept in motion, and with this view the vessel should be "frequently drawn out of the fire at intervals of from one to "five minutes according to the intensity of the fire." Another apparatus may be used consisting "of a hollow cylinder open "at both ends, made to revolve upon pivots or axes, and "having with inside it from one end to the other a screw-like "channel." "The cylinder is placed in a proper fireplace, "and the grain being continually poured into one end of it "and the cylinder kept turning round the grain is progressively carried forwards and delivered at the other end." "If the process be continued too long and the temperature "be raised too high, or the grain be not sufficiently agitated, "its colouring property will be diminished, and ultimately it "will be converted into a coaly substance, insoluble in "water, and of course yielding no colour." "The process "may also be performed in kilns made nearly of the ordinary "construction under proper management."

[*Printed*, 3d. *No Drawings.*]

Daniel Wheeler's 1817 patent for the drum malt roaster.



Richard Evans' roaster patent.

4112, "The Improved Method of Drying and Preparing Malt," better known as the drum malt roaster, worked in the same way as the cylindrical coffee roaster. It allowed brewer's malt to be kilned evenly and consistently, so that less was required to meet target extracts, and brewers could maximize their profits.

Wheeler described his device as "a cylindrical iron machine or vessel similar in its construction to that now commonly used with a revolving motion for roasting of coffee."

Since the first patents for coffee roasters were not filed until 1824 by Richard Evans, and later by James Carter in 1846, we can conclude that the coffee roaster on which Wheeler based his invention was none other than the 17th-century revolving cylinder roaster from Cairo. Wheeler's adaptation of an ingenious Egyptian coffee roasting invention would end up revolutionizing the beer brewing industry.

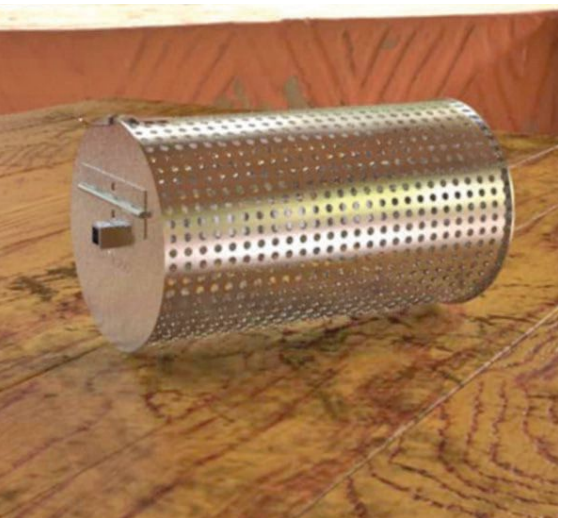
THE REFINEMENT OF MALT

When Daniel Wheeler introduced black patent malt in 1817, the malt bill for most commercially produced porter changed dramatically. Now porter could be brewed mostly from pale malt, elevating the efficiency by nearly 30%. Budget-conscious brewers were quick to embrace patent malts and were extraordinarily successful, so much so that porter brewing became a booming business by the end of the 18th century. Britain's Truman, Hanbury, Buxton and Company became one of the largest breweries in the world by the end of the 19th century with the sales of its porter.

The introduction of the drum malt roaster sparked the creation of Munich and Vienna malts, courtesy of Gabriel Sedlmayr and Anton Dreher, respectively. Those paler base malts made it possible to produce Munich helles and Pilsner, the latter of

A modern Kaspar Schulz kiln at Root Shoot Malting in Loveland, Colo. makes use of the same rotating drum design.

Photo courtesy of Amahl Turczyn (grill drum roaster)



RK Drums 2-lb coffee roaster drum shown with 3/16" hole size. Use 1/16" for best results with barley roasting.

which would go on to become the world's most popular beer style. Modern maltsters still rely on the rotating drum design for everything from sprouting, to drying and kilning, to roasting.

Homebrewers interested in kilning or smoking their own malts can also benefit from Egyptian ingenuity, as there are now perforated stainless steel drums on the market that can be fitted to a standard rotisserie gas grill. And if they happen to enjoy coffee as well as beer, these rotating roasters can easily be used for both beans and grains.

Was it simply oversight that the Egyptians had this drum roasting technology for centuries and never used it for their own beer? Or does it suggest that they liked their beer the way it was?

Regardless, the next time you are enjoying a modern beer style with a malty flavor, you can thank the Egyptians and their love of coffee for your tasty brew.

BIBLIOGRAPHY

Visit HomebrewersAssociation.org/ja24 to view the full bibliography and associated links.

Luis M. Hernandez is an experienced beer sommelier and master brewer. A graduate of Doemens Academy in Munich, he further honed his skills completing the master brewer program at Siebel Institute of Technology, later earning certifications as a Cicerone beer server and barista. He has brewed for Cerveza Cumbre and Grupo Cervecero Cadereyta, and has served as a beer industry consultant. He is currently writing a book on coffee beers.

Photo courtesy of RK Drums


FROM
GARAGE TO
OKTOBERFEST
GIESINGER BRAU

Photos © Getty/ FooTToo (beer fest); moster1305 (man)

By Ryan Pachmayer

The world's most famous beer festival hasn't added a new brewery in over a century. Tents at Oktoberfest are only allowed to pour beer from the six official Munich breweries. This status quo has remained unchanged for so long that even a tiny increase in beer prices from one year to the next can dominate news coverage surrounding the festival.

That may very well change soon, however, since Giesinger became the seventh official Munich brewery in 2020. Does this mean it can pour beer at the festival? Well, not quite—or at least not yet. There are plenty of politics still involved in Giesinger's status as a potential seventh brewery at the festival. But after I spoke with various figures in Germany, including many in the brewing industry and also a government official, the likelihood of this happening in the near future is more likely than not.

→

Giesinger isn't betting on it quite yet, though. In fact, the brewery doesn't really like to talk about it too much at all these days. Owner Steffen Marx prefers to discuss the company's growth, the next big production target, and his responsibility to the people he employs.

UNORDINARY BEGINNINGS

Marx founded the brewery in 2006. Back then, the brewery scene in Munich was much like Oktoberfest's—very little change took place year to year, or even decade to decade. Craft breweries were unheard of. Drinkers generally chose between a handful of classic brewery offerings, drinking primarily pale lagers, with the occasional dunkel, doppelbock, or weissbier thrown in for variety. Marx went a different direction.

He had just finished military duty and was on a three-year pension from the army. He was studying geology. Despite having no experience in brewing, he decided it made sense to open a brewery. He quickly realized that his interest in actually brewing the beer was minimal; he was instead drawn to the operations side. The next logical step, of course, was to start a brewery in a garage. Everybody thought Marx was crazy. "They still do," he laughs. "Every great idea started in a garage," he says, citing Steve Jobs as an inspiration for the original brewery.

The garage brewery was located in the Untergiesing (lower Giesing) area of Munich, a historically working-class area. The breweries in and around the city were known for bright, beautifully filtered beer, the most popular style being helles. So, Marx started with an unfiltered helles he called Erhellung, which can be translated as "enlightenment." "In my opinion, it's the best beer we have," says Marx. And while it's tempting to claim that he was a visionary, seeing an opportunity in the market for something different, Marx is quite humble about the reason he originally brewed an unfiltered beer. "We didn't have free space in the garage for filtration," he says. As homebrewers know, sometimes what appears to be a shortcoming in your brew system isn't necessarily something to fix or hide. It can instead be a strength that sets your brewery apart. Marx embraced his way of brewing, and made it work to his advantage.

In the early years, he also served a weissbier, a rotbier (a reddish-amber lager), and a dunkel. While these styles made a mark, it was that original unfiltered helles that really drew the crowds—it was a neighborhood favorite. And of course, being made in small batches in a garage, it was also very fresh. At present, the beer represents about half of the brewery's sales. Erhellung was a little more raw, a little bolder and livelier than other pale lagers served in the area when the brewery began.

Clockwise from top:
Open fermentation at the brewery in Giesing;
The new north Munich brewery transformed for festivities;
Max Henkies gives the author a tour.

Photos courtesy of Ryan Puchmayer; Giesinger Brau; Teresa Blaisure

GIESINGER GROWS AGAIN

Eventually Giesinger outgrew the garage and made a short move in 2014 to allow for its expansion. The brewery's current logo is taken from the Holy Cross Church across the street from the second brewery.

Not long after, in 2018, Marx decided that the brewery needed to expand again. It had grown quite a bit since its start in the garage. "People want to drink more beer than we can produce in Giesing," he says.

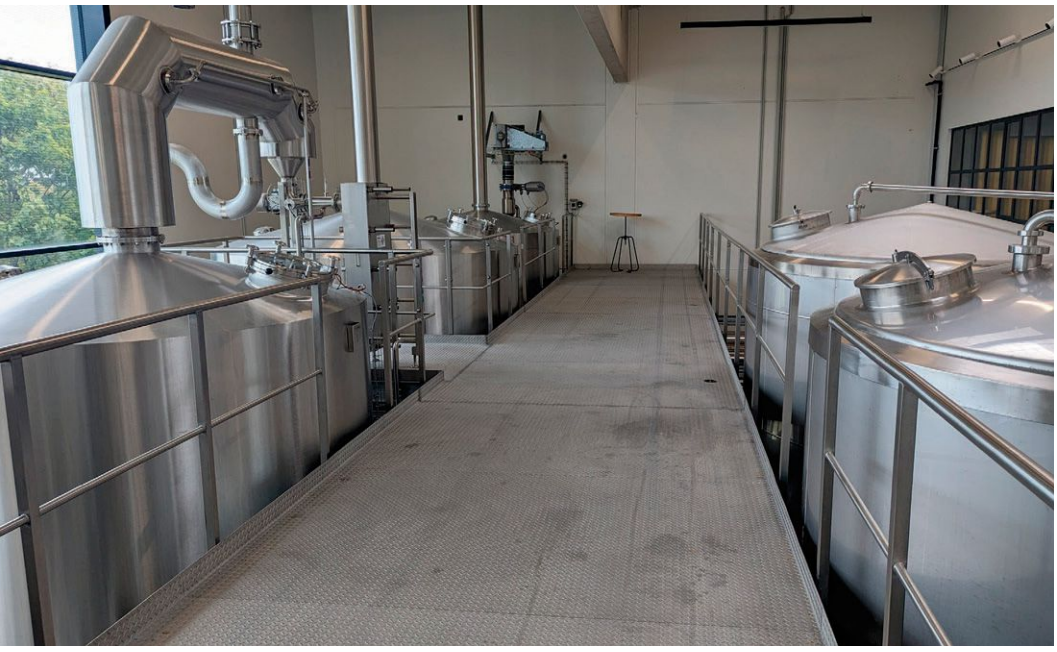
But with more expansion comes more debt. "Our breakeven in 2013 was 12,000 hectoliters," (10,226 bbl) says Marx. The brewery reached that goal, but then continued to expand. "Today, our breakeven is 42,000 hectoliters," (35,791 bbl) he says. Giesinger's 2023 production finished about 7,000 hectoliters (5,965 bbl) short of that goal. Marx's current motivation is twofold: first, to hit that production goal and bring the company back into stable profitability. And second, to pour his beer in a tent at Oktoberfest.

STATE OF THE ART

The new brewery in north Munich is a state-of-the-art facility. It rivals some of the best regional breweries in Germany. When planning the brewery, the team decided to use one company for all its equipment: brewing manufacturing giant Krones. "You have one programmer, you have one electrician, you have one hydraulic controller," says Giesinger brewer Max Henkies, who was instrumental in designing the layout of the brewing system and working with the contractors on its implementation. Troubleshooting is quick and efficient. "I can call Krones on a support line; they look at our screens, know what the problem is, and connect us with the people who can solve it."

This streamlined approach, while obviously smart for a large professional brewery, has its merits on the homebrew scale too. Often overlooked is the quality of customer support offered by homebrewing equipment companies, particularly with the more advanced products on the market today. There are also benefits to being a regular customer purchasing from only one manufacturer—many companies quickly recognize you are a repeat buyer, and may offer loyalty discounts or added support. Further, homebrewing equipment is often designed to work in concert with other products offered by the same brand,

Left: Marx pouring beer at his bar.
Below: The brew deck at the new brewery in north Munich.



ERHELLUNG

Recipe courtesy of Giesinger Brau, Munich

Erhellung is the beer that started the brewery in the garage way back in 2006. Unfiltered and bold, with a bit of a rounded mouthfeel, this is one of my favorite Munich lagers. If you want to make it like the new brewery does, and really accentuate the roundness, use a very soft water profile to mimic their water from the deep well.

Batch volume:	5.5 U.S. gallons (20.82 L)
Original gravity:	1.051 (12.6°P)
Final gravity:	1.010 (2.6°P)
Color:	5 SRM
Bitterness:	18 IBU
Alcohol:	5.3% by volume

MALTS

10 lb.	(4.54 kg) German Pilsner malt
5 oz.	(142 g) Weyermann Carahell®

HOPS

1 oz.	(28 g) German Tradition, 5.2% a.a. @ 60 min
0.5 oz.	(14 g) Saphir, 3.1% a.a. @ flameout
0.5 oz.	(14 g) Hallertau Mittelfrüh, 4% a.a. @ flameout

YEAST

Giesinger uses a yeast strain from the famed Weihenstephan Hefebank. Use your favorite German lager yeast.

BREWING NOTES

Giesinger uses Müller malt, but you're unlikely to find that in the U.S., so use your favorite high-quality German Pilsner malt. Mash in at 126°F (52°C) and quickly bring the temperature up to 145°F (63°C), holding for 40 minutes. Raise to 163°F (73°C) and hold 20 minutes before mashing out at 172°F (78°C) for 10 minutes. Ferment at 47–53°F (8.5–11.5°C) until primary fermentation is complete. Lager near freezing temperatures for three weeks. Serve unfiltered.

whereas it can take some tinkering and modification to get equipment from multiple brands to work together effectively.

BRINGING OLD SCHOOL UP TO SPEED

Like many production breweries around the world, particularly in Germany, Giesinger has extra vessels on the brew deck, allowing the team to brew multiple batches more efficiently. This again harkens back to lessons for the homebrewer. A system that can handle two batches concurrently can allow brewers to produce more beer in a far shorter timeframe than it would otherwise take.

As one would expect, only quality German ingredients are used in the brewery's lagers. The base malt is from Müller, a highly respected maltster about an hour's drive from Munich, and world-renowned Weyermann® provides the specialty malt. Hops come from Hopsteiner, with Hallertau Mittelfrüh, Tradition, and Saphir being three prominently used varieties.

Giesinger uses single-vessel fermentation tanks, which simplifies the cellaring process. Five to seven days of primary fermentation at 54°F (12.5°C) is followed by a quick cooldown to near-freezing temperatures, where the beer will lager for several weeks before going through a filtration process (depending on the beer), and then to packaging.

The brewhouse space is a rarity in an industry that often squeezes production out of every nook and cranny—Giesinger has room to grow. "It's a plug-and-play system," says Henkies. "We have piping that we finished before we put in new tanks." By comparison, how many homebrewers section off just enough space to house their current setups instead of planning for future expansion?

In a departure from older, traditional breweries, Giesinger has some beers in its portfolio that fall outside typical German stalwarts. The Lemondrop Tripel, a distinctly fruity Belgian-style strong ale brewed with Lemondrop™ hops, is one noticeable example. Considering the older styles that make up most of its lineup, however, you can hardly call Giesinger a "new school" craft brewery. With its size (the second largest privately owned brewery in Munich), and the fact that it's been around for nearly two decades, there's no denying it is a legitimate Munich contender. Giesinger doesn't fit neatly into a box, or a category; neither does Marx. You get the feeling walking around both of its locations that, like many home and craft breweries, Giesinger sort of hums to its own tune. It is a unique brewery unlike any other in the region.

ONE FLAGSHIP OR THREE?

The unfiltered helles Erhellung is the most popular beer, but there are two different versions. One is made in Giesing, and the other is brewed at the new brewery in north Munich. The new version is made with Munich water; Marx paid roughly a million euros to dig a 500-foot well so the brewery could access this legendary liquor. The result is that the Erhellung brewed at the new brewery is much softer and round-

FESTBIER

Recipe courtesy of Giesinger Brau, Munich

If Giesinger is allowed to pour at Oktoberfest and decides to brew the same type of beer as the other six breweries, it would look something like this. Pale in color, almost like a bigger version of helles, Festbier has a strong enough flavor to keep people interested, while being drinkable enough to quaff all day long.

Batch volume: 5.5 U.S. gallons (20.82 L)
Original gravity: 1.056 (13.8°P)
Final gravity: 1.010 (2.6°P)
Color: 6 SRM
Bitterness: 22 IBU
Alcohol: 6% by volume

MALTS

10 lb. (4.54 kg) German Pilsner malt
20 oz. (567 g) Munich I malt
4 oz. (113 g) CaraRed® malt
2 oz. (57 g) CaraAmber® malt

HOPS

1.75 oz. (49 g) Saphir, 3.5% a.a. @ 60 min
0.33 oz. (9 g) Hallertau Mittelfruh, 4% a.a. @ flameout

YEAST

Use your favorite German lager yeast.

BREWING NOTES

Mash in at 126°F (52°) and quickly bring the temperature up to 145°F (63°C). Hold for 40 minutes, then raise to 163°F (73°C) and hold for 20 minutes before mashing out at 172°F (78°C) for 10 minutes. Ferment at 47–53°F (8.5–11.5°C) until primary fermentation is completed. Lager near freezing temperatures for three weeks. Serve unfiltered.

RED ALE

Recipe courtesy of Giesinger Brau, Munich

While traditional lager sales lead the way, Giesinger does sell less traditional ales as well. This craft beer helps the brewery hold appeal to a wider range of drinkers and offer up something a bit different. The red ale has a pleasant maltiness, with a late hop burst.

Batch volume: 5 U.S. gallons (20.82 L)
Original gravity: 1.051 (12.6°P)
Final gravity: 1.013 (3.3°P)
Color: 14 SRM
Bitterness: 17 IBU
Alcohol: 5% by volume

MALTS

10 lb. (4.54 kg) Red X malt
1 lb. (454 g) Pilsner malt

HOPS

0.25 oz. (7 g) Vic Secret, 17.6% a.a. @ 60 minutes
0.4 oz. (11 g) Vic Secret, 17.6% a.a., whirlpool
1.5 oz. (42 g) Vic Secret, 17.6% a.a., dry hop
2.5 oz. (74 g) Monroe, 2.9% a.a., dry hop

YEAST

Fermentis US-05 or other American ale yeast

BREWING NOTES

Mash in at 126°F (52°C) and quickly bring the temperature up to 145°F (63°C). Hold for 40 minutes, then raise to 163°F (73°C) and hold for 20 minutes before mashing out at 172°F (78°C) for 10 minutes. Ferment at 65°F (18°C) in primary, then raise to 68°F (20°C) towards the end of fermentation to clean up the beer. Cold condition at near freezing temperatures for up to 20 days.

er to the taste, noticeably different from the version made at the old brewery and served at the Braüstübl (loosely translated as a "brewery tavern") in Giesing.

Digging the expensive well meant far more than just accessing softer water—it was also a primary factor in making Giesinger the seventh official Munich brewery. Giesinger can now brew an official Munich helles—the fact that it's filtered and brewed within the city limits of Munich with pure Munich water makes it so.

Enter Giesinger's third helles. For that beer, Giesinger uses a slightly different recipe than the one for the Erhellung made in Giesing. It is lower in alcohol than the unfiltered helles, and lighter in color, but has a more pronounced hop character. Ultimately, the brewery has three versions of its flagship, and everybody has their favorite. Many regulars make it a point to ask for their preferred version of Erhellung when visiting the Braüstübl in Giesing.

UP AND UP

Marx makes a habit of walking around the brewhouse, and is always there to help. "He's running around in work trousers," says Henkies. "If there are problems, I can grab him, and he'll help me; he's never far away."

At the same time, Marx is very focused on future growth and feels it is a responsibility to the people who work for him. Between the breweries, two bars and the restaurant, Giesinger employs 120 people. "We grow up and up," says Marx.

Crowdfunding is another important part of the brewery's growth. "We have 8,000 people invested in this brewery," says Marx. Most of the investors are locals who live within 100 kilometers of the brewery. They invest for 8–10 years and see a six percent return on their money per year—the catch being that they must take that six percent in the form of beer and food. "It brings them closer to the brewery," says Marx. Again, the parallels to the U.S. home and craft brewing movements are easy to see—the collaborative connections that bring brewers together over a mutual enthusiasm for good beer aren't unique to our shores. And with a little luck, those 8,000 fans will soon get to enjoy their favorite Giesinger brews under the giant tents of the most famous beer festival in the world.

Ryan Pachmayer is the marketing and events director at New Image Brewing in Wheat Ridge and Arvada, Colo., and former head brewer at Yak and Yeti Restaurant and Brewpub in Arvada.

Erhellung

Märzen

Brew This!

SUMMER ALE

Recipe by Max Henkies

In his early twenties, Henkies was already working with the installation and production teams on the newest Giesinger facility. He studied at Weihenstephan and continues his higher education at the Doemens Academy.

Of this ale, he says, "When we finish for the day at the central station in Munich, it's very hot, so we decided to make a lighter beer," he says. "It's more of a beer to drink at the beach. You can drink three or four of them."

Batch volume:	5.5 U.S. gallons (20.82 L)
Original gravity:	1.044 (11°P)
Final gravity:	1.010 (2.6°P)
Color:	6.5 SRM
Bitterness:	18 IBU
Alcohol:	4% by volume

MALTS

7 lb. 1 oz. (3.2 kg) Pilsner malt
1 lb. (454 g) Vienna malt
1 lb. (454 g) wheat malt

HOPS

0.75 oz. (21 g) Callista, 5% a.a. @ 65 min
0.33 oz. (9 g) Sabro, 14% a.a., whirlpool 20 min
0.66 oz. (19 g) Galaxy, 16.4% a.a., dry hop 3 days
0.66 oz. (19 g) Amarillo, 9.2% a.a., dry hop 3 days
0.66 oz. (19 g) Mosaic, 12.2% a.a., dry hop 3 days

YEAST

Fermentis US-05 or other American ale yeast

BREWING NOTES

Mash in at 126° (52°C) and quickly bring up to 144°F (62°C). Hold for 25 minutes, then raise to 149°F (65°C) and hold for 10 minutes. Raise to 162°F (72°C) and hold for 20 minutes before mashing out at 172°F (78°C) for 10 minutes. Boil for 70 minutes. Ferment in primary at 65°F (18°C), then raise to 68°F (20°C) towards the end of fermentation to clean up the beer. Cold condition for one week at 41°F (5°C). Dry hop cold for a few days, or until hop aroma is acceptable.

KegSack

LOSE THE CO_2 WITH BAG-IN-A-KEG SYSTEMS

By Andy Tipler and Pierre Margraff

→

This is the third and final article of our *Zymurgy* series on how homebrewers can minimize the necessity of using tanked carbon dioxide (CO_2). The first article investigated how to use CO_2 more efficiently with traditional practices, and the second considered the generation and use of home-produced CO_2.

Our third article examines the use of pressurized CO_2 for the dispensing of kegged beer. Draught beer usually requires some form of driving force, normally gravity or gas pressure, to push the beer out from the keg, through some tubing and a faucet, and into the serving glass. Using gravity is still an option for some beers, notably English cask real ales. For beers requiring higher carbonation levels, gas pressure is the main option. Because this gas is in contact with the beer and needs to maintain the beer's condition, it's usually CO_2, although nitrogen (N_2) is used for some beer, particularly stouts. So, serving beer from pressurized kegs normally requires a source of pressurized CO_2. Because the beer is often dispensed over some time, the CO_2 supply must be readily available when needed, so tanked CO_2 is usually the best option.

How much CO_2 do we need to fully dispense a keg of beer? Ideally, we want to maintain the initial pressure of the beer in the keg once it's been conditioned. For example, if we have 19 liters (five gallons) of beer in our keg, conditioned to a pressure of 20 psig (see Note), we need the same volume of CO_2 at this pressure to fully displace the beer and keep its condition. We normally express volumes of CO_2 at atmospheric pressure and at 0°C (32°F). To make this conversion, we use Boyle's Law (shown below), invented in the 17th century by the Anglo-Irish natural philosopher, chemist, physicist, alchemist, inventor, and generally clever guy, Robert Boyle.

$$P_1 \cdot V_1 = P_2 \cdot V_2$$

Where (for this example):

- P_1 is the atmospheric absolute pressure (14.7 psia).
- V_1 is the volume of CO_2 at atmospheric pressure (that we want to calculate).
- P_2 is the absolute pressure of the CO_2 inside the keg (20 + 14.7 psia).
- V_2 is the volume of beer (19 liters).

For our example, we calculate that the volume of CO_2 needed to dispense our beer is almost 45 liters. A temperature change would also have a minor effect on the result, which we ignore here. What options do we have to reduce or even eliminate this moderate consumption of tanked gas?

NOTE: Gas pressures are expressed either as a gauge pressure (for example, psig), which is the pressure above that of the atmosphere, as would be displayed on a pressure gauge; or as an absolute pressure (for example, psia), which is the pressure above a vacuum. To convert a gauge pressure value to absolute pressure, just add the atmospheric absolute pressure to it.

The first option we considered was the use of an alternative gas such as nitrogen. While this would push the beer out of the keg, it would change the nature of the beer's carbonating condition (CO_2 would come out of the beer and N_2 would go in), affecting body, mouthfeel, and flavor perceptions. Also, some significant additional expenses are involved—pressurized tank of N_2, regulator, etc. We also considered using nitrous oxide (N_2O), which appears to be readily available and quite inexpensive, but could result in us doing jail time. N_2O is now banned in the U.K. as a Class C drug. No other gas seemed suitable from a cost, safety, or practical viewpoint.

Our next option was to investigate the "Bag in a Keg" concept—and this showed real promise.

THE BAG IN A KEG (BIAK) SYSTEM CONCEPT

The main issue in using a pressurized gas to dispense kegged beer is that it makes direct contact with the beer inside the keg. This means that molecules can travel both ways between the gas and the beer—either of which can affect the flavor or the condition of the beer. One approach is physically separating the gas from the beer. If we can do that, then it doesn't matter what the gas is—it can even be air (horrors!).

One way of separating the beer from the gas is to use a big piston—but that's not very practical. Another idea is to put a flexible bag (or bladder) into a keg, load the beer into the bag, and add a pressurized gas such as air around the outside of the bag to push the beer out of the keg—see Figure 1. Alternatively, the beer can be put in the keg and air can be pushed into the bag.

The big benefit here is that no CO_2 is needed to fully dispense beer from a keg and the composition and condition of the beer are maintained. If the beer is naturally conditioned in the keg, then no additional CO_2 is required at all to make or dispense beer at home, which is our primary objective.

COMMERCIAL BIAK SYSTEMS

The BIAK idea is not new and anybody who has recently visited a European hostel serving good beer will have probably encountered beer served from commercial BIAK products. Unfortunately, this type of product is not yet readily available to homebrewers and does not yet have a strong commercial presence in North America.

While BIAK systems have the potential to reduce the consumption of carbon dioxide, which is of prime importance to many homebrewers, commercial brewers have different priorities. Traditionally, beer kegs are made from stainless steel. While they do a great job of maintaining the quality of beer, they are big, heavy, and expensive items to buy, clean, and ship. Commercial BIAK systems are made from polyethylene terephthalate (PET)—what soda bottles are made of—so they are relatively inexpensive, light, and easy to ship. They are typically intended for single use so that shipment only needs to be one-way, and no cleaning is required. These benefits are compelling to both the brew-

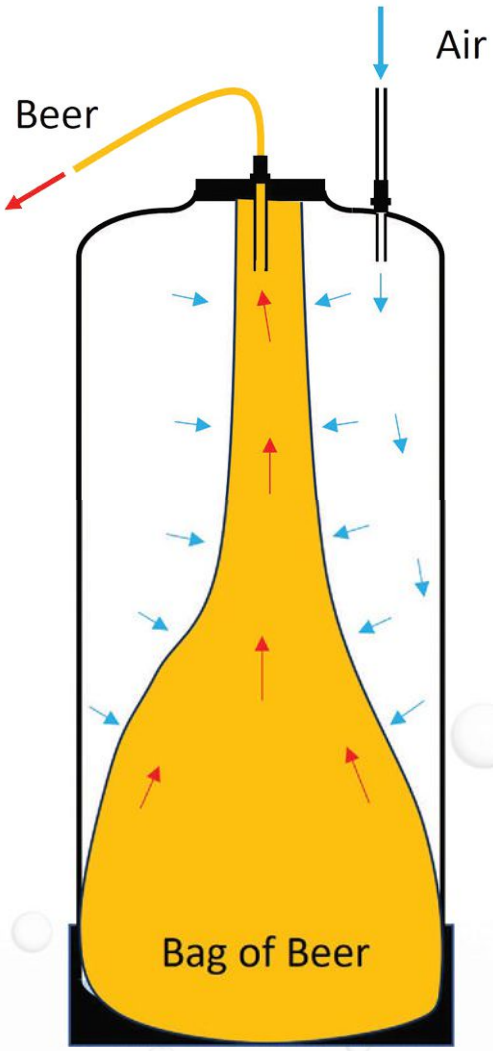


Figure 1: Bag in a Keg. Keeping air outside the bag (but in the keg) at a constant pressure maintains carbonation.

Photos courtesy of Andy Tipler and Pierre Margraff

eries and their direct customers. Although some manufacturers have begun recycling these vessels, disposal of the used kegs may raise environmental concerns.

We reached out to the three manufacturers of this type of keg (Ecodraft, PolyKeg, and KeyKeg), shown in Figure 2, to get their take on the use of their products for homebrewing. Of the three, KeyKeg showed interest and supplied us with some of their kegs to evaluate in a homebrewing environment.

We spent a significant amount of time testing these kegs, and despite a few initial technical issues, we had great success using them to condition and dispense homebrewed beer without the use of any pressurized CO_2. Figure 3 shows a storyboard summary of the methodology we used. We concluded that KeyKegs could be used very successfully by homebrewers and would indeed eliminate the need for an external supply of carbon dioxide for dispensing of beer. However, at the moment, it doesn't appear to make good business sense to KeyKeg to support the homebrewing community with their products.

Although the commercial BIAK products may seem appealing to homebrewers, besides not being readily available currently (manufacturers like to sell big pallets of these things to commercial brewers), there are also other disadvantages:

Figure 2: Ecodraft, PolyKeg and KeyKeg commerial BIAK systems.

- Some of the kegs are not reusable, making them a very wasteful and expensive option for homebrewers.
- It's not easy to dispose of the used kegs.
- A special valve/adapter is required for each keg—these can be expensive.
- Air pressure must be maintained while dispensing beer, or else the beer will de-gas.

However, the BIAK idea is still very attractive, as it requires no CO_2 for carbonation or dispense. So we felt compelled to find our own alternative to the commercial options: what we call the KegSack system.

DIY KEGSACK SYSTEM

Our ideas for this system were simple:

1. Put a big wine bag in a Cornelius (Corny) keg;
2. Connect the wine bag to the keg's liquid post using suitable tubing and fittings;
3. Fill the bag with newly fermented beer;
4. Add priming sugar;
5. Seal the keg;
6. Naturally condition the beer in the bag; and finally,
7. Inject pressurized air through the keg's gas post into the space surrounding the bag inside the keg to dispense it.

That was what we did—and we were very successful! However, the devil was in the details, and it took a lot of experimentation and trial and error to get things working just the way we wanted. We'll spare you the dreadful details and just describe how to put together a working KegSack system for homebrewers.

There are several elements that need to be considered:

- The bag (sack)—to hold the beer;
- The dip tube—stopping the bag from self-sealing during serving;
- The keg connections—how to get air in and liquid out;
- The process of filling the bag—getting the beer and priming sugar into the bag without introducing air; and
- The pressurized air supply—how to push out the carbonated beverage.

The Bag

The bag used to hold the beer needs to be big enough to hold all the beer in the keg and flexible enough to allow for compression as the beer is dispensed, so some form of thin-walled plastic bag would be most suitable. All plastic bags are permeable to oxygen, so any compressed air in the keg passes through the bag walls and eventually oxidizes and degrades the beer inside. Most bags we considered had to be eliminated from the project for this reason.

For instance, we did some initial work with FoodSaver-type vacuum bags, which worked really well from a practical perspective. However, these bags are made from a nylon-polyethylene copolymer and have an estimated oxygen transmission rate (OTR) of 4mL/100 sq in./24 hours.[1] This doesn't sound like much, but an adequately sized

Figure 3: Filling and using a KeyKeg system.

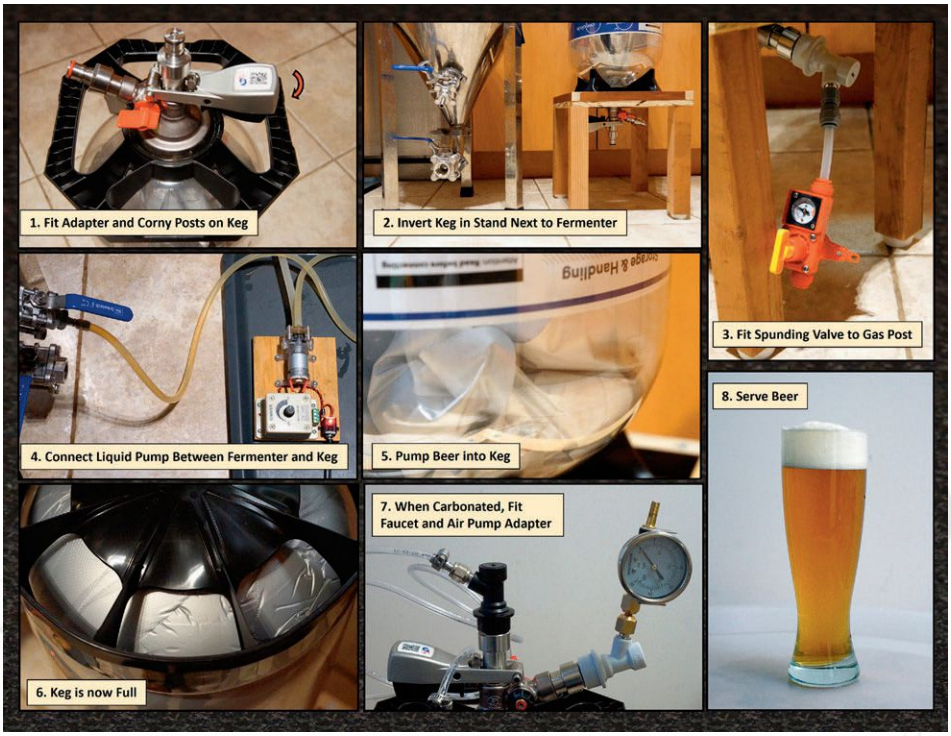


Figure 4: 25-Liter aluminized mylar bag for storing wine.

bag for the keg would have a wall area of at least 700 sq in. between the beer inside the bag and the air outside. This could allow a daily infusion of oxygen of up to 30 mL into the beer, which would certainly have a negative impact on the quality of the beer over a few weeks.

Mylar is a much better material for this purpose, since it is available with an integrated aluminum layer to further reduce oxygen permeability. The OTR of this material is about 63,000 times less than that of the FoodSaver-style bags[2] and it proved to be ideal for our BIAK work.

We managed to find a supplier[3] offering 15- to 25-liter Mylar bags with the embedded aluminum layer (as shown in Figure 4) designed for wine storage. They are also surprisingly strong and flexible. The 25-liter bag was not an exact fit for the five-gallon keg—it needed to be a bit taller to fill the whole keg. However, we were still able to fill this bag, while inside the keg, with a volume of 4.7 gallons (17.8 liters) of beer, which was good enough for our needs.

The Dip Tube

As the beer was dispensed, the air pressure surrounding the bag would start to squeeze it, and we realized it might self-seal, trapping and isolating a lot of beer below it. To minimize this possibility, we used a length of ¼" inner diameter (ID) silicone tubing, perforated every 1.5 inches, as shown in Figure 5, as a flexible dip tube that extended right to the bottom of the bag. This way, if the bag does self-seal, there's always an outlet path for the beer.

A soft PVC tube connected to the keg's liquid post was threaded through a #6 rubber stopper. Silicone tubing should not be used here since it's very permeable to oxygen. A 5/16" to 3/8" polypropylene-barbed adapter was pushed into the tube, and then this adapter and tube were pushed into the stopper. The perforated silicone dip tube (described above) was pushed onto the 3/8" barb, and the stopper and dip tube were pushed into the bag inlet. A rubber/TPU cap was pushed over the stopper and mouth of the bag to stop it from being pushed out during use. We 3D-printed the cap, and the STL print file can be downloaded.[4]

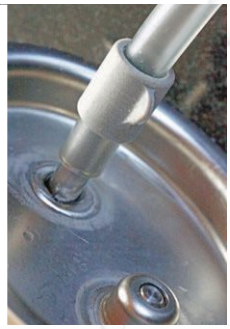
The Keg Connection

Once the bag and dip tube had been fully assembled, they needed to be connected to the keg's liquid post for dispensing. Normally, the liquid post has a long dip tube that extends to the bottom of the keg. This needs to be removed and replaced with a short dip tube (like that used on the gas post). The soft PVC tubing was pushed onto the shortened liquid dip tube installed earlier. Alternatively, a keg carbonation lid[5] could be used to make this connection, as shown in Figure 6. While

Figure 9: Process for filling DIY BIAK system.

Figure 5: Perforated silicone dip tube.

Figure 6 & 7: Using a carbonation lid to make the beer outlet connection; Using a 3d-printed screw clamp to secure tubing to keg liquid post dip tube.



this does simplify the connection, it also requires additional cost.

We found out the hard way that as the bag descends, the full weight of the beer left in the bag pulls on the tubing between the bag and the keg's liquid post. A full bag can weigh up to 50 lb. (22.7 kg) and can easily pull apart the tube connections. For this reason, it's important to have a long enough tube to reach to the bottom of the keg.

Once connected, use a suitable hose clamp to secure the connection to the liquid post dip tube to help prevent the soft PVC tube from being blown off during use. We used a 3D-printed screw-on clamp for this purpose[6], as seen in Figure 7. There are also barbed dip tubes available to help retain a connection to the tube.[7]

Filling the Bag

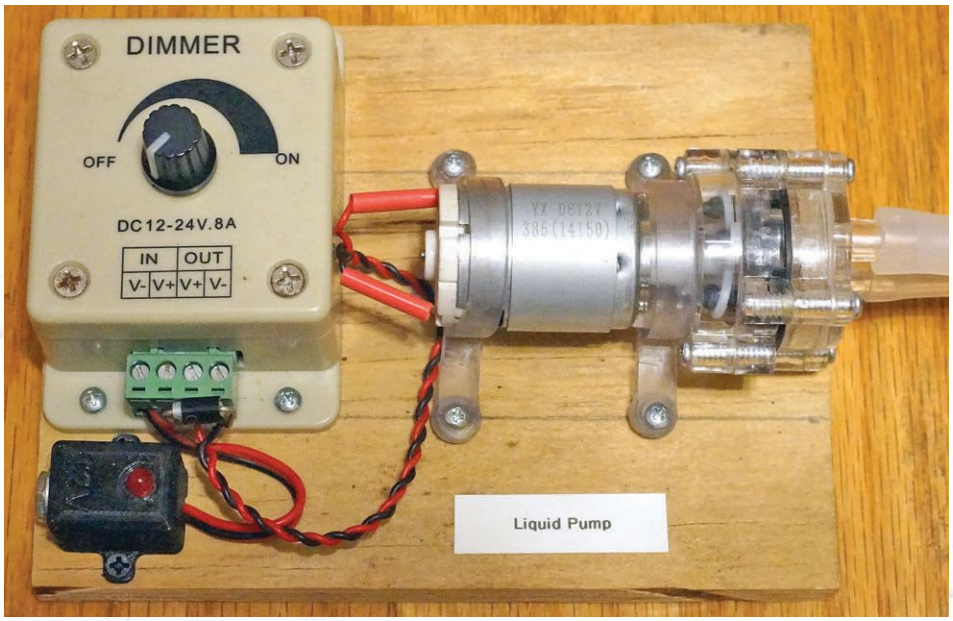
The process of filling the KegSack was very similar to that of the commercial KeyKeg system. The beer was pumped into the bag and naturally conditioned. The full procedure is summarized below.

1. Assemble the bag with the perforated silicone dip tube, post connection PVC tubing, stopper, and TPU retainer.
2. Add about one liter of StarSan (or other homebrew-grade sanitizer) solution to the bag, shake it up, and wait 10 minutes.
3. Pump out the StarSan solution.
4. Pump in about one liter of boiled water, rinse, and pump out.
5. Connect a hose clamp near the end of the inlet tube to keep air out.
6. Roll up the evacuated bag and slide it into the keg, inlet side up.
7. Connect the inlet tube to the short dip tube on the keg's liquid post.
8. Remove the hose clamp.
9. Prepare a boiled and cooled solution of priming sugar in 200 mL (0.84 cups) of water to prime the beer.
10. Put the keg on its side (it fills better this way).
11. Connect the liquid pump to the keg's liquid post.
12. Pump the sugar solution into the bag through the keg's liquid post.
13. Connect the liquid pump between the beer vessel and the keg's liquid post using soft PVC tubing. The connection of the tube from the bag to the keg's liquid post must be secure. Use a hose clamp if necessary.
14. Pump or siphon the beer into the bag until it's full.
15. Remove the connector for the liquid post, move the keg to its vertical position, and install the keg lid.
16. Connect compressed air to the gas post and add compressed air until the target pressure is reached.
17. Remove the compressed air source and connect a pressure gauge to the gas post.
18. Leave at room temperature and wait for the beer to carbonate naturally.

Notes:

The liquid pump[8] we used to transfer the liquids in and out of the bag, shown in Figure 10, proved to be very successful. It operates from a 12v supply, it's self-priming, and we could use a dimmer control[9] to set the pump speed.

Figure 10: 12V pump with dimmer speed control for liquid transfers.



If you don't plan on carbonating your beer with priming sugar, force-carbonating the beer once it's added to the keg is possible. Once the keg has been sealed and pressurized with air, a source of pressurized CO_2 can be connected to the liquid post to force-carbonate the beer inside the keg. But what's the point of doing this if the main intent is to eliminate the use of external CO_2?

It should also be possible to transfer carbonated beer into the BIAK system. Once the empty bag is in the keg, the keg must first be sealed and pressurized with air. A spunding valve can be fitted to the gas post to maintain the pressure inside the keg as beer is transferred into the bag.

Once our beer was properly carbonated, it was served the same way you would with a normal keg. One big difference between our KegSack system and the commercial BIAK system is that the bag inside our keg is not suspended. This means that as the beer drains out of the keg, the bag inside is free to drop—and it does, just like a piston! This means that when the keg is empty, the bag is squashed against the bottom.

Our experiments have shown that once the pressurized air has pushed all the beer out of the squashed bag, there's only about 100 mL (0.4 cups) left—and most of this is sediment. This represents a 99.4% extraction of the beer from the keg during dispensing—not bad at all!

The most important aspect of this whole project was the quality of the beer that was finally dispensed. Well, the English bitter still tasted like an English bitter. Although the carbonation for this style is lower than others, the keg pressure and carbonation were maintained until the last pint was poured. The beer came out clear, with a good head on top—perhaps a bit too big, but it soon settled. We couldn't detect any oxidation in the beer, so the bag seals held up well and it didn't look (or taste) like oxygen was permeating through the walls of the bag inside the keg.

Pressurized Air Supply

We found that one of the big issues with using these BIAK systems (both commercial and DIY) was that if the air pressure surrounding the bag was not maintained, the pressure applied to the beer dropped, and the beer would start to outgas CO_2, which would collect inside the bag. The beer would then pour very foamy until it eventually went flat inside the bag. It's therefore important to maintain the air pressure inside the keg and around the bag as the beer is being served. This requirement turned into a major part of our work for this article. We tried various air compressor

options to add and maintain this air pressure, with varying degrees of success.

Connecting any of the following air compressor systems to a keg requires a valve to be fitted on the keg's gas post that makes it look like a tire. Fortunately, Schrader valve-to-NPT adapters that can be fitted to a keg's gas post connector (see Figure 11) are readily available from online vendors.

Bicycle Pump

Although this sounds a bit silly, a bicycle pump actually did work well. The big benefits of this method are affordability and portability. You can purchase small bicycle pumps designed to fit inside a backpack. The big problem is that it takes a huge amount of effort to add enough air to the keg for it to be effective. This is a good option for very energetic, light drinkers.

Shop Tire Air Compressor

On the other end of the spectrum, a shop air compressor is perhaps overkill, but is much easier than using a bicycle pump. Most units have a set shutoff pressure so they don't run continuously, and an outlet pressure regulator will set the keg pressure. Unfortunately, they are normally big, heavy, expensive, and very noisy. We successfully used a cheap model from Harbor Freight, but any air compressor should work. We also found that some of the really cheap ones don't turn themselves off automatically.

Portable Battery-Powered Compressor

Instead of using a shop compressor, we tried a portable tire inflator. These are fairly inexpensive and do a great job pumping up beer kegs. Because they're portable and

Figure 11: Schrader valve adapter fitted to keg gas connector.

don't need to be plugged in, they are great to use at parties and picnics. However, there are still a couple of issues. They will turn themselves off when the pressure is reached, so they must be manually turned back on after serving each beer. Because these pumps are so readily available, many homebrewers may still find this option to be the most convenient.

DIY
Keg Air Pressurization System (KAPS)

None of the previous inflator options were practical for automatically maintaining the pressure inside a keg for a long period. For homebrewers, it may take weeks to finish a keg of beer, so maintaining a constant air pressure over this time is important. If you are slightly insane like the authors of this article, and you can't find something that meets your needs, you naturally try to build something yourself. That's what we did, and our KAPS device works perfectly with both commercial and DIY BIAK systems. Our requirements, which we fully met, are as follows:

- Cheap
- Reliable
- Easy to use
- Automatic
- Able to set a range of pressure
- Constant display of internal keg pressure
- Portable
- Long battery life

It's beyond the scope of this article to go into detail on how this device was designed and built. However, we can give a short summary of how it works. Figures 12 and 13 show the fully assembled and functioning device.

To pressurize the air, we used two miniature air pumps designed for use in breast pumps.[12] These little pumps, as shown in Figure 14, cost $0.66 each, draw about 0.5 amps at 5 volts, and can deliver an air pressure of up to about 18 psig, although getting there can be a slow process. If we connect two of these pumps in series, we can achieve more than 30 psig and get there a bit faster. This is a very impressive achievement for such small and cheap pumps—no other pumps we tested came anywhere near this performance.

A small microcontroller unit (MCU), an Arduino Nano, read the keg pressure from an inline pressure transducer and turned on the pumps if more air pressure was needed in the keg. Once the target pressure was reached, the MCU would turn off the pumps. We used a pair of 18650 lithium-ion batteries to power the system, and used an uninterruptable power supply (UPS) module to enable the device to run

Figure 14: Miniature breast pumps.

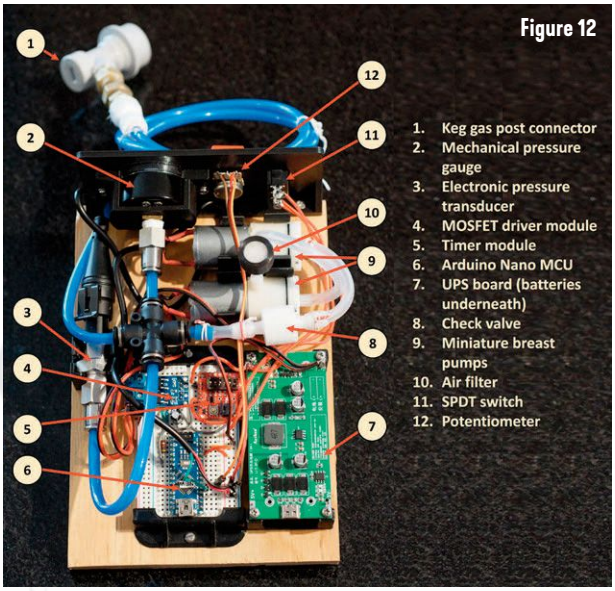


Figure 12

Figures 12 & 13: Home-built Keg Air Pressurization System (KAPS).

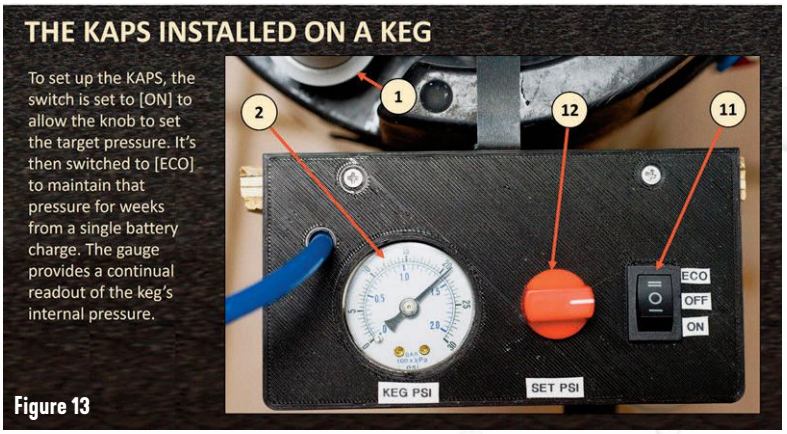


Figure 13

continuously off either battery, or external power. We wanted the batteries to last at least one month and hopefully two. We calculated that the two batteries had enough power to fully empty about four kegs.

If we connected the device to just a single keg, the remaining power could be used to power the electronics. When the system was idle, a timer module turned on the power to the MCU every 30 seconds for just enough time (typically less than 150 milliseconds) to read the pressure sensor and turn on the pumps if necessary. If the pumps had to be run, there would be a much higher current draw, but this would usually take just a few seconds (after someone had just poured a beer). In this way, the power consumption was kept very low. We fitted this KAPS unit to a KegSacked batch of English bitter inside a five-gallon keg and served the beer over a long period of time. We found that when the keg kicked after 80 days, the battery was still running from a single charge—so this would be very suitable for a long-term, portable application.

Although the KAPS may look complicated, there isn't that much to it. Details are on our website[13] to help other semi-lunatics have a go at building one of these devices themselves.

DISCUSSION AND CONCLUSIONS

We feel our KegSack system offers numerous advantages to homebrewers:

- Uses standard Corny kegs (could be adapted to others)
- Uses off-the-shelf parts
- Beer has no contact with metal
- Very low oxygen exposure
- Can orient the keg in any position
- Can use a partially filled keg
- No external CO_2 is needed at all (for flushing, carbonating, or dispensing)
  - Doesn't tie up CO_2 tank
  - More portable
  - Cost-effective and no dependency on fluctuating CO_2 supply
- Many options to supply pressurized air
  - Bicycle pump
  - Portable battery-powered compressor
  - Shop tire air compressor
  - DIY keg air pressurization system
- Full contents of keg are dispensed
- True "real ale" can be achieved
- Easy to dispense
- Dispensed from the top of the beer results in pours with less sediment
- Dispensing pressure is not the same as carbonating pressure
  - Carbonation of beer unaffected by the amount left in the keg
  - Single pressure supply for multiple kegs
  - (Potentially) less foam in glass
- Cheap
- Reusable

The only real problem is the ready availability of these systems. Not all brewers want to spend time ordering all the parts and putting together such a system. There's a great opportunity for a commercial business to adapt existing bag-in-a-keg products for use by homebrewers, or to offer ready-made bags that will fit inside and connect to existing Corny kegs—the authors would be pleased to help.

FINAL THOUGHTS ON THE SERIES

This is the final article in our series on mitigating the need for pressurized CO_2 in homebrewing. The authors are quite pleased that, finally, we found practical ways to brew, ferment, carbonate, and serve beer without the need for any additional tanked CO_2. Much of what we achieved was the result of developing solutions where off-the-shelf options just didn't exist, or weren't readily available. No fancy laboratory facilities were available to us, and much of the experimental work was performed in our own kitchens while our wives were out doing more important things.

All the parts we used can be purchased from online vendors or made with a cheap 3D printer. We believe this work can be reproduced by interested and enterprising homebrewers who will hopefully take some of these ideas and expand upon them. If nothing else, we hope this material generates some interest and perhaps leads to interesting conversations over a pint or two of high-quality homebrew.

LINKS AND REFERENCES

Visit HomebrewersAssociation.org/ja24 for all links and references.

Born and raised on Tafelbier in Belgium, Pierre Margraff moved to the States 25 years ago and learned to homebrew shortly after tasting his first American beer. Andy Tipler grew up in England and moved to the United States 30 years ago for his job as a research chemist. He has been homebrewing (legally) for more than 50 years and is a certified beer, mead, and cider judge. Andy is active in competitions as a judge and as a contestant, and he enjoys talking and writing about brewing. He is a member of the Underground Brewers of Connecticut (the second oldest homebrew club in the USA). He would very much like to have an English pub next door.

Getting In On INDUCTION

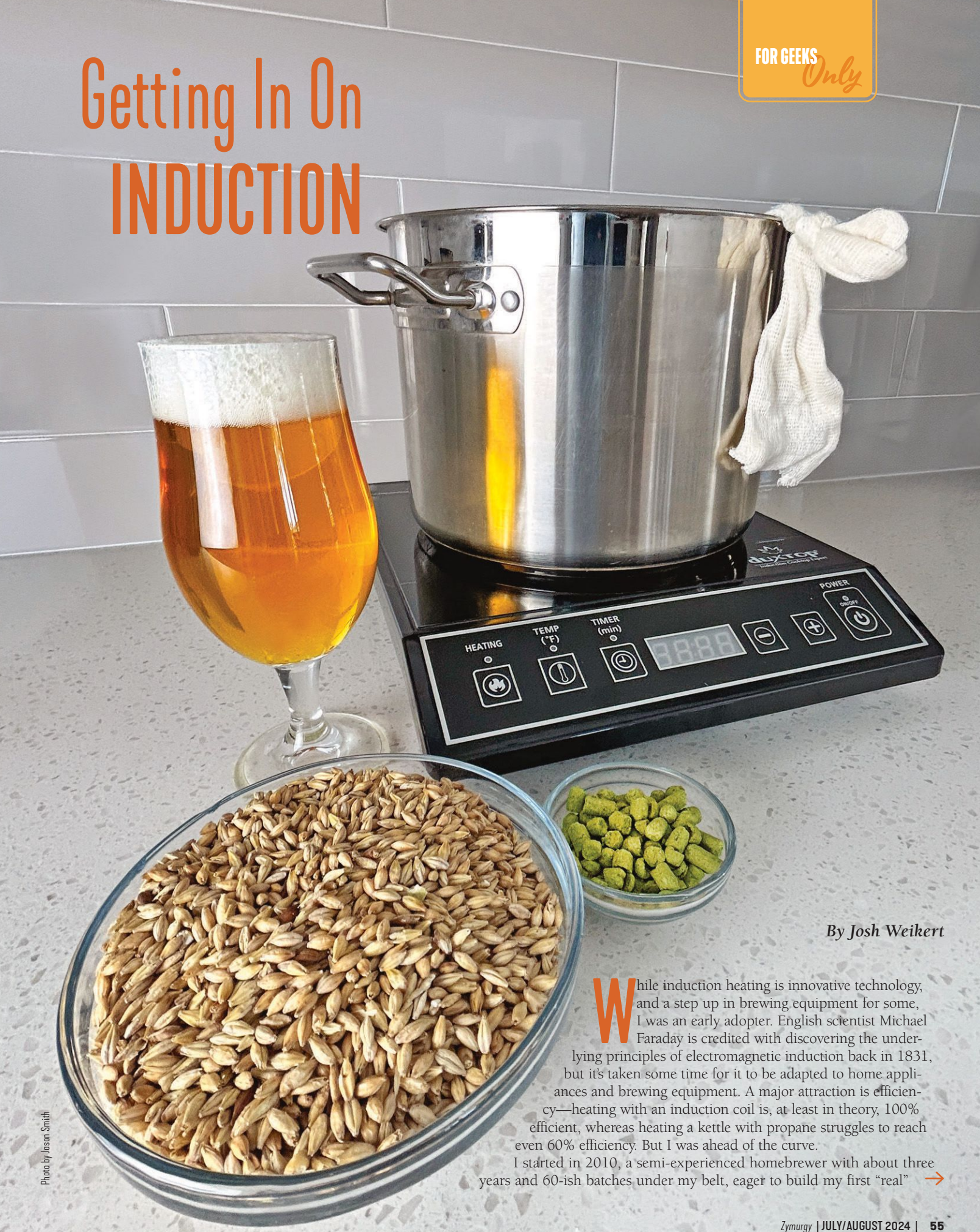


Photo by Jason Smith

By Josh Weikert

While induction heating is innovative technology, and a step up in brewing equipment for some, I was an early adopter. English scientist Michael Faraday is credited with discovering the underlying principles of electromagnetic induction back in 1831, but it's taken some time for it to be adapted to home appliances and brewing equipment. A major attraction is efficiency—heating with an induction coil is, at least in theory, 100% efficient, whereas heating a kettle with propane struggles to reach even 60% efficiency. But I was ahead of the curve.

I started in 2010, a semi-experienced homebrewer with about three years and 60-ish batches under my belt, eager to build my first "real" →

home brewery after years of abusing the stovetop in our little townhome. See, we had just moved into a house with a *whole garage bay just for me*, and the conventional brewing wisdom of the time said that the next obvious step was to rig up a two- or three-tier, 10-gallon, jet burner-powered brewery, and let me tell you, I was *stoked*. I lovingly unpacked all that shiny, heavy equipment, set it up, built my recipe, bought my ingredients…and absolutely hated it. It was a massive time suck, used what seemed like an obscene amount of propane, and was awkward to clean. And I'd be lying if I didn't say I was also a little intimidated by the roar of that burner. So, back went the shiny, heavy burner to the manufacturer and back went I to the drawing board. About three weeks later, on September 21, 2010, I laid out my plan to build an *induction brewery*. The rest, as they say, is history.

At the time, I was the only induction brewer I knew, but the merits of it seemed too good to pass up: safe to operate, cheap to fuel, more environmentally friendly, and, best of all, compatible with indoor brewing, which removed a lot of the vagaries and variables that seemed intrinsic to outdoor gas-powered brewing. I took the leap. I did some testing, learned some lessons, and my leap of faith was rewarded: put simply, it worked. Since it solves some common brewing challenges (as we're about to discuss), I wanted to share my experience. I put together a brief presentation for members of my homebrew club, then pitched it to some other clubs in the Philly area, and finally presented at the National Homebrewers Conference™. I now had more than a few converts and was even asked to write up a version of my presentation for *Brew Your Own (BYO)* magazine (fun fact, the start of my beer writing career!). I envisioned a world where thousands of homebrewers stormed restaurant supply houses to pick up induction cooktops and moved back inside after decades of relegation to driveways and cold, drafty garages. Somehow, though, it didn't work out that way.

So, here we are, coming up on 15 years later, and induction is old…but somehow still new and relatively unknown. My mission today is to reintroduce readers to the utility, efficiency, and effectiveness of induction brewing and add in some updates from my own and others' experiences. Let's see if we can make this old technology new for some homebrewers out there.

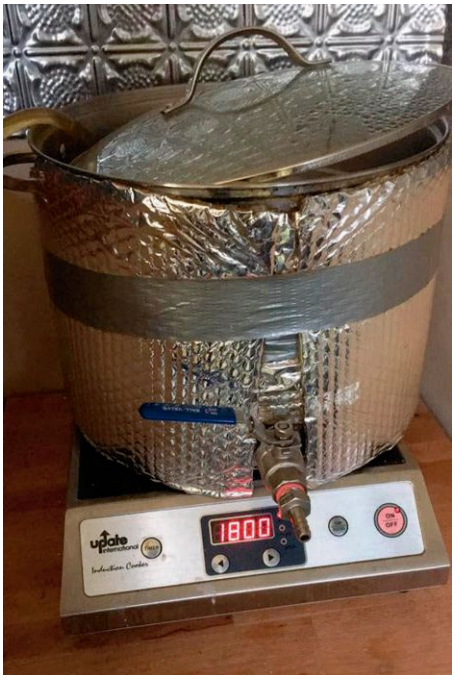
THE TECH

First things first: what is induction? Simply put, this centuries-old technological wizardry is a form of electric heating, and it's perfect for brewing applications. How does it work? Imagine your stovetop, but instead of a flame or a heated coil, the heat is generated inside the material of the *kettle* itself. It's like the Jedi mind trick of heating, if you will. Sounds a bit less physical than metaphysical, but I promise, there's a logical explanation. Say you've got a coil that can carry alternating current. When current passes through the coil, it creates a magnetic field around it. Now, if you put a conductive material within that field, like the metal of a brew kettle, the electrons in the metal start to tango due to the magnetic forces induced by the coil, and that movement creates friction. Friction, as we know, creates heat. It's like the kettle saying, "All right, I'll play your magnetic games, but I'm heating up in the process!" And just like that, your kettle—not the stovetop—is boiling its liquid content all on its own.

THE PITCH

If you're not yet convinced by induction's magical, magnetic ways, know that this method comes with many perks. To begin, induction is super precise. You can control the temperature with finesse, usually in 100-watt increments. Instead of just guessing at gas flow rates, or what "medium-high" means on your stove dial, you can hold a certain temperature to within a few degrees by controlling the amount of energy flowing through the induction coil. This makes it perfect for applications such as holding step mash temperatures, while at the same time offering plenty of energy to get water or wort to a boil quickly.

There are several advantages here. First, since there's no direct contact with a heating element, there's almost no risk of scorching, and in my experience it's easier to avoid boilovers. This means that a lot of steps that require us to kill the heat or move the kettle (which is always a pain) can now be done on the fly and under power. That absence of a flame also means that you can walk away to tend to other business rather than having to babysit a roaring fire to keep the dog from singeing its fur. I once had to leave my induction-powered rig mid-brew to pick up



In-house induction bewery setup, with a closer look at the insulated kettle.

Photos courtesy of Josh Weikert

my niece who was having car trouble, and the brew day never missed a beat. Priceless!

Second, induction brewing is *cheap*. I was shocked when I learned how much other brewers spend on energy costs. Propane burners vary in output, but let's just start with the average cost of propane per pound. According to a quick survey of vendors, you're paying about $1.30 USD per pound of propane, a few cents less if you're filling rather than swapping tanks. That translates to about 20,000 British Thermal Units (BTUs). Applying that math to some common burners, ranging from the dirt cheap to the higher end, you're burning between $4.23 to $9.10 *per hour* at max output, most of which is just blowing up and around the sides of your kettle. Using national average electrical rates, an induction element uses a tiny fraction of that energy, to the tune of about 26 cents per hour for an 1,800-watt element and 51 cents per hour for a 3,500w model. Why? Because since it's the kettle that's heating itself, there's very, very little energy loss. You're getting almost 100% of your energy into the pot, and then into the liquid. You can even increase this efficiency by wrapping your kettle in insulation (my kettles usually feature two to three circuits of Reflectix, an inexpensive product that's like metallic bubble wrap), which is another trick you can't get away with over an open flame. The insulation helps retain the heat energy generated by the kettle.

Then there's the cost of the element itself. Simply put? They're also cheap. As in, you might catch a sale and pick one up off an end cap at Target for under $30 USD (a friend started his induction brewery doing just that). Even sourcing a more robust model from a restaurant supply shop (which you'll want if you're going to put a kettle with several gallons of liquor on it) only bumps the cost up to the $100–200 USD range. Plus, you get yourself a handy addition to your kitchen—these are versatile machines. Case in point: A gas stove, due to its inefficiency, will heat up your kitchen and, by extension, your house, along with the food you're preparing, every time you need to cook something—not an ideal scenario when you're struggling to keep the house cool in the heat of summer. Not to mention the carbon monoxide and other nasties generated by burning gas indoors. Even a standard electric range is producing lots of peripheral heat. Not only is induction cheaper, it's quicker, safer, and cleaner. And although there is a fan in most models that can be loud, and that runs continuously to keep the induction coil cool, it's nowhere near as loud as the jet aircraft roar of a high-pressure propane burner at peak output.

For brewing applications, perhaps the best argument for induction is that you get to brew *indoors*. No more freezing your tail off outside in the cold season, or sweating it out in a stifling hot garage in the hotter months.

Let's assume you're at least tentatively on board. What equipment will you need, and how do your choices affect what you're brewing?

THE EQUIPMENT

If you've ever used, looked into buying, or even seen a hot plate or electric stove, you're already familiar with the basic packaging of an induction element. All that's changing is how the energy is produced. I'll also discuss induction compatibility of kettles (and kettle geometry), but it's not going to be anything unfamiliar to most brewers.

When you purchase a gas-powered burner, you're almost certainly looking at ratings based on BTU output as a measure of power. Induction elements' ratings are based on wattage, not BTUs. For most brewers, you're looking at either an 1,800w element that runs off a 110-volt wall socket, or a more powerful 3,500w element running on a 220v outlet. Each has advantages and limitations.

The 1,800w option has the virtue of running on a standard wall socket—a massive convenience that lets you choose almost any room or location in which to brew. It's also a cheaper unit to purchase, owing to its lower power and (usually) smaller dimensions. The biggest limitation is batch size: an 1,800w element *can* boil more than five gallons of wort, but it's going to take a long time to do so, and that's time you might not want to spend.

Instead, you can up your game to a 3,500w element, which is only marginally more expensive, but can easily handle a 10-gallon batch (or really stomp on the "gas" for a 5-gallon batch). The downside of the 3,500w setup is a slightly higher initial equipment price, a slight risk of warping in your kettle (more rapid temperature changes can cause distortion in the metal of the pot), and (most significantly) the requirement of a compatible 220v outlet on an appropriately rated breaker. This will either require the services of an electrician, or limit your location options. You might get lucky though, and have access to a 220v outlet for an electric dryer, which might also be conveniently located near a water supply. I would further note that

Portable induction cooktop.

both the 1,800w and 3,500w units I just priced are both cheaper (about $100 for an 1,800w and $140 for a 3,500w) than they were when I purchased them more than a decade ago. Not much falls into that category, and it's a great argument for making the jump to induction brewing, even if only for a pilot system.

When it comes to kettle selection, don't fall victim to the *it must be marked induction-compatible* crowd. So long as a pot is made of a ferromagnetic material—and many of them are, whether marked as such or not—you're good to go. It's a simple test: hold a magnet to the bottom. If it sticks, it's ferromagnetic. The bigger challenge is in kettle geometry.

First, the kettle will work with induction much better if its bottom is perfectly flat. That maximizes contact with the coil. A warped or rounded bottom will lead to hot spots and uneven heating. Second, think tall and skinny (soup can) rather than short and wide (tuna can). The rationale here is driven by the dimensions of your heat source: it's on the narrower side. Most induction units have a coil that's about 9–12 inches (23–30 centimeters) in diameter. This means that for every inch of kettle overhang beyond that diameter, you're losing out on available heating surface and not heating your liquid as effectively. Instead, you want a nice, tight column of heat coming straight up through your wort. Insulation will help, but we'll get to that in just a minute. For now, focus on finding a kettle that's going to work with your system, and minimize its limitations: match your kettle's width to that of your heating element's. Base thickness matters, too, but I've also gotten away with brewing on some pretty low-rent kettles with super-thin bases.

The bottom line is that induction equipment can be surprisingly affordable in both the short and long term.

BREWING WITH INDUCTION

On one level, an induction element is just another heating element. You adjust the power to the task at hand, whether it's heating mash or sparge water, bringing wort to a boil, holding temperature for a whirlpool, or what have you. On the other hand, if you're going to get the most out of your induction brewery, there *are* some functional elements to consider as you make the transition.

First, and this probably isn't unique to induction, you're going to have to engage in some trial and error. Heat settings on an induction element allow you to toggle between selecting a wattage for output or a temperature—but due to kettle volume and geometry variations, the selected temperature doesn't necessarily correspond to the actual temperature of the liquid in the kettle. Obviously, if you're boiling, you'll probably be setting it to maximum output, but for holding lower temperatures, you'll need to do some tinkering to find out which setting on the element produces the desired temperature.

> “Induction is nearly ideal for one method in particular: Brew-in-a-Bag (BIAB).

Next, when brewing five gallons with an 1,800w or 10 gallons with a 3,500w, you may find that you want to help your induction heater get its job done. I've already mentioned adding some insulation to your kettle, and it's both a good idea and an inexpensive addition that will definitely save you heating time. You may also find that it's necessary to fully or partially cover your kettle to get your wort to a boil: that's normal, and as long as you are letting most of the steam escape during the boil proper, you should have no worries about ineffective off-gassing of off-flavors such as dimethyl sulfide (DMS). And while you certainly *can* use an induction unit in a garage or shed, it is more efficient to use indoors, where you can minimize heat losses and keep yourself more comfortable. This might require some accommodation, however, namely in the form of steam management.

You're going to evaporate some percentage of your wort, and that steam has to go somewhere. Personally, I've never had any issues: My indoor brewing space is fairly large, my evaporation rate is minimal (about 10% per hour), and I've never noticed any condensation effects. However, in designing my brewery I *did* leave room for the addition of a vent hood, and others have solved this problem by adding a steam condenser to their brew kettle.

Then there's brewing method, and induction is nearly ideal for one method in particular: Brew-in-a-Bag (BIAB). Now, I spent most of my induction brewing life doing a conventional-ish, cooler mash tun, no-sparge, drain-into-the-kettle operation, but BIAB is so convenient with an induction element! If you're already rocking a 3,500w element and a 10-gallon-plus kettle, it's nothing at all to start with about 8.5 gallons of water and a mesh bag of grain, and just ramp that baby up to your target temps, as my friend Bill McMahon does. If you're in the 1,800w/five-gallon-batch camp, a smaller three-ish-gallon BIAB batch is also perfectly comfortable.

Finally, be sure to keep your system clean. One of the cooler things about this technology is that you can actually lay down a thin silicone mat or some other non-ferrous heat-proof barrier between the glass surface of the unit and your kettle, and as long as the kettle's flat bottom remains within the coil's magnetic field, heating will still commence. In the unlikely event of a boil over then, you have an extra layer of defense keeping your burner free of sticky grime.

ALL IN ON INDUCTION

I'm an economist by training, and I think that background really hooked me on induction. It's inexpensive to acquire, inexpensive to operate, and (once you've spent some time ironing out your process) both more consistent and just as fast or faster than most gas-powered brewhouse heaters. Even if all you did was put together a simple system to augment, and not replace, your "big" system for recipe development or small, one-off batches, you'd still be spending your time and money wisely. My advice? Get in on induction now, and I bet you'll thank yourself later.

Josh Weikert is a professor of political science and is a founding member and past president of the Stoney Creek Homebrewers. He has medaled in every BJCP beer style, is a BJCP Grand Master Judge and Certified Cicerone, and is a two-time Eastern Pennsylvania Homebrewer of the Year.

Best Bitter

Dry Hop Comparison

By Bobby Rinehart

Experimenting with recipe tweaks is one of the best parts of homebrewing. Subbing out this or that malt, trying a new yeast strain (or two), adding a new mash step, or in the case of this article, trialing different dry hop varieties. Homebrew clubs provide a great outlet for these enquiries. Many people in the fairly new Lakewood Fermentation Club (LFC) were happy to sample the results of my brewing trials and provide feedback. We launched in January 2020 and have been faithfully supported by Old 121 Brewhouse in Lakewood, Colo. for our entire existence. In fact, the current owners of Old 121 were founding members of the club, and often participate in the experiments right alongside current club members.

Education is at our core. We meet once a month and host guest speakers from the local brewing industry, tour other breweries or brewery-adjacent facilities (e.g., local maltsters or yeast producers), conduct off-flavor training, have quarterly club brewing challenges (the annual white elephant ingredient exchange is a favorite), and perform sensory analyses to explore the impacts of ingredient or process variations.

The club is also thriving on the competition scene, landing third place overall in the 2023 Front Range Homebrew Circuit (a registered circuit in the Master Homebrewer Program), with three members placing in the top 12, including the 2023 Front Range Circuit Homebrewer of the Year Terry Fast.

MAKING THE BEERS

The club's most recent evaluation involved comparing different dry hops in English Best Bitter (BJCP Style 11B). I worked up a recipe and hosted a club brew day to make the wort. In this instance, we scaled up to a bit larger 6.5-gallon (24.6-L) batch using my single-vessel Brew-In-A-Bag (BIAB) setup. Making wort with fellow brewers is always fun, but the ribs and wings smoked onsite by a fellow club member were what really shined that day. The wort was fermented and then evenly divided into five 5-liter mini kegs for dry hopping and "cask" conditioning.

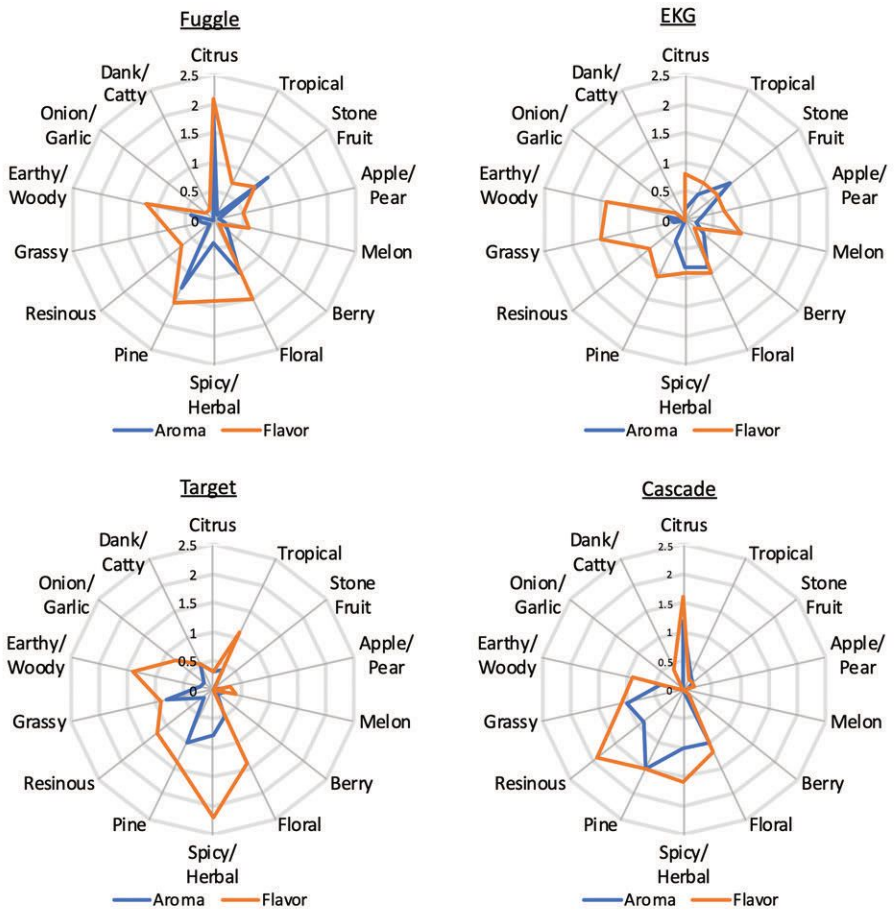
Several well-known regional breweries package beer in these mini kegs, so they are readiy available. They can be purchased for a reasonable price, especially if it's a seasonal beer that has been put on clearance—and the kegs can be cleaned, sanitized, and reused a number of times. (Though it should be noted, once you dry hop in them, there's no easy way I've found to remove the dry hops.)

Once the beer was divided, each keg was dosed with a priming sugar solution. One keg was not dry hopped, and it served as the control for the tasting event, while the other four mini kegs each received a half ounce (14 g) of a different dry hop (equivalent to about two ounces in a five-gallon batch). The dry hop varieties used were Fuggle, East Kent Golding (EKG), Target, and Cascade. The kegs were held at 70°F (21°C) for 12 days to condition before chilling and serving.

The Tasting

The attendees at LFC's January 2024 meeting were presented with the recipe and basic information about the four dry hop varieties before diving in. Each member tasted the base beer, then blind-sampled each dry-hopped beer. Tasters took notes on their experience and also attempted to determine which dry hop was used in each beer, based on their sensory perceptions, basic info provided, and previous experience with the four hop varieties.

Two questions motivated this experiment: how would the various dry hops be perceived in the Best Bitter style, and would my willing subjects be able to correctly identify which hop was which? Also bouncing around the back of my mind was the question, "Would people play along and have fun with the tasting, or was this going to be too much work and not enough beer drinking to make for a good club meeting?" Well, LFC was great (how could I have doubted?). Nineteen brave folks took a stab at guessing which hop was which, and 10 gluttons for punishment completed the sensory survey for all five beers.



Radar graphs depicting average flavor and aroma perceptions for the four dry hop varieties.

Of the 19 participants, three correctly identified all four hop varieties. Interestingly, when just distinguishing the lower-alpha, milder hops (Fuggle, EKG) from the higher-alpha, more assertive hops (Target, Cascade), 13 out of 19 participants were correct, indicating to me that differentiating between hops of a different ilk altogether is a bit easier than attempting to identify each individual variety. This is supported by the finding that Target was the most reliably identified dry hop variety, with 10 out of 19 tasters recognizing it.

Two more interesting findings from the guessing game were that it was very common to confuse the lower-alpha English hops with Cascade, and that Cascade was the least reliably identified of the four varieties. A look at the radar graphs, which depict the sensory data, helps shed light on this. On this particular day, in this particular beer style, Cascade presented as primarily piney and resinous, with only moderate amounts of citrus. In contrast, Fuggle had the highest scores for citrus, tropical, and stone fruit, with EKG being slightly less fruity, and more of a grassy and earthy/woody character. It seems the mild-mannered traditional English hops can be fruitier than we give them credit for!

Similarly, while Cascade is a very well-known hop, our preconceived notion about how it presents in a style that we might not expect to find it in can be misleading. While it did have a prominent spike for citrus, the radar graph for Cascade reveals that it might be more similar to the English hops than we would have thought (at least when used as a dry hop at a relatively low level). The fact that the Cascade dry-hopped beer was tasted last might also contribute to this. Since many tasters were likely convinced that one of the fruitier English hops tasted previously was Cascade, they probably omitted it as a dry hop option for later samplings.

Graphs courtesy of Bobby Rinehart

Brew This!

LFC Best Bitter

Recipe courtesy of Bobby Rinehart

Batch Volume: 5 U.S. gallons (18.9 L)
Original Gravity: 1.044 (11°P)
Final Gravity: 1.012 (3.1°P)
Efficiency: 75%
Color: 12 SRM
Bitterness: 35 IBU
Alcohol: 4.2% by volume

MALTS

6.5 lb. (2.95 kg) Maris Otter pale malt (82%)
10 oz. (283 g) British 55°L extra light crystal malt, (8%)
6 oz. (170 g) British 135°L medium crystal malt, (5%)
6 oz. (170 g) Victory 25°L malt, (5%)

HOPS

0.8 oz. (23 g) EKG, 5.6% a.a @ 30 min
0.8 oz. (23 g) Fuggle, 5.8% a.a @ 30 min
0.8 oz. (23 g) EKG, 5.6% a.a @ 5 min
0.8 oz. (23 g) Fuggle, 5.8% a.a @ 5 min
0.5 oz. (14 g) dry hops (any chosen variety) in each 5-L mini keg

WATER

Calcium 85 ppm, Sodium 15 ppm, Sulfate 125 ppm, Chloride 50 ppm, Bicarbonate 50 ppm

YEAST

Propagate Labs MIP-110 Hazy IPA (or other London Ale III strain)

ADDITIONAL ITEMS

Whirlfloc @ 15 min
Yeast nutrient @ 15 min

BREWING NOTES

Filter or treat water to remove chlorine/chloramine, and acidify to target a mash pH of 5.3. For a BIAB setup, mash in with 6.8 gallons (25.7 L) of water at 159°F (71°C), targeting a mash temperature of 154°F (68°C). Volume and temperature may vary based on your system. Rest for 60 minutes, then pull bag and let drain. Pre-boil volume should be just over 6.5 gallons (24.6 L), at a gravity of about 1.036 (9°P). Boil for 60 minutes, adding hops as indicated. Chill to 62°F (17°C), oxygenate, and pitch plenty of healthy yeast. Let fermentation temperature free rise to 64°F (18°C) and hold there. After two days, increase temperature to 68°F (20°C) over the course of two more days and let the beer finish fermenting. Package, targeting a soft carbonation of about 1.5 volumes.

TAKEAWAYS

There is always something to be learned in this hobby of homebrewing, and I discovered several things from this experiment. First, the traditional English hop varieties are more fruity and complex than I had been giving them credit for. For future brews, I will be adding these varieties as late kettle and dry hop additions to some of my American styles.

Second, using five-liter mini kegs taught me a couple of lessons. Next time, I will use hop socks to limit the amount of hop particles picked up by the keg dip tube (and maybe increase the amount a little bit to account for poorer utilization). I will also account for a little hop creep when calculating the priming sugar. While the base beer was perfectly carbonated, the four dry-hopped kegs were overcarbonated.

Finally, the biggest takeaway is that homebrew clubs are awesome. I had a blast brewing and drinking this beer with fellow brewers who have turned into good friends. I could have done this tasting by myself and made my own observations, but it wouldn't have been nearly as much fun, and I would not have gained as much knowledge as I did with the input from my club members. Our hobby is great, and it is even greater when shared!

Bobby Rinehart is a Geotechnical Engineering Laboratory Manager by day, and a beer brewer pretty much the rest of the time. He has been homebrewing for more than 20 years (college apartment stovetop days were the best!) and recently completed the Craft Brewing Certificate program at Regis University. Rinehart is a certified BJCP judge and also enjoys woodworking, gardening, camping, and spending time with his wife, three daughters, and grandson.

Tasters hard at work.

Mini kegs on the bar ready for pouring.

Photos courtesy of Bobby Rinehart

Relax, Don't Worry, Have a *Homebrew!*

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 (66–67.2°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 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)

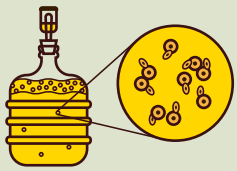
SMaSH – single malt and single hop

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. (28 g) 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

ADVERTISER INDEX

To advertise in *Zymurgy*, contact us at sales@BrewersAssociation.org

LAST Drop

BY MARK PASQUINELLI

I Got This

Nothing ventured, nothing gained. Sometimes a little adversity is exactly what's needed to bring out your best. I entered the world of homebrewing with great excitement, but my enthusiasm was tempered by reality. I soon realized this hobby would present me with an ever-evolving set of challenges to overcome.

When asked once how he writes his many massive novels, Stephen King replied, "One word at a time." Baby steps, I told myself. Don't get bogged down in minutiae and complicate what's simple, as I tend to do.

Knowledge is power, and it was in short supply when I began homebrewing nearly 30 years ago. The internet was in its infancy—an enigma to a Luddite like myself—and even then it appeared to be littered with misinformation. I relied heavily upon Charlie Papazian's *Complete Joy of Homebrewing* and *Zymurgy*, and eventually subscribed to other magazines. As I became more tech savvy, I started following primitive message boards, participated in forums, and graduated to social media groups, which provided rapid feedback to my posted enquiries and exposed me to how other homebrewers were solving their own problems. Perhaps this unquenchable thirst for information is why I feel compelled to write about this hobby and assist others through my discoveries and occasional failures.

Many homebrewing pioneers were engineers, innovators who could either build from scratch or repurpose items into equipment that didn't yet exist. As someone blessed with zero mechanical ability, my learning curve in this area was (and still is) steep. When I finally joined a club, I asked questions about brewing rigs and processes, made countless trips to hardware stores—discovering tools and parts that I didn't know existed—and became a big YouTube user. Now I'm proud to say I'm almost competent: I can solder, connect gas pipelines, and experience only minimal fear of amputation whenever I miter-saw a super strut.

Some projects, however, are best approached by deferring to a professional. Not wanting to short-circuit my township's power grid or electrocute myself, I farmed out the wiring of my garage and brew stand to a retired electrician and club member in exchange for some homebrews and craft IPAs. To borrow the words of Clint Eastwood's Dirty Harry, sometimes "a man has to know his limitations." When you meet other people through brewing clubs, this kind of collaborative possibility nurtures relationships and makes life a little easier for you too, so you don't have to take the time and energy to learn everything yourself.

With retirement from the nine-to-five grind on the horizon, I have made changes to my brew garage and workflow to keep Father Time at bay. I've installed more lighting to compensate for my encroaching farsightedness. My eyesight also forces me to take an extra moment to check connections and be sure the proper valves are open or closed. Yet these concessions to age have also proven to be blessings in disguise, allowing me time to stop and smell the roses (or in this case, boiling wort).

Time is my most valuable—and irreplaceable—commodity. As such, to maximize efficiency and reduce effort, I've streamlined several processes, such as minimizing my sparge and boil times (to no ill effect), and not dry-hopping my beers for longer than two to three days. As a result, brew sessions that used to run well into the afternoon are now a wrap by lunchtime.

I love drinking high-alcohol beers, but for my health's sake, many of my house brews have become more sessionable. And guess what? They can be every bit as tasty as the big boys, and I can have more than one.

I want to homebrew for as long as I'm physically able, and for that to happen, I foresee a time when I'll need to simplify and scale down my three-vessel operation. Homebrewing guru Denny Conn did just that, retiring his hose braid mash tun cooler for a Grainfather after more than 500 brews. His brew days are now less than four hours, including cleanup. For both of us, brewing remains a top priority as we age. I guarantee there will be a single-vessel brewing system in my future.

Curiously, I've also been waging an ongoing battle with myself. Sometimes I'm too smart for my own good, resulting in tunnel vision and false confidence. Something I often say to my wife is, "I know what I'm doing." A coworker once quipped that my headstone should bear the proud epitaph "I got this." Most of the time I do, but occasionally I don't, and my words come back to haunt me. As a result, I've learned to run some of my crazier ideas past a pro brewer friend first.

While writing this article, I was struck by an epiphany. Homebrewing has helped me overcome some of my biggest personal challenges, making me a better person. It's provided the impetus for me to make friends with technology, collaborate and ask for help, enjoy the brew day even more than I used to, optimize processes, plan for the future, and do it all as a humbler human being. I've erased many self-doubts by improving in all these areas

When I'm with fellow homebrewers, I feel as if I belong. I'm with my tribe. Shyness is mostly a thing of the past, although it's admittedly easier to connect with people while drinking a beer. I'm also a better problem solver, and an almost passable handyman around the house. Serving as my club's president has also taught me leadership and diplomacy, and honed my logistical skills—for example, by helping to get the PA Alers' beer poured at Club Night in Pittsburgh. Plus, I'm making better beer than I would have ever imagined. Indeed, I got this—and I owe it all to homebrewing.

Photo © Getty/rasilja

Mark Pasquinelli resides in the bucolic town of Elysburg, Pa., where he spends his time in varying degrees as a husband, writer, homebrewer, microbiologist, and manservant for seven felines.


Now Serving
CRAFT MASTER GROWLERS
Nitro Cold Brew
Craft Cold Brew Coffee Kit
Infuse - Filter - Serve
N2O
www.craftmastergrowlers.com