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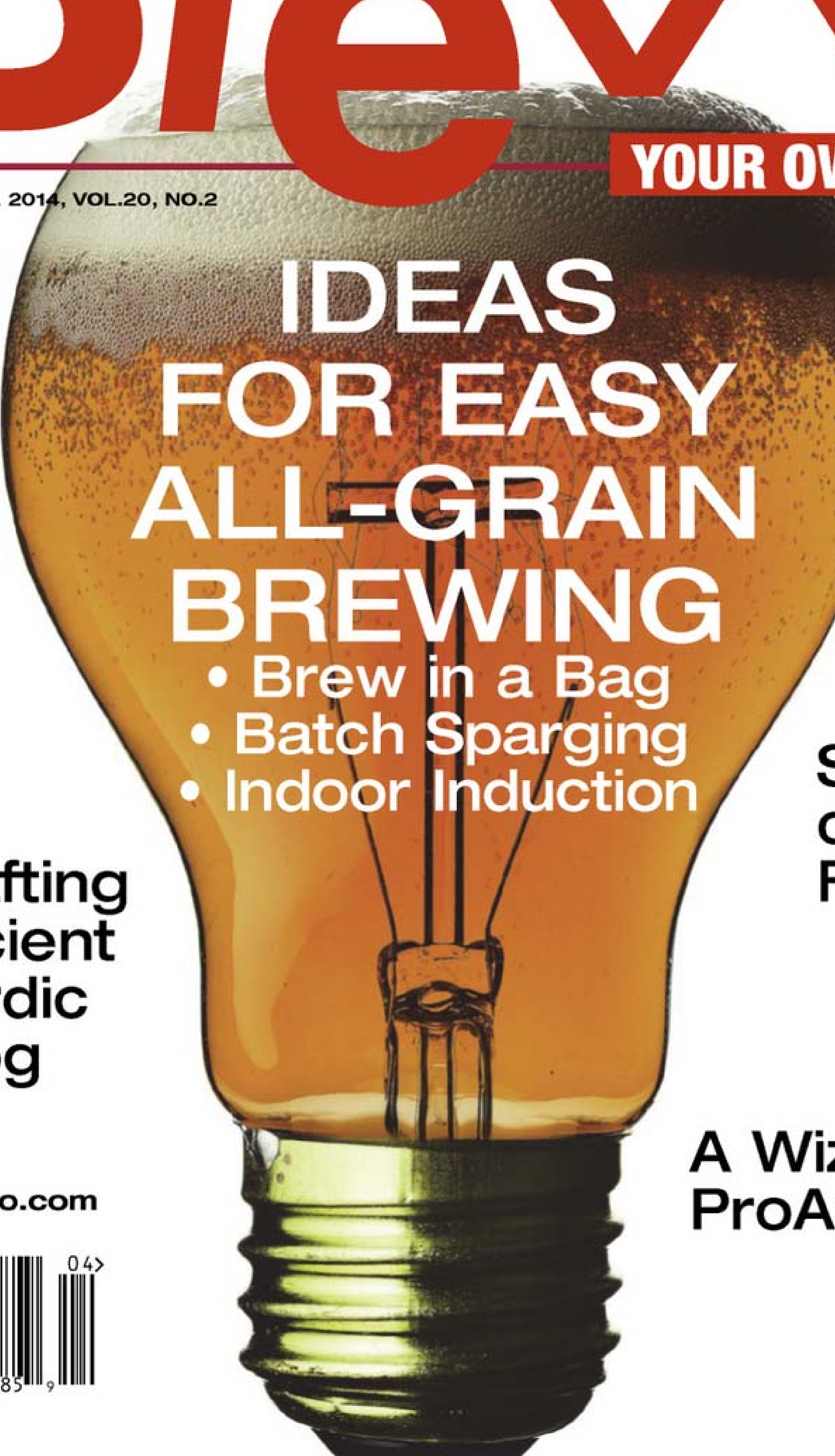
Brew Your Own®

THE HOW-TO HOMEBREW BEER MAGAZINE

MARCH-APRIL 2014, VOL.20, NO.2



IDEAS FOR EASY ALL-GRAIN BREWING

- Brew in a Bag
- Batch Sparging
- Indoor Induction

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A Wizard ProAm Brew

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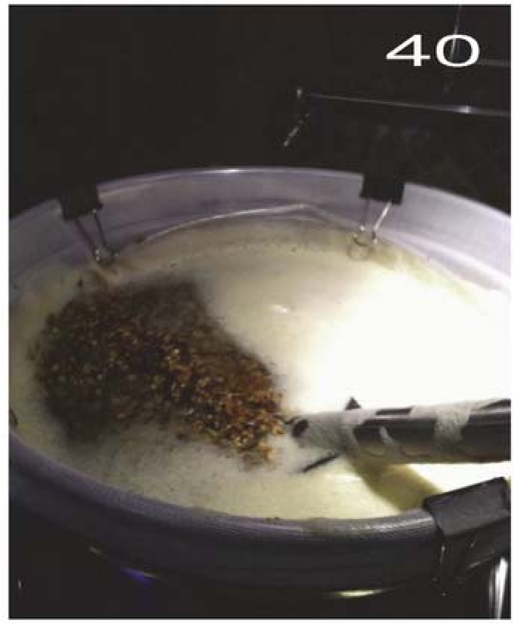

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BYO RECIPE STANDARDIZATION

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

Extract values for malt extract:
liquid malt extract (LME) = 1.033–1.037
dried malt extract (DME) = 1.045

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

Hops:
We calculate IBUs based on 25% hop utilization for a one-hour boil of hop pellets at specific gravities less than 1.050. For post-boil hop stands, we calculate IBUs based on 10% hop utilization for 30-minute hop stands at specific gravities less than 1.050.

what's happening at **BYO.COM**

Two Ancient Brews

Dogfish Head Craft Brewery, known for their innovation and esoteric beers, have proven that what's old is new if you go back far enough in time. In addition to the Nordic grog on page 58 of this issue, check out clone recipes for Dogfish's Midas Touch and Chateau Jiahu: http://byo.com/story1537

10 Classic Mr. Wizard Questions

Mr Wizard, Ashton Lewis, has been answering qustions for *Brew Your Own* readers since way back in 1995. Read some of his favorite questions and answers from over the years: http://byo.com/story4-10

Yeast Ranching

One of the biggest advantages commercial brewers have over homebrewers is an ample and ready supply of yeast. They routinely "harvest" yeast from a recent batch and pitch it onto a new batch of beer. If you can't reuse your yeast in a timely fashion at home, there are a number of ways to store it, then grow it up to pitchable amounts later: http://byo.com/story1662

Keep up with *BYO*'s Editor

Follow along throughout the year with *Brew Your Own* Editor Betsy Parks as she brews, drinks beer, travels and writes about homebrewing: http://byo.com/editorsblog

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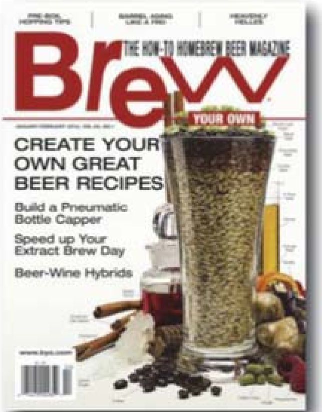


IBU calculation question

I thought this would be a good time to throw this question out to *BYO* since Brad Smith (author of BeerSmith brewing software) just did his first article for the magazine in the January-February 2014 issue ("Homebrew Recipe Design"). I've had a difficult time getting IBU calculations in BeerSmith to line up with other sources (including *BYO*). I've found that for the most part, if I apply a -2.2% utilization factor to hop pellets in BeerSmith (an unrealistic number I realize), that the IBUs posted in *BYO* recipes seem to line up for the most part. The exception seems to be when whirlpooling is involved. I'm wondering if Brad can provide any insight for the readers as to how to properly configure BeerSmith to more accurately represent IBU calculations. Sure, I can blindly follow recipes from the magazine because I know they are reliable, but I'd like to understand it a bit better so I can apply the same logic to other recipe sources.

Brian Jameson
Poughkeepsie, New York

Story author Brad Smith replies: "Hi Brian. BeerSmith uses the Tinseth equation to estimate bitterness by default. Tinseth is considered to be more accurate for full boil brewing such as all-grain. However, some other sources prefer to use the Rager equation for estimating IBUs. Rager generally will give you a higher IBU estimate than Tinseth, but is widely used for extract brewing. You can change to either equation within BeerSmith by simply going to the Options->Bitterness page if you prefer one over the other." BYO *Recipe Editor Dave Green adds: "The* BYO *formula is closely aligned to Rager's formula assuming 25% hop utilization with hop pellets for an hour boil (gravity dependent). For whirlpools we use the same formula but assume 10% hop utilization for a half-hour whirlpool."*

Cask ale question

It seems you always have an article that amazes me. A case in point is your December 2013 cask conditioning story by Christian Lavender. I have been conditioning my

contributors

Derrick Hakim is a homebrewer from Bloomfield Hills, Michigan, who began brewing back in the mid 90s. After taking some time off from homebrewing he started back up in 2011, and shortly thereafter he began brewing exclusively Brew-in-a-Bag (BIAB). Derrick runs the website http://BiabBrewing.com, where he blogs about his BIAB projects and brew days, with articles and videos that detail his entire journey through the Brew-in-a-Bag method of all-grain brewing. In this issue, starting on page 40, Derrick shares his first feature story for *Brew Your Own* that details the basics of BIAB for the first-timer, including the equipment you will need (spoiler alert: you probably already have a lot of it!) and how a typical BIAB brew day breaks down.

Michael Dawson is the Brand Manager at Wyeast Laboratories, Inc. in Odell, Oregon, which provides fresh, pure liquid yeast to hobbyists and professionals around the world. Before coming to Wyeast, Michael worked as the Brand Manager and Senior Product Development Manager at Northern Brewer in St. Paul, Minnesota, where he helped create Brewing TV, a webcast and community-based project that used video to tell the stories of American homebrewing and craft beer. He is also an active homebrewer and contributes to a number of brewing magazines. In this issue, starting on page 64, Michael discusses using yeast nutrients in your homebrews.

Josh Weikert took up homebrewing in 2007 as a means of staying sane during graduate school, and even though school is over the brewing continues! He is a founding member and the president of the Stoney Creek Homebrewers (from East Norriton, Pennsylvania), has medaled in every BJCP beer style, is a BJCP Master Judge, and is a two-time (and reigning) Eastern Pennsylvania Homebrewer of the Year. Josh is a professor and lecturer in political science, specializing in political communication and political psychology. He lives in Collegeville, Pennsylvania with his wife, Barbara (also an award-winning homebrewer), and their dog Biscuit (who has yet to win any medals). In this issue, on page 28, Josh discusses brewing with induction heat.

beer in Corny kegs for about 20 years. When I want English barrel ale I just set my CO_2 pressure so that it just brings my beer to the tap. I have no additional cost. What am I missing?

George F. Fike
Buford, Georgia

Story author Christian Lavender replies: "George, your method certainly does work, but it is a step further away from the CAMRA definition of what 'real ale' is. My method still uses a beer pump to pull beer from the 'cask' and a sparkler to give the beer a nice head. The CO_2 is only used as a blanket to keep the beer from spoiling too quickly and the breather valve makes sure the pressure from the CO_2 never gets high enough to absorb into solution.

It sounds like you use the CO_2 to push beer all the way to the tap, which eliminates the need for the beer pump and sparkler. Lots of different ways to skin this cat and some are closer and further to what CAMRA considers authentic cask conditioned 'real ale.'"

Control box clarification

In the story "Homebrewing Electrical Design 101: Build an Electrical Control Panel" in the December 2013 issue of *Brew Your Own*, the SSR is not used to turn on and off other devices. The SSR pictured can cycle 25 amps as often as you want and the SSR's in that family are rated up to 75 amps. They are used because they do not have contacts and do not wear like a mechanical relay does. I normally use dual SSR's with a 2-10 vdc input card that pulses the relay in relation to the input — they can be switched very quickly. I work with building automation and temperature control systems daily. Mechanical and SSR relays switch at the same speed, the difference is how much they can be cycled before they fail.

Rich Carson
via email

Story author Walter Diaz responds: "Hi Rich. We are both talking about the same concept. You mention the SSR in the picture is used to cycle 25 amps of current. This cycling of current is what turns on/off devices. I am referring to the practical application. Also, you mention that the SSR can be switched very quickly, which is what I mean when I talk about fast switching loads. In my opinion, if the mechanical relay is prone to failure when used at fast switching speed then it is not suitable for fast switching applications. This is why I recommend SSR for fast switching loads, and mechanical relays for slow switching loads." BYO

homebrew nation

READER PROJECT: Hop Bread

Matt Frey • Montrose, Colorado

As we were hiking through the San Juan Mountain Range of the Colorado Rockies one afternoon, my friend Neal asked an interesting question: "Do you think that you could get hop flavor into a freshly baked loaf of bread?" And so the quest began.

I had access to plenty of hops; that was the least of my problems. Cascade, Columbus, Chinook, and Centennial were in ready supply in the backyard of another friend, Joel McRae. We had been all-grain brewing together for quite a while and he was just as excited about baking a loaf of "hop bread" as I was. The difficulty was figuring out how to do it.

I scoured the Internet on brewing sites, and cooking sites without finding anything substantial. There are plenty of "beer bread" recipes out there of course, but not a lot of information on utilizing the aromas and flavors of the hop plant in the baking process. I called local bakeries, spoke to breweries with established restaurants, and emailed a number of publications that dealt with food and beer on a regular basis. Unfortunately, it seemed no one had ever attempted such a project before.

A local brewer and entrepreneur, Tom Hennessy, founder of Colorado Boy Brewery and Pizzeria (among others), offered a suggestion that seemed to make the most sense. As opposed to boiling the hops like you would to extract the alpha acids, he thought it would work to steep the hops in 190 °F (88 °C) water like you would with finishing hops. That "hop tea" could then be used in place of the water in the bread recipe.

I steeped a 1-gallon (3.8-L) bag of whole, dried Cascades, in just enough water to envelop the entire bunch for 15 minutes. I then substituted the appropriate amount of this hop tea into a basic white bread recipe. The result was surprisingly good: just enough citrusy, piney, and floral flavor to notice the hops, but not an overpowering bitterness.

My second attempt was even better. With a one-gallon (3.8-L) bag of whole Columbus hops in hand this time around, the flavor profile of the hops was accentuated even more. I also rubbed a few of the hop cones over the freshly buttered tops of the loaves right after taking them out of the oven in order to "sprinkle" them with the lupulin from the remaining Columbus. There was an unmistakable hop bite to the bread, leaving a lingering dryness on the back of the tongue just like a good IPA tends to do. In fact, it was so similar to a hop-forward beer that my wife, a wheat beer drinker, refused to eat it. My brother Adam (in the picture, on the right), on the other hand, who helped me bake this batch, couldn't get enough of it.

Up next: Hop hamburger buns? Hop pizza crust?

reader recipe
Hop Bread (2 loaves)

Ingredients

- 4½ tsp. dry active yeast
- ¾ cup warm, hop-steeped water
- ¼ cup granulated sugar
- 1 tbsp. salt
- 3 tbsp. unsalted butter
- 2⅔ cup additional warm, hop-steeped water
- 9-10 cups all-purpose flour
- 4 tbsp. unsalted butter, melted

Follow the cooking instructions found at http://www.thecurvycarrot.com/2011/03/28/rosebuds-butter-topped-white-bread/

byo.com brew polls

Do you ever homebrew using the brew in a bag method?

Yes, BIAB is how I usually homebrew 33%
No, but I would like to learn how 26%
No, I am not interested 25%
Yes, occasionally 16%

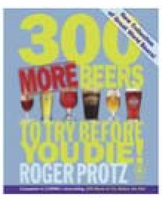
what's new?

Patagonia Malt & Gleneagles Maris Otter

PATAGONIA MALT by MALTEXCO

Patagonia Malt and Gleneagles Maris Otter by Crisp Malting are now available to homebrewers through Brewers Supply Group. Patagonia malts, grown in the unique climate conditions of the central-south zones of Chile, range from an Extra Pale Malt base malt that is low in color and DMS (dimethyl sulfide) precursors to rich caramel malts ranging from 15 °L to 190 °L to Black Pearl, a 100% huskless roasted malt that is and extremely low in astringency. Gleneagles Maris Otter is an English, ale-style malt made from the famous Maris Otter barley variety and malted in a traditional floor-malting facility. Ask for these malts at your homebrew retailer.

300 More Beers to Try Before You Die!



An extensive companion to *300 Beers to Try Before You Die!*, Roger Protz's new release *300 More Beers to Try Before You Die!* challenges readers to seek out even more of the world's best beers. It allows readers to easily search for a wide variety of beers, which are organized by style and flagged with the brewery location. There is also space for readers to jot down their tasting notes. *300 More Beers to Try Before You Die!* will encourage both connoisseurs and novice beer drinkers alike to expand their knowledge and palate. Available at major booksellers.

Avangard Malz

AVANGARD MALZ

LD Carlson introduces Avangard Malz to US brewers, as Avangard's exclusive stateside distributor. Produced in accordance with the German Beer Purity Law of 1516, strategic placement of their four state-of-the-art malting facilities near German grain producers assures the freshest and highest quality malt will be delivered quickly and consistently. Ask your local homebrew retailer for Avangard malts by name; Premium Pilsen, Premium Munich Light, Premium Wheat, Premium Caramel Light and Premium Caramel Medium. (Premium Munich Dark and Premium Pale Malt are coming soon.)

2014 WineMaker International Amateur WINE COMPETITION

calendar

March 7
Deadline for the 2014 WineMaker International Amateur Wine Competition
Manchester Center, Vermont

Submit your best meads by March 7 into the world's largest amateur wine and mead competition to get valuable feedback from experienced judges. Compete for medals in three different mead categories and a Best of Show Mead award. Judging will be held April 11-13.
Entry Fee: $25 per entry
Web: www.winemakermag.com/competition

March 22
Charlie Orr Memorial Chicago Cup Challenge
Crest Hill, Illinoise

Entries for the 23rd annual competition hosted by the Brewers of South Suburbia will be accepted from February 24-March 8. The AHA-sanctioned competition is part of the Midwest Homebrewer of the Year competition circuit and features the Chicago Beer Cup, which is awarded to the homebrew club that accumulates the most points. Prizes will be awarded to the winners of each flight, and a separate Best of Show. Among this year's judges will be Gordon Strong, President of the Beer Judge Certification Program and author of *Brewing Better Beer,* who will also be speaking at the evening's awards dinner afterwards.
Entry Fee: $7
Web: www.bossbeer.org/competition.html

March 29
Brew-Seum Battle of the Brew
McAllen, Texas

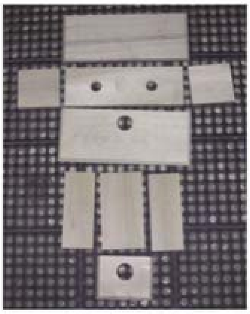
The third annual Battle of the Brew homebrew competition is an AHA-sanctioned event accepting beers from categories and sub-categories 1-22 from the BJCP Style Guide. The competition is one of many events that celebrate the International Museum of Art and Science's Brew-seum Craft Beer Week, which will be held March 29-April 5th, 2014. Entries must be received or post marked by March 3.
Entry Fee: $10 per entry
Web: www.brew-seum.com

homebrew drool systems

Wooden Draft Tower

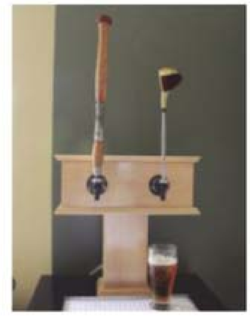
Andre Viau • Montréal, Québec

After my full-size refrigerator-turned-kegerator died, I was left wondering how I could build a new kegerator while re-using the parts. I decided to go with a smaller dorm fridge that I bought at a discount with a two-faucet tower. My previous kegerator did not have a tower, so I needed to find a way to build one. Soon after, I saw a project, kind of a portable bar with a wood tower for the faucet . . . BINGO!



I drew up the plans, did all of the measurements, and even made a cardboard model. When I knew exactly what I wanted, I brought the plans to a wood shop my friend François owns. It's good to have a friend with a wood shop who you can pay for services with homebrew!

On a Saturday we cut and assembled the wooden puzzle that would become my draft tower. I left the top section of the tower without a back to give me space for cleaning the taps and tubing. And it's the perfect place to store kegging tools.



By the end of the project, I was able to reuse my two faucets and all the fittings, spend time with a friend, and make a classier looking kegerator! The final touch, in memory of my father and my father-in-law, was making one tap handle from a fishing pole and another from a golf club.

FRESH HOPPING

by dawson raspuzzi

One of the best things about growing your own hops is the opportunity to then experiment with them in your homebrew. One way to do this is to try fresh hopping (sometimes called wet hopping) — that is, forgoing the drying process and using the hops in your brewing the same day you pick them from the bines. Of course, fresh hopping is an opportunity that comes only once a year (unless you can source fresh hops from a supplier in another region) as hops must be used or dried and stored within days of being harvested or they will lose some of their key brewing properties. Even if you don't grow your own, hop suppliers have caught on to the trend of "harvest beer" (beer that includes fresh hops) in recent years and found ways to market fresh hops that can be delivered overnight to your door.

Generally, hops are harvested, dried, and compressed into bales. Over the course of the year the bales are broken apart and the whole hops are milled and pelletized and then vacuum-packed to be sold as hop pellets. Much like fresh produce that has been frozen, hops are sure to lose a little bit of the freshness quality as they age. Fresh hopping can give your beer a more vibrant hop aroma and taste, however little scientific research into the variation of aroma compounds in fresh hops compared to dried hops has been done, as Stan Hieronymus points out in his book *For the Love of Hops*. "Results of studies that track how dramatically essential oils change in the days before hops are picked imply that wet hops, which do not contain the same oxygenated fractions as kilned hops, may produce different odor compounds than those that are dried. Unfortunately, no similar studies about wet hops have been published," Hieronymus states.

Most brewers stick to dried hops at the beginning of the boil to extract bitterness in their harvest beers and then use fresh hops near the end of the boil, in a whirlpool, or for dry hopping in the secondary fermenter. One reason fresh hops are not often used to add bitterness is that the alpha acid content of the hops is unknown. One of the great things about homebrewing is you can experiment with small batches and determine when, and in what quantity, fresh hop additions work best! A word of caution though, using too many fresh hops can give a beer a "grassy" taste. Some homebrewers on the Internet warn against using fresh hops to dry hop, however Ashton Lewis, *BYO*'s own Technical Editor and Mr. Wizard, says neither drying nor freezing hops will reduce the microbiological load on hops and there should be no microbiological concerns when using fresh hops in the secondary. "The truth is that dry hopping is not implicated with causing micro problems in beer," he states. The bigger concern, he says, is that fresh hops may impart more "grassy" aromas than desired for some beers, which is a good argument for adding fresh hops to the kettle instead.

One of the most important things to take into consideration when using fresh hops is the weight differential between them and those that have been dried. According to Mark Garetz's book *Using Hops: The Complete Guide to Hops for the Craft Brewer*, hops fresh off the bine are 80% percent moisture, but when dried the moisture content is just 8%. With that water weight adding nothing in the way of taste or aroma, brewers often use anywhere from 5 to 8 times as much fresh hops (in weight) as dried hops. For instance, if a recipe calls for 1 oz. of dried hop pellets at knockout, you will want to add 5 to 8 oz. of fresh hops in their place to impart the same effects.

by marc martin

DEAR REPLICATOR, EVERYONE HAS A FAVORITE BEER — MINE IS SWITCHBACK ALE FROM SWITCHBACK BREWING CO. IN BURLINGTON, VERMONT. IN FACT, MY WIFE AND I LIKE IT SO MUCH WE SERVED IT AT OUR WEDDING. CAN YOU HELP GET THE RECIPE SO I CAN TRY BREWING SWITCHBACK ALE AT HOME?

SETH BEAUREGARD
MT. TABOR, VERMONT

You would be hard pressed to find another brewery owner and Brewmaster with a more diverse background than Bill Cherry.

Bill started his working life in the food products quality control industry — first in a bologna factory then a Claussen pickle plant. Having a distinct fondness for beer, and seeing the bourgeoning craft beer movement, he decided the beer industry should be his next move.

In 1992, his next stop was UC-Davis, where he even worked with *BYO*'s "Mr. Wizard" columnist Ashton Lewis to teach some classes. Wanting to learn brewing on a large scale, Bill interned at Anheuser Busch in Colorado. He later became the Head Brewer at Boulevard Brewery in Kansas City, Missouri and he remained there from 1993 to 1998.

With his brewing skills perfected, Bill decided it was time to set out on his own. A good friend, Jeff, who owns an electrical engineering company, claimed that Burlington, Vermont would be ideal. Jeff's engineering expertise combined with Bill's brewing knowledge proved to be the magic combination. With a 15 barrel brewing system procured from a defunct brewery in Arizona, their first batch was brewed and served in the fall of 2002. From the beginning, Bill's idea was to not be a slave to style guidelines. He wanted to brew beers that would be different from the standard craft beers and would appeal to a wide variety of consumers.

Things started slowly but his marketing plan proved successful. From those humble beginnings, they quickly outgrew the original 15 barrel system, although he still uses it for specialty beers. A beautiful 66 barrel copper brewhouse was imported from Beerfelden, Germany and this allowed Switchback to hit the 10,000 barrels per year mark in 2012. With a bottling line added last year, sales jumped to 15,000 barrels largely due to the demand for Switchback Ale. Now their beers are available throughout much of New England and production continues to grow.

The Switchback Ale recipe appears fairly simple, but the combination of grains lends a distinct complexity. Light and dark carastan malts create nice caramel notes with a somewhat nutty background while the black malt is only included for color. The hopping level is just enough to develop a perfect balance with the remaining sugars. The addition of a three-varietal hop blend for only five minutes helps develop a complex aroma. Bottle conditioning provides a fine white head that lasts to the bottom of the glass. A great beer for spring, but good for any season.

There you go Seth. You'll never run out of Switchback Ale again because now you can "Brew Your Own." For more information about Switchback Brewing Company visit www.switchbackvt.com. BYO

Switchback Brewing Company's Switchback Ale Clone
(5 gallons/19 L, extract with grains)

OG = 1.046 FG = 1.008 IBU = 30 SRM = 13 ABV = 5%

Ingredients

3.3 lbs. (1.5 kg) Briess light, unhopped, liquid malt extract
1.5 lbs. (0.68 kg) light dried malt extract
1 lb. (0.45 kg) 2-row pale malt
10 oz. (0.28 kg) light carastan malt (14 °L)
1 lb. (0.45 kg) carastan malt (34 °L)
2 oz. (57 g) black malt (530 °L)
9.6 AAU Simcoe® hop pellets (60 min.) (0.75 oz./21 g at 12.8% alpha acids)
1.7 AAU Sterling hop pellets (5 min.) (0.25 oz./7 g at 6.7% alpha acids)
1.1 AAU Vanguard hop pellets (5 min.) (0.25 oz./7 g at 4.5% alpha acids)
1.1 AAU U.S. Saaz hop pellets (5 min.) (0.25 oz./7 g at 4.3% alpha acids)
½ tsp. Irish moss (30 min.)
½ tsp. yeast nutrient (15 min.)
White Labs WLP001 (American Ale), Wyeast 1056 (American Ale) or Safale US-05 (American Ale) yeast
Priming sugar (if bottling)

Step by Step

Steep the crushed grain in 2.5 gallons (9.5 L) of water at 154 °F (68 °C) for 30 minutes. Remove grains from the wort and rinse with 2 quarts (1.8 L) of hot water. Add the malt extract and boil 60 minutes. Add the hops, Irish moss and yeast nutrient as per the schedule. When done, add the wort to 2 gallons (7.6 L) of cold water in a sanitized fermenter and top off with cold water up to 5 gallons (19 L). Cool the wort to 75 °F (24 °C). Pitch your yeast and aerate the wort heavily. Allow the beer to cool to 68 °F (20 °C). Hold at that temperature until fermentation is complete. When complete, transfer to a carboy, avoiding spashing, and allow the beer to condition 1 week. Then bottle or keg.

All-grain option:

This is a single step infusion mash using an additional 7 lbs. (3.2 kg) 2-row pale malt to replace the malt extracts. Mix all of the crushed grains with 3.5 gallons (17 L) of 166 °F (78 °C) water to stabilize at 154 °F (68 °C) for 60 minutes. Sparge with 175 °F (79 °C) water. Collect approximately 6 gallons (23 L) of wort runoff to boil for 60 minutes. Reduce the 60-minute Simcoe® hop addition to 0.5 oz. (14 g) (6.4 AAU) to allow for the higher utilization factor of a full wort boil. The remainder of this recipe and procedures are the same as the extract with grains recipe.

Vienna Lager

tips from the pros
by Dawson Raspuzzi

Hard to find, harder to brew

VIENNA LAGER ORIGINATED IN AUSTRIA IN THE 1830s BUT HAS SINCE GONE JUST ABOUT EXTINCT IN EUROPE, WITH BREWERIES REPLACING THE STYLE WITH PILSNERS AND OKTOBERFESTS. AUSTRIAN IMMIGRANTS MADE VIENNA LAGERS POPULAR IN MEXICO LATER IN THE 19TH CENTURY AND TODAY THERE ARE A HANDFUL OF AMERICAN CRAFT BREWERIES PRODUCING VIENNA LAGERS AS WELL.

Vienna-style lagers were the first beers I fell in love with during a high school trip to Germany. Good Vienna-style lagers are smooth, malty, and slightly sweet. You want a good balance between the base malt and Munich malts. This appeals to a wide audience even in today's market.

Darker crystal malts tend to be a little harsh or "roasty" for the style. I prefer medium-colored Munich malts — 20 °L is my favorite. Don't overuse the crystal malts, keep them under 30% or they become overpowering. We use 11.8% light Munich, 7.8% each of crystal 60 °L and Munich 20 °L. Then just two-row base malt.

The biggest key is aging — four weeks from brew day is a minimum, but 5 to 6 weeks is best to temper the hops and sulfury lager flavors.

We use Millennium as our bittering hop for Schildbrau. We used to use German noble varieties for the finishing hops, but their availability is somewhat intermittent. Mt. Hood is a good substitute and remains readily available. Schildbrau varies from 16-18 IBU because I adjust things from year to year as the malt flavors change. Yeast performance can also vary, which affects the final sugar profile. The IBUs are a little low for the style guidelines, but I do prefer a sweeter beer for this style, thus accentuating the malt character.

Our lager yeast prefers to ferment at 60 °F (15.5 °C). That's a little warm, but we use a refrigerated cellar so I suppose it needs to compensate for the ambient cellar temperature. It takes 5-10 days for the primary fermentation, then I transfer it off the yeast and age it another 2-3 weeks.

Water is very important for this style. If your water is hard, keep the O.G. higher (over 1.048) by using more base malt or blend in some distilled water when mashing.

Chris Priebe is Co-Owner, Head Brewer and Chief Engineer at Millstream Brewing Co. in Amana, Iowa. Chris graduated from the Siebel Institute of Brewing Science and has received national and international acclaim for his beers. His Vienna lager, Schildbrau Amber, won a gold medal at the World Beer Cup in 2010.

Vienna lager is a hard style to brew. It puts your methods right out there in the open because there is nothing to hide off-flavors. Most American breweries create bitter, drier versions of Vienna lagers, but we steer towards the more traditional European version of the sweeter-style lager. The decoction boiling process adds to the complexity of this recipe and creates the crisp lager we are looking for.

We make 15-barrel batches. The grain bill for our recipe is two-thirds Vienna malt and then about 17% light Munich malt, 8% dark Munich malt, 8% Pilsner malt and less than 1% acidulated malt.

Our first hop addition uses Perle and Hallertau, and for the second addition I use Tettnang and Saaz. The hops are subtle with a low noble hop aroma. Hallertau and Perle complement each other well with their earthy/spicy qualities. The Tettnang are peppery and act well with the delicate flowery aroma of the Saaz.

We ferment four days at 50 °F (10 °C), then at 54 °F (12 °C) for four days for a diacetyl rest and crash at 33 °F (1 °C) for three days. Then we give it 30 days to lager at 36 °F (2 °C).

My best advice for homebrewers who want to try the style is to adhere to your fermentation and lagering temperatures. Your diacetyl rest is critical and can define your brew, not in a good way. The style should not have fruity esters or diacetyl in it whatsoever. If you are diligent in your techniques, you will be rewarded with a clean Vienna-style lager.

JP Williams became the Brewmaster of Trapp Lager Brewery in Stowe, Vermont in 2012. Prior to that, he was a Brewer and General Manager at Magic Hat Brewing in South Burlington, Vermont. JP began homebrewing in college after a trip to the Guinness Brewery in Dublin, Ireland sparked his interest in fine beer.

Jason Oliver is Brewmaster for Devils Backbone Brewing Co. in Roseland, Virginia. He attended the UC-Davis Master Brewers Program and has been brewing professionally since 1996. Since opening in 2008, Devils Backbone has received numerous accolades including the 2013 Great American Beer Festival "Small Brewing Company & Brewmaster of the Year." Its Vienna Lager has received gold medals at both the GABF and World Beer Cup.

For half my career I exclusively brewed Germanic-style beer and in two of the breweries I worked, Märzen was one of the flagships. When I started Devils Backbone, I didn't want another Märzen because I was never a huge fan of the style. I decided to make Vienna-style lager one of DB's flagships because they are slightly lower in gravity than Märzen, a little more refined, more delicate, and more to my taste.

The secret to a great Vienna lager, first, is it has to have a clean lager fermentation. It should have that lager drinkability with an apparent malt character that is a balance of toasted and caramel malt flavors. Hops are a supporting role that should not overwhelm and essentially just hold the malt in check.

Our Vienna Lager is brewed from a base of roughly equal parts Pilsner and Vienna malt, with dark Munich and caramel malt adding character in roughly equal percentages to each other as well. Our Pilsner malt is Canadian Malting Superior Pils, which I like because of its low DMS potential and its delicate flavor. The Vienna, Munich, and caramel malts are all of European origin.

We use German Northern Brewer for bittering. It's kind of an old fashion hop now, but I love it. It tastes and smells like a hop should. It has classic hop character, not just bittering potential. For flavor and aroma we use Czech Saaz. If you asked me five years ago if the type of bittering hop mattered much I would have said "not really," but now I really think they do. While you may not be able to put a finger on it all the time, bittering hops add more than just IBUs.

We cool the wort to about 52 °F (11 °C) and let the temperature rise into a fermentation range of 53-54 °F (12 °C). The total production time is about 5 weeks. BYO

For more tips from these pros, visit http://byo.com/story2964

Dextrin Malts

High gravity mystery, water filtration

help me
mr. wizard
by Ashton Lewis

Q I UNDERSTAND THAT DEXTRAPILS® GIVES BODY AND HEAD, BUT WHY? WHAT IS THE PROCESS IN MAKING THIS MALT AND HOW DOES IT BREAK DOWN IN A MASH? WHAT TYPE OF SUGARS OR STARCHES DOES IT PROVIDE? I DO KNOW THAT DEXTRAPILS® GRAIN ITSELF IS CRUNCHIER AND NOT AS SWEET AS 2-ROW MALT. I DID A TEST AND BREWED MY IPA RECIPE, BUT LEFT OUT THE DEXTRAPILS® AND REPLACED IT WITH 2-ROW MALT. THIS WAS ONLY ABOUT 5% OF THE GRAIN BILL. MY OG WENT UP 3 POINTS. I HAVE MY GEAR DIALED IN AND HAVE BEEN ABLE TO DUPLICATE THIS RECIPE WITH THE SAME NUMBERS SEVERAL TIMES. SO IF YOU COULD PLEASE CLEAR UP WHAT THE SCIENCE IS BEHIND DEXTRAPILS® I WOULD GREATLY APPRECIATE IT.

JUSTIN BURDT
OAKLAND, CALIFORNIA

A DextraPils® is a specialty malt produced by the Great Western Malting Company located in Vancouver, Washington. DextraPils® is a type of crystal malt that is often referred to as dextrin malt. Other companies produce similar products, for example Briess Malting produces CaraPils® and Weyermann Malting produces Carafoam®, so for the sake of clarity in my answer I will refer to these malts as dextrin malts. These products are known to increase fullness, increase the final gravity and to enhance foam. These same properties are also associated with other types of crystal malt, but the difference is that dextrin malts are no darker than typical Pilsner malt nor do they add the caramel-like flavors associated with darker crystal malts.

All crystal malts are made by converting the starch in malted barley into what is basically wort before the malt is roasted. This is usually done by beginning with "green malt" or malt that has yet to be kilned. The green malt is heated to conversion temperatures (150-160 °F/66-71 °C) without allowing the grain to dry. This process is known as "stewing" and is usually performed in a roasting drum. Under these warm and moist conditions, the enzymes in green malt convert starch into fermentable and un-fermentable sugars, also known as dextrins. Just like with mashing, the stewing temperature affects wort fermentability. Maltsters who produce these types of malts are protective of their processes, but if I had to wager a bet I would guess that the stewing process is carried out at the upper end of alpha-amylase's temperature range in an

> "These products are known to increase fullness, increase the final gravity and to enhance foam."

effort to minimize the activity of beta-amylase. These conditions would favor the production of dextrins and minimize the production of maltose, which of course is fermentable.

After the conversion rest, the malt is kiln-dried and roasted to promote the Maillard reaction. This is a reaction involving so-called reducing sugars and amino acids. The reducing sugar involved in the reaction can be the monosaccharide glucose, or it can be the one end of a dextrin polymer that is described as the reducing end. Although starch and dextrins in malt will be converted to fermentable sugars in the mashing process, carbohydrates that participate in the Maillard reaction yield compounds that are not converted to fermentable sugars during mashing. Dextrin malt has very little color, so the process must be controlled to limit color development. The malting and stewing conditions and

Photo courtesy of MoreBeer!

the kilning and roasting profile are critical to minimizing color and flavor development. Under-modified malts are probably used for dextrin malts to limit protein breakdown during malting. The result of the process is a type of crystal malt containing Maillard reaction products (MRPs) with very little color or flavor.

I do not know the exact reason why these malts improve foam stability. The general explanation is that the types of MRPs associated with dextrin malts contain more foam-positive compounds than pale malt types. Under-modification is certainly one way to improve foam stability. Foam is stabilized by foam-positive proteins and the process used to produce dextrin malts clearly results in a greater concentration of these types of proteins than the process used to produce pale malt. Like other crystal malts, dextrin malts do not have to be mashed and homebrewers using extract with specialty malts added by steeping can add dextrin malts to their beers. This topic is really the "black box" of these products; no companies producing very pale dextrin malts explain their proprietary process and seem to take great pleasure in the air of mystique surrounding their products.

One thing that is simple to answer is the reason your OG increased when you replaced the DextraPils® with pale malt. The pale malt has a higher extract yield, but not enough to account for a 3-point increase. You noted in your question that you noticed that DextraPils® is crunchier than 2-row. This is one way to describe the texture of dextrin malt, the description I would use is hard, almost like a rock! You may not have been milling the DextraPils® fine enough to obtain a very good yield. I hope this has given you a little more insight into dextrin malt.

Q

I AM CURRENTLY BREWING A HIGH GRAVITY BEER (1.097 OG). AFTER 6 DAYS I NOTICED THERE WERE NO BUBBLES IN THE AIRLOCK. I TOOK A GRAVITY READING OF 1.034. I POURED THE SAMPLE BACK INTO THE FERMENTER AND CHECKED THE TEMPERATURE TWO HOURS LATER. THE AIRLOCK WAS BUSILY BUBBLING AWAY AT 5 TO 6 SECOND INTERVALS. TWO DAYS LATER THERE WERE NO BUBBLES IN THE AIRLOCK. I CHECKED THE GRAVITY AGAIN AND GOT A READING OF 1.026. SAME THING, TWO HOURS LATER THE AIRLOCK WAS BUBBLING AWAY. HAVE I DISCOVERED A WAY OF UNSTICKING A STUCK FERMENTATION? I DID USE A YEAST STARTER. IS THERE A PERCENTAGE OF GRAVITY DROP BEFORE RACKING INTO THE SECONDARY FERMENTER? ALSO I HAVE READ ABOUT DIACETYL REST, DOES THIS TAKE PLACE IN THE PRIMARY OR SECONDARY FERMENTER?

BEN KALOTA
JACKSONVILLE, FLORIDA

A

This is one of the questions that makes me scratch my head, and for more reasons than one. My first response actually has nothing at all to do with the question. And that response is "stop pouring samples back into your fermenter!" Taking a sample from a fermenter to check gravity can easily result in the sample being contaminated with bacteria or wild yeast from your gear, therefor returning it to the fermenter is not a practice I would choose to use. I do advocate taking gravity samples to confirm that fermentation has ended and I understand why homebrewers are tempted to return their samples to the fermenter. If you ferment in glass then you can visually determine when things are slowing down. I prefer watching the airlock and the appearance of the fermenter and then taking two or three samples towards the very end to confirm that the gravity has stopped dropping. But that is a different subject.

OK, I am still scratching my head about the observation because I am quite sure that taking a sample, checking its gravity and returning the sample to the fermenter has nothing to do with causing the fermentation to pick up activity. Perhaps pouring the sample back in the fermenter caused enough turbulence to release some dissolved carbon dioxide from the beer, resulting in the bubbles. Or the airlock may have a leak between the rubber stopper and the top of the carboy that was sealed by removing and replacing the airlock. Or maybe you somehow aerated the sample and that really did have an effect on the fermentation. None of these answers are very satisfactory. But one thing I am fairly sure about is that you have not discovered a way to remedy a stuck fermentation!

When brewing high gravity batches there are a few things that are very important. While pitching rate and proper aeration are the obvious things to be mindful of, the importance of these two topics cannot be stressed enough. Yeast strain is also something to carefully consider. Some strains do not perform well with high-gravity wort. Yeast suppliers do an excellent job of describing the strains they sell and I suggest choosing a strain that is described as performing well in high-gravity wort. The use of a yeast nutrient containing zinc is also something to be considered.

Knowing the right point in fermentation to rack a beer to the secondary is hard to determine if you have never brewed the beer before, that is; if one chooses to rack to a

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secondary fermenter. If you have a beer that you want to move off of yeast for prolonged aging I would wait until the fermentation slows and is about 4-6 points above the expected final gravity. This will allow enough carbon dioxide production during secondary fermentation to purge the headspace of the fermenter of air.

If you are brewing a beer that is not being aged in the secondary, but really just being moved prior to bottling I have a different opinion. I would hold my beer in the fermenter until fermentation is complete and the gravity stops dropping. At this point I would hold the beer for an additional four days for the diacetyl rest, remove the airlock and seal the top of the fermenter with plastic wrap and then move the fermenter to a refrigerator that is set to 34-38 °F (1-4 °C) and leave it in the refrigerator for at least two days. This will help clarify the beer prior to racking. If you have a Cornelius keg you can purge the keg with carbon dioxide before racking and either carbonate in the keg for draft dispense or add sugar and yeast before bottling. Or you can rack to another carboy or bottling bucket. In my opinion, there is really no real benefit to racking beer into a secondary fermenter for a short aging duration.

Q

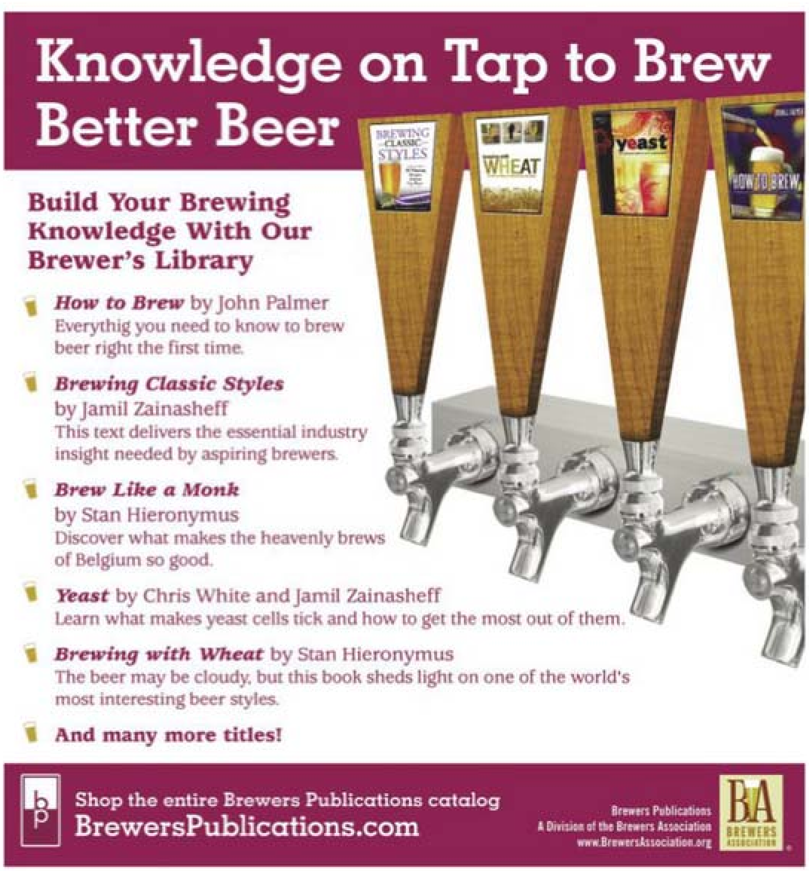
I GOT A WATER QUALITY ANALYSIS FROM MY LOCAL WATER DEPARTMENT. I AM WONDERING, IF I FILTER MY WATER, DOES IT CHANGE THE ANALYSIS IN ANY SIGNIFICANT WAYS?

CRAIG COLLINS
CASPER, WYOMING

A

The answer to this question depends on what type of water filtration that you are planning to use.

Carbon filtration is the most common type of home water filtration. Carbon filters contain activated carbon (charcoal) and are primarily used to remove heavy metals, chlorine, chloramines and trihalomethanes from drinking water. Heavy metals and



trihalomethanes represent health concerns in drinking water and chlorine and chloramines negatively affect water and beer flavor, so all of these compounds can be removed without having any detrimental effects to your brewing. In short, carbon filtration will not significantly change your water chemistry with respect to the analysis prepared by the local water department, so you do not need to worry about that.

If you use something like a salt-based water softener then you will significantly affect your water since water softeners replace calcium and magnesium with sodium. Although some water contains too much calcium and magnesium, salt-based softeners are not ideal for treating brewing water because of the addition of sodium. In fact, the replacement is a two-to-one multiplier since two sodium ions are added to water for every one calcium or magnesium ion removed.

Salt-based water softeners are commonly used as pretreatment before reverse osmosis membranes. Reverse osmosis filtration of water removes almost all dissolved ions from water leaving the water in a state that is very similar to distilled water. Using reverse osmosis filtration does indeed significantly alter brewing water.

I live in Springfield, Missouri where the ground water contains relatively high levels of calcium and carbonate due to the karst topography of our region. At Springfield Brewing Company we use four types of water treatment to prepare water for brewing. The first filter is a pleated filter to trap solids before the water flows to our carbon filter. Incoming water is then softened, pumped through reverse osmosis membranes and the water is then stored in our ambient water tank.

We remineralize this water depending on the beer we are brewing. If you have water with a nice blend of minerals I recommend simply filtering your water with a carbon filter and adding any minerals that may need a boost. BYO

Vienna Lager

style profile
by Jamil Zainasheff

A lager with a crisp, clean malt character

If you are a beer geek, certainly you know the name Anton Dreher. It was from 1836 to 1840 that he developed a new, paler lager. Brewed with the new lighter-colored malts of the time, it had a beautiful copper hue and the crisp, clean malt character of a great lager. He gained praise and fortune for his new Schwechater Lagerbier and eventually his Schwechat Brewery became one of the largest in all of Europe.

Today, we refer to this beer as Vienna lager and there are no breweries making their fortune solely on this style. It is a shame that Vienna lagers are hard to come by, as this is a great beer to have on tap year-round.

Vienna lager is a light reddish amber to copper German lager with toasty and bready malt character that starts in the aroma and lasts all the way through the finish. People often describe Vienna lager as having a soft, elegant malt character, but it is not a sweet beer. A good example of the style should be well-attenuated with enough hop bitterness to have a balanced, but moderately crisp finish. This is a cleanly fermented lager (no fruity esters or diacetyl), with a soft, medium body that some describe as creamy. There should be no caramel or roast flavor. Hop flavor and aroma are low at most, and when present, have a spicy or sometimes floral quality.

A common mistake when brewing a beer described as "malt-focused" is to assume that maltiness and sweetness are the same thing. A beer with a lot of sweetness from malt is not necessarily "malty," it is sweet. It may or may not also have a lot of malt character. It is quite possible to have a dry beer that has lots of malt flavor and aroma or malt character. When most beer judges use the term "malty," they are referring to the rich grainy, bready, toasty flavors and aromas that come from the malt, not the residual malt sweetness.

As you might guess, it is possible to brew a Vienna lager using only Vienna malt. Vienna malt is kilned darker than most base malts (3-6 °L), but it is not as dark as Munich malt. A beer made from only Vienna malt has a nice bready, biscuit malt character, which is appropriate for the style. If you really want to get to know this style, you should try brewing a batch with just Vienna malt. While it is possible to make a nice Vienna lager without using Vienna malt, it seems like a shame to do so. For that reason, I always include Vienna malt in my Vienna recipes.

"A beer made from only Vienna malt has a nice bready, biscuit malt character, which is appropriate for the style."

Often brewers want to make a beer like this more complex, using other malts to develop color and flavor. Usually this means using a portion of Pilsner malt for the base, which lightens the color and reduces the Vienna malt character, resulting in a less toasty, bready beer. Then you add back the missing malt character and color using other malts, such as Munich, aromatic, melanoidin, roast, and caramel. As a general rule, neither Pilsner malt nor Munich malt should be more than one-third of the total grist. Conversely, Vienna malt should always be at least one-third of the grist. Even when using light Munich malt, using it for more than one-third of the grist can overpower the Vienna malt flavor.

You can choose to add a small amount of mid-color or caramel malts (30-70 °L) such as CaraVienne and CaraMunich® to increase color and give a little residual sweetness to the finish. You want to use restraint though. Vienna lager should not have

Continued on page 23

vienna lager
by the numbers

OG:	1.046–1.052 (11.4–12.9 °P)
FG:	1.010–1.014 (2.6–3.6 °P)
SRM:	10–16
IBU:	18–30
ABV:	4.5–5.5%

Photo by Charles A. Parker/Images Plus

Vienna Lager

(5 gallons/19 L, all-grain)
OG = 1.050 FG = 1.012
IBU = 26 SRM = 10 ABV = 5.0%

Ingredients

5.5 lbs. (2.5 kg) Vienna malt (4 °L)
3.3 lbs. (1.5 kg) continental Pilsner malt (2 °L)
1.4 lbs. (0.64 kg) Munich malt (8 °L)
1.8 oz (50 g) Carafa® Special II (430 °L)
4.8 AAU Hallertau hops (60 min.) (1.2 oz/35 g at 4% alpha acid)
1.6 AAU Hallertau hops (10 min.) (0.4 oz/11 g at 4% alpha acid)
1 tsp. Irish moss (15 min.)
White Labs WLP838 (Southern German Lager) or Wyeast 2308 (Munich Lager) yeast
Priming sugar (if bottling)

Step by Step

I currently use Best Malz Pilsen, Vienna, and Munich, but feel free to substitute any high quality malt of the same type and color from a different supplier. Carafa® Special II is a product of Weyermann. My hops are in pellet form and come from Hop Union, Willamette Valley, or Hopsteiner depending on the variety.

Mill the grains and dough-in targeting a mash of around 1.5 quarts of water to 1 pound of grain (a liquor-to-grist ratio of about 3:1 by weight) and a temperature of 152 °F (67 °C). Hold the mash at 152 °F (67 °C) until enzymatic conversion is complete, which may take 60 to 90 minutes at this temperature. Infuse the mash with near-boiling water while stirring or with a recirculating mash system raise the temperature to mash out at 168 °F (76 °C). Sparge slowly with 170 °F (77 °C) water, collecting wort until the pre-boil kettle volume is around 6.5 gallons (25 L) and the gravity is 1.039.

The total wort boil time is 90 minutes, which helps reduce the S-Methyl Methionine (SMM) present in the lightly kilned Pilsner malt and results in less Dimethyl Sulfide (DMS) in the finished beer. Add the first hop addition with 60 minutes remaining in the boil. Add Irish moss or other kettle finings when there are 15 minutes left in the boil and the final hop addition with 10 minutes remaining. Chill the wort to 50 °F (10 °C) and aerate thoroughly. The proper pitch rate is about 340 billion cells, which is 3 packages of liquid yeast or one package of liquid yeast in a 1.5-gallon (6-L) starter.

Ferment around 50 °F (10 °C) until the yeast drops clear. With healthy yeast, fermentation should be complete in two weeks or less, but do not rush it. Cold fermented lagers take longer to ferment than ales or lagers fermented at warmer temperatures. If desired, perform a diacetyl rest during the last few days of active fermentation. Rack to a keg and force carbonate or rack to a bottling bucket, add priming sugar, and bottle. Target a carbonation level of 2 to 2.5 volumes. A month or more of cold conditioning at near-freezing temperatures will improve the beer. Serve at 43-46 °F (6-8 °C).

Vienna Lager

(5 gallons/19 L, extract with grains)
OG = 1.050 FG = 1.012
IBU = 26 SRM = 13 ABV = 5.0%

Ingredients

7.1 lb (3.2 kg) Munich liquid malt extract (LME)
1.8 oz (50 g) Carafa® Special II (430 °L)
4.8 AAU Hallertau hops (60 min.) (1.2 oz/35 g at 4% alpha acid)
1.6 AAU Hallertau hops (10 min.) (0.4 oz/11 g at 4% alpha acid)
1 tsp. Irish moss (15 min.)
White Labs WLP838 (Southern German Lager) or Wyeast 2308 (Munich Lager) yeast
Priming sugar (if bottling)

Step by Step

There are many Munich extract blends out there. It is always better to choose the freshest extract versus choosing one based on name. If you cannot get fresh liquid malt extract, see if you can find a dry Munich extract instead. Using fresh extract is very important to this style. My hops are in pellet form and come from Hop Union, Willamette Valley, or Hopsteiner depending on the variety.

Mill or coarsely crack the specialty malt and place loosely in a grain bag. Steep the bag in about ½-gallon (~2 L) of water at roughly 170 °F (77 °C) for about 30 minutes. Lift the grain bag out of the steeping liquid and rinse with warm water. Allow the bag to drip into the kettle. Do not squeeze the bag. Add the malt extract and enough water to make a pre-boil volume of 5.9 gallons (22.3 liters) and a gravity of 1.040. Stir thoroughly to help dissolve the extract and bring to a boil.

Once the wort is boiling, add the first hop addition. The total wort boil time is 1 hour after adding the hops. Add Irish moss or other kettle finings with 15 minutes left in the boil and the final hop addition with 10 minutes remaining. Chill the wort to 50 °F (10 °C) and aerate thoroughly. The proper pitch rate is about 340 billion cells, which is 3 packages of liquid yeast or one package of liquid yeast in a 1.5-gallon (6-L) starter.

Ferment around 50 °F (10 °C) until the yeast drops clear. With healthy yeast, fermentation should be complete in two weeks or less, but do not rush it. Cold fermented lagers take longer to ferment than ales or lagers fermented at warmer temperatures. If desired, perform a diacetyl rest during the last few days of active fermentation. Rack to a keg and force carbonate or rack to a bottling bucket, add priming sugar, and bottle. Target a carbonation level of 2 to 2.5 volumes. A month or more of cold conditioning at near-freezing temperatures will improve the beer. Serve at 43-46 °F (6-8 °C).

an evident caramel flavor. Keep these specialty grains to no more than 5% of the total grist. At most, the specialty malts should accentuate the malty Vienna notes, as opposed to competing with them.

If you want more color, or are trying to make a dark Mexican-style lager, a small portion (~1%) of a dark, huskless grain such as Briess Blackprinz® or Weyermann Carafa® Special malt will darken up the beer without adding roast notes. Vienna lager should never have any roast malt character.

Since there are no pure Vienna malt extracts, extract brewers will need to use a Pilsner malt extract and partial mash some malts such as Vienna and Munich or use Munich malt extract as the base and enhance the color by steeping caramel or color malt. Most Munich malt extract is a blend of Munich and Pilsner (or other pale malts) in different percentages. The Munich malt in the blend adds a nice bready malt character to the beer, but keep in mind that Munich malt and Vienna malt are not the same thing so this will not make the most authentic Vienna lager, but it can get fairly close.

I like to avoid any work that I do not feel improves the beer, so I prefer a single infusion mash. Perhaps, historically, a brewer would use a decoction mash when brewing most German-style beers, but I find that high quality continental malts, a single infusion mash, and excellent fermentation practices will produce beer every bit as good as the best commercial examples. It is far more important to invest time and effort in fermentation, sanitation, and post-fermentation handling than decoction. If you have ensured that all of those other aspects of your process are flawless, then decoction might be something of interest. For a single infusion mash, target a mash temperature range of 150-154 °F (66-68 °C).

Like most beer styles, you can brew a good Vienna lager with almost any kind of water, but sometimes tweaking your water is the last key to perfecting a style. For Vienna lager, moderately hard, moderately carbonate-rich water is best. For very soft water, add gypsum and chalk, about ½ teaspoon of gypsum and 1 teaspoon of chalk per 5 gallons (19 L) should get you close. If your water source is very hard, you can always dilute it with some distilled water.

Hop flavor and aroma are never more than background notes in Vienna lager. Hop bitterness is restrained, just firm enough to provide a nice balance to the malt sweetness. I really like using German-grown Hallertau hops for flavor and aroma, although sometimes they are hard to source. Other German-grown hops, such as Tettnang, Perle or Tradition, work well also. These hops, when grown outside of Germany, can still work well but you should check with your supplier first if you are not sure how closely they match the German-grown hops. If you cannot get any of those hops, you do have some flexibility. The trick is to select hops with that same flowery or spicy noble hop character. You do not want to use anything fruity or citrusy. Some decent substitutions are Liberty and Mt. Hood. You can also try Crystal, Ultra, and Vanguard. It is really the overall impression that matters. The big picture is that you want very low hop character and a balancing bitterness, with both complementing and integrating with the malt. The balance of bittering versus malt sweetness should always be close to even. The bitterness to starting gravity ratio (IBU divided by the decimal portion of the specific gravity) ranges from 0.4 to 0.6, but you will want to target the middle, 0.5. While there is no real need for a late hop addition, I do like to toss in a little late addition near the end of the boil (last 10 to 20 minutes). Keep the addition to no more than a ½ oz (14 g) in a 5-gallon (19-L) batch. This might be too much hop character for the style when the beer is fresh out of the fermenter, but after a few months of lagering, it can be just right. A bit bold for the style, but not out of style. Since there is very little specialty malt or fermentation esters, these subtle amounts of hop flavor are more noticeable than in a bigger beer style.

You can ferment Vienna lager with almost any lager yeast, although my favorites are White Labs WLP838 (South German Lager) and Wyeast 2308 (Munich Lager). You will find that each lager yeast will emphasize different aspects of the beer. Some will have more malt character and some more hop character, but all can produce an excellent Vienna lager with proper fermentation. If you want to use dry yeast, Fermentis Saflager S-23 is probably your best choice.

As when brewing any lager, it is important to control the fermentation temperature and to pitch plenty of clean, healthy yeast. You want the beer to have a clean, low ester fermentation profile, but you also want to make certain that the beer attenuates fully. This is the most common mistake new brewers make when attempting lagers. You need to make sure you pitch enough yeast, provide enough oxygen and nutrients, and use temperature control to not only start the fermentation on the cool side, but then raise it toward the end of fermentation. This rise in temperature not only helps reduce some of the unwanted compounds produced during fermentation, but it ensures that the yeast is active enough to attenuate the beer more fully.

When making lagers, I like to chill the wort down to 44 °F (7 °C), oxygenate, and then pitch my yeast. I let the beer slowly warm over the first 36 hours to 50 °F (10 °C) and then I hold this temperature for the remainder of fermentation. If fermentation seems sluggish at all after the first 24 hours, I am not afraid to raise the temperature a couple degrees more. The idea is to reduce the diacetyl precursor alpha-acetolactate, which the yeast creates during the early phase of fermentation. Once the growth phase of fermentation is complete, it is important that fermentation be as vigorous as possible. It may never be as robust as fermentation at ale temperatures, but it is important to have enough activity to blow off aromatic sulfurs and other unpleasant compounds. Vigorous yeast activity at the end of fermentation also improves reduction of compounds such as diacetyl. Starting fermentation colder only works well if you are pitching enough clean, healthy yeast at the start. If not, you will need to start warmer (perhaps 55 °F/13 °C) to encourage more yeast growth. Even if you start fermentation warmer, you can still raise the temperature toward the latter part of fermentation.

Since diacetyl reduction is slower at colder temperatures, a cold-fermented lager may require a diacetyl rest. To perform a diacetyl rest, raise the temperature into the 65-68 °F (18-20 °C) range for a two-day period near the end of the fermentation. While you can do a diacetyl rest after the fermentation reaches terminal gravity, a good time for a diacetyl rest is when fermentation is 2 to 5 specific gravity points (0.5–1 °P) prior to reaching terminal gravity. Brewers ask how they should know when fermentation has reached that stage. My advice is to raise the fermentation temperature for a diacetyl rest as soon as you see fermentation activity significantly slowing. It will not hurt the beer and it should help the yeast reach complete attenuation as well.

It seems that every beer improves with some period of cold conditioning and this style is no exception. Traditional lager conditioning utilizes a slow temperature reduction before fermentation reaches terminal gravity. The purpose of the slow cooling rate is to avoid sending the yeast into dormancy. After a few days, the beer reaches a temperature close to 40 °F (4 °C) and the brewer transfers the beer into lagering tanks. If you want to use this technique, you will need precise temperature control so that fermentation slowly continues and the yeast remains active. Rapidly chilling the beer near the end of fermentation can cause yeast to excrete a greater amount of ester producing compounds instead of retaining them.

Personally, I prefer to wait until fermentation is complete, including any steps such as a diacetyl rest, before lowering the beer temperature. The yeast is far more active and able to reduce fermentation byproducts at higher temperatures. Once I am certain the yeast have completed every job needed, I use a period of cold storage near freezing. This time in storage allows very fine particulates to settle out and the beer flavors to mature. In any case, great lagers take time, so do not rush things. BYO

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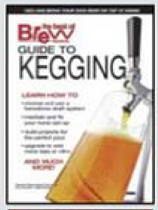

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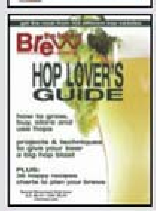

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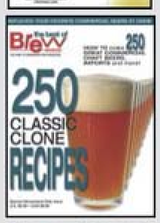

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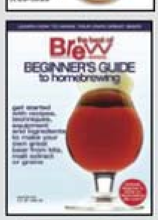

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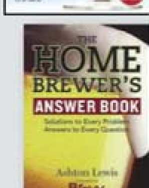

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Induction Heat

"Induction is a highly efficient, safe, and cost-effective source of brewing heat . . ."

by **Joshua Weikert**

Brewers tolerate a lot of adversity for the sake of their beer. We are subjected to adverse elements; who among us hasn't ended the brew day by patching up cut fingers that numbly tried to attach a small fitting to a razor-sharp thread in sub-zero temperatures? (Well, at least those of us who brew in colder temperatures?) As I was writing this article, a friend called and told me he had to put off brewing for a bit because his outdoor water line had frozen solid. And then there's the fact that we're often cranking up an industrial-strength jet burner that would melt the face off of the Stay Puft Marshmallow Man in about fifteen seconds flat, to say nothing of what it feels like to stand next to a floor-mounted flamethrower on a blazing summer day. What would we give to brew in better conditions? Induction is a highly efficient, safe, and cost-effective source of brewing heat that can be operated indoors and has very few drawbacks. My love for induction was based on the fact that it addresses not only the challenges of traditional outdoor jet burner systems, but also the limitations of other indoor options. It is an electric-based heat source that generates no heat, a low-output heat source that can nevertheless boil 5 gallons (19 L), and it requires induction-compatible equipment that most of us are already using without knowing it.

Let me first say that I have nothing to gain by writing this article. I do not manufacture induction elements. I hold no stock in mining interests that would see a boost in demand for metals if induction takes off among homebrewers. I do not represent a cookware company that wants you to buy a new pot (and you may not even need to — I'll explain later). I'm just a guy who hates brewing in variable conditions because it creates variations in the beer, and I wanted to find a better way. I would also like to add that I am not a metallurgist or physicist; the science behind induction is something I understand in much the same way that I understand brain surgery — I'm aware that it exists and the basic mechanics are clear to me, but I'm not in a posi-

Photos courtesy of Dipo Induction

Top: Induction brewing elements in a commercial kitchen. Induction elements are a safe source of indoor electric heat.
Middle: You can purchase 120-volt 1800-watt induction element from most restaurant supply stores starting at around $200.
Bottom: If you want to brew larger batches, you can invest in a larger element. For example, a 6000-watt unit being used at a commercial gin distillery. The induction process controls the heat, which prevents scorching or burning the herbs.

tion to do it myself. What does this mean about induction? Well, first, that I objectively believe it to be an excellent alternative source of brewing heat. It also means that you don't need to be technologically savvy to use it. Let's get into it, and we'll see if you agree.

The Magic of Induction

When exposed to induction for the first time, many people find it nearly miraculous. A pan placed half-on/half-off of an induction element has an egg cracked into it; the half of the egg on the pan over the element begins to sizzle, the other half lays inert and covered in salmonella. What sort of wizardry is this?

Induction heat elements work by generating an electric current, which creates fluctuating magnetic fields. A conductor (in this case, your steel boil kettle) reacts to those magnetic fields, creating additional currents and smaller additional magnetic fields. All of this pushing and pulling of molecules within the pot creates friction within the metal itself, and friction creates heat. What this means is that an induction element is not a heating element — it's your pot that's doing the heating. The element is just making your POT hot, and undergoes no thermal heat production of its own, which means that induction is near-100% efficient. The heat level is controlled by increasing or decreasing the wattage passing through the induction element (see the figure on page 32).

There are two key components needed for this process to work, though. One, obviously, is electricity. The good news here is that you can get sufficient power out of a standard 120-volt wall outlet to boil wort. The second is that your kettle must be made of a ferromagnetic material — it must have certain amount of iron in it to react appropriately to the magnetic fields. Most types of stainless steel are induction-compatible (but not all types). Aluminum, copper, and some other steel blends will not work with induction elements. The easiest way to tell if your equipment will work on induction burners is to place a magnet on the bottom of your pot. If the magnet sticks, it will work. First, however, let's talk about why you should be using induction heat, and then we'll look at any new or different equipment needs, including where to get your own induction element.

Why Use Induction?

What's good about induction? Well, first off, it will save you money. My 1800W induction element was actually a few dollars cheaper than a floor burner, but that's not where the real savings are. For a hypothetical 5-gallon (19-L) batch of beer with an ingredient cost of $30 and about 2.5 hours of total "heating" time, propane will add roughly 20% (about $6 from a $15 tank fill, excluding the cost of purchasing the tank) to the cost of producing that batch of beer. If you're one of the lucky few who have a dedicated natural gas line, you'll only add 8–10% (about $3, excluding the cost of installation of the line) to your cost per batch. Induction, however, is practically free: running my induction element at full-bore adds less than one percent to my beer production costs (about 20 cents per batch, and all I need is an existing wall outlet). Induction is nearly 100% efficient, but most of the heat from a jet burner is blowing up the sides of the pot, not getting into your wort. In other words, by comparison to using a propane or liquid natural gas (LNG) burner, an induction element will essentially pay for itself in about 25 batches. (The savings is increased even further if you factor in the price of a ventilation hood if you want to use LNG indoors. No ventilation is required for induction.)

Second, induction is safe. There is no hot element to worry about, just a hot pot. No chance of fire from a tipped element. No worry about improper ventilation causing a carbon monoxide (CO) buildup. No drifting paper towels to catch flame, blow across the driveway, and burn your house down (OK, that last one is a stretch, but it's the one my wife raised when I brought home my jet burner). And since there's no flame or hot resistance element, you can thoroughly wrap your kettle to avoid any burns from hot kettle surfaces. The only real dangers left once you switch to induction are those that you cannot eliminate from brewing, namely steam coming from the pot and the presence of boiling liquid. It just doesn't get much safer than that.

The third advantage that I briefly mentioned earlier is that induction creates no special ventilation requirements, which means that it can be done anywhere, particularly indoors. This means that in December you can be brewing in your warm kitchen, in full view of a 50" HDTV showing the latest Dallas Cowboys collapse, as the winds and snow howl outside. It also means you don't have to contend with the winds that hurt your boil and attack the repeatability of your process. Now, while the same is true of other electric or natural gas elements (particularly those on your range), their power output is not usually enough for a full-wort boil on a 5-gallon (19-L) batch. And while there are those who use electric elements or heat sticks of sufficient power to boil a full batch, there is a substantial DIY component to such systems, and they also have the potential to add flavor and/or aroma elements as a result of the exposure of the wort to intensely-focused heat. Induction requires no special outlets, spreads heat evenly and cuts down the chance of scorching (cleaning your pot has never been easier), and is perception-neutral.

A fourth advantage to induction brewing is that it is incredibly quiet. Instead of the sound of jet engines that you get from using gas burners, you can fill the sound up in your homebrewery with something a little more pleasant — like jazz music or the baseball game.

So why do it? A better question might be, "why WOULDN'T you do it?" Well, there are a few reasons . . .

Limitations to Induction

No method is perfect, and induction does suffer from some drawbacks. None are insurmountable, but they do need to be dealt with if you're going to be happy with your new system. They fall into four categories: power, temperature, time, and equipment.

Photo by Joshua Weikert

Is It Cold In Here or Is It Just Me? Induction Alt

(4 gallons/15 L, all-grain)
OG = 1.054 FG = 1.013
IBU = 40 SRM = 21 ABV = 5.4%

This is my most reliably excellent beer. It's won over a dozen medals, including honorable mention in the second round of the National Homebrew Competition (NHC), and ages beautifully. While most Brew Your Own *recipes are 5 gallons (19 L), this is written as 4 gallons (15 L), based on my 5-gallon (19 L) induction brewpot — a good size for an 1800-watt element. This recipe can easily be scaled up, however, depending on your specific induction homebrew setup.*

Ingredients

7.4 lbs. (3.4 kg) Maris Otter pale ale malt
0.75 lbs. (0.34 kg) Munich malt
0.25 lbs. (0.11 kg) Caramunich® I malt (37 °L)
0.25 lbs. (0.11 kg) Carafa® II malt (420 °L)
0.19 lbs. (86 g) pale chocolate malt (200 °L)
8 AAU Nugget hops (60 min.) (0.6 oz./17 g at 13% alpha acids)
1.2 AAU Hallertauer hops (5 min.) (0.25 oz./7 g at 4.8% alpha acids)
Wyeast 1007 (German Ale) or White Labs WLP036 (Dusseldorf Alt) yeast
Priming sugar (if bottling)

Step by Step

This is a single infusion mash. Mash the crushed grains at 150 °F (66 °C) and hold at this temperature for a total of 75 minutes. Sparge slowly with 168 °F (76 °C) water, collecting wort until the pre-boil kettle volume is around 5 gallons (19 L).

The total wort boil time is 90 minutes, with hop additions called for at 60 minutes and 5 minutes before the end of the boil.

Chill the wort to 60 °F (16 °C) and aerate thoroughly. Pitch the yeast and ferment at 60 °F (16 °C). After fermentation is complete, bottle or keg, carbonating to approximately 2.4 volumes.

Is It Cold In Here or Is It Just Me? Induction Alt

(4 gallons/15 L, extract with grains)
OG = 1.054 FG = 1.013
IBU = 40 SRM = 21 ABV = 5.4%

Ingredients

3.3 lbs. (1.5 kg) Maris Otter liquid malt extract
2 lbs. (0.91 kg) dried malt extract
0.25 lbs. (0.11 kg) Caramunich® I malt (37 °L)
0.25 lbs. (0.11 kg) Carafa® II malt (420 °L)
0.19 lbs. (86 g) pale chocolate malt (200 °L)
8 AAU Nugget hops (60 min.) (0.6 oz./17 g at 13% alpha acids)
1.2 AAU Hallertauer hops (5 min.) (0.25 oz./7 g at 4.8% alpha acids)
Wyeast 1007 (German Ale) or White Labs WLP036 (Dusseldorf Alt) yeast
Priming sugar (if bottling)

Step by Step

Steep your crushed grains in 2 qts. (1.9 L) water at 160 °F (71 °C) for 20 minutes. Rinse the grain bag with hot water, collecting the runoff. Top off your kettle to 5 gallons (19 L). stir in the extracts and bring to a boil.

The total wort boil time is 90 minutes, with hop additions called for at 60 minutes and 5 minutes before the end of the boil.

Chill the wort to 60 °F (16 °C) and aerate thoroughly. Pitch the yeast and ferment at 60 °F (16 °C). After fermentation is complete, bottle or keg, carbonating to approximately 2.4 volumes.

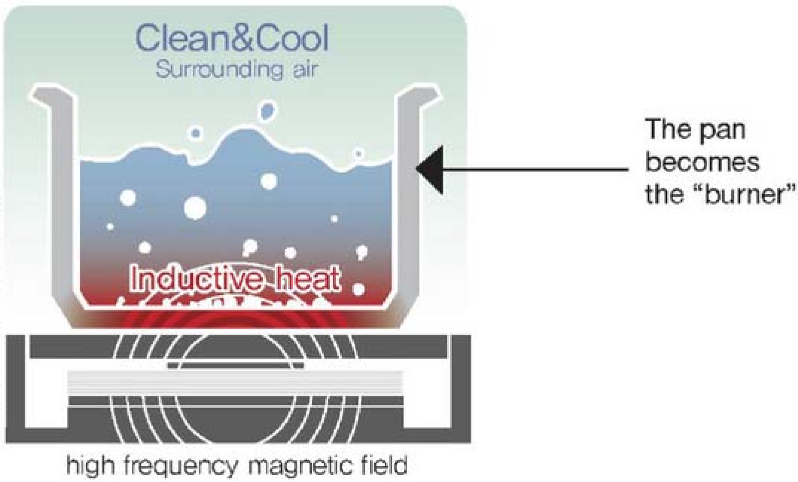


Illustration courtesy of Dipo Induction

Instead of heating up a burner that then heats up a pot or pan and eventually heats the contents, Induction heat directly heats the pot itself, while the surface of the element stays cool.

There is an upper limit to the amount of power that a 120V wall outlet can deliver, and it tops out at about 2000 watts. That translates into only 6,824 BTUs (equivalent) coming from your 1800W induction element; when stacked up against the 70,000-plus BTUs you get from some jet burners, the induction element looks like a 90-pound weakling by comparison. There are two things that keep this from being a deal breaker, though. First, nearly all of that 6,824 BTUs is going into your wort, so our 90-pound weakling is more like the WBA flyweight boxing champ: there's not much there, but what IS there packs a punch. It is more than enough to boil 5 gallons (19 L), with only minimal insulation to maximize your efficiency. Second, we aren't necessarily limited to just 120 volts — many homes have 240 volt outlets available, and if they don't installing one is a quick job by a certified electrician, who can put one just about anywhere you'd want. That increase in the power budget means you can invest in a 3000W-plus induction element, which should be enough power even for those who like their 10-gallon (38-L) (and larger) batches. The one consideration to keep in mind when scaling up the size of your induction element this way, however, is that they do increase in price.

Now, just what kind of a boil will you get? Admittedly, at 1800 watts you will not get the leaping, roiling, violent boil you can achieve with a jet burner — but so what? If the goal is to break the surface of the liquid and allow for off-gassing of compounds we don't want in the beer, then a little bubbling and rippling is all that's required. If the goal is to get good convection to aid in that process, then an amount of heat sufficient to accomplish that movement is all that's required. Induction gives us both. Since the boil is not as active, there's also less risk of a boil-over. And while not an impressive-looking boil, it adds one additional benefit: evaporation rates should drop, saving you wort and making for a more-pleasant (and less rainforest-like) indoor brewing experience. My evaporation rate is just under 9% (compared to an informal survey of reported rates by other brewers of around 15%). It's not a “pretty” boil, but it means more beer and less cleaning. That's a win in my book. The key with all of this is Dimethyl Sulfide (DMS) removal and break formation. Commercial brewers typically evaporate 6–10% during the boil, so 9% is right in the norm. The proof in the pudding is flavor and stability. A “rolling boil” is subject to interpretation; evaporation rate is measurable. If you prefer a more vigorous boil, however, that is easily remedied by using a higher-power induction element.

If there's one consistent complaint I've heard from those considering switching to induction, it's about time. Induction does not heat wort at speeds anything like the meteoric increases in temperature you get out of a jet burner, but with proper planning it is no slower. It's more a question of anticipation, and doing it the same way every time, which is hardly the worst thing to promote in your brewing process. I'll get into more later on in the “how-to” section of this story, but for now, suffice it to say that from the time I fire up my mash tun pre-heating water to the final towel-gathering after cleanup, my process for a 4.5-gallon (17-L) all-grain batch-sparged beer clocks in at just under four hours.

Then there's equipment. As mentioned previously, induction elements themselves are not prohibitively expensive. You can purchase an 1800W induction element from most restaurant supply stores for under $200. Instead of the brand name, focus on two things: element diameter and construction. You want the widest possible diameter to improve your performance: too small an element and you'll end up with a narrow pillar of heated wort that gives up too much energy to the cooler wort around it to maintain a proper boil. My cooker has a 9-inch-diameter (23-cm) element, and that seems sufficient. It also has a steel case and a thick glass surface, which are easy to clean and easily holds the 45-or-so pounds (~20 kg) of pot and liquid that rest on it. Use your best judgment — and if you find a great deal on an induction cooker that's a little flimsy, there are plans out there for simple support and framing systems to share the load. One of the cool things about induction is that the pot doesn't actually need to contact the surface of the element — it just needs to be nearby!

When it comes to kettles, your focus should not just be on materials, it should also be on geometry. Use the magnet test on your brew pots described on page 30 to determine if your equipment is induction-compatible. If the magnet holds, you're good to go! This doesn't apply only to "specialty" pots with some kind of "induction-approved" logo on them and a hefty price tag; my 5-gallon (19-L) kettle came from Target and set me back only $47. One drilled hole and a weldless fitting later and I had a ported induction-capable boil kettle. Obviously, you need a pot that will heat, but pot geometry is nearly as important. You want to think soup can rather than tuna can here; a tall and thin shape will maximize the convection created by the element, minimize the heat loss that prevents a good boil, and has the added benefit of reducing evaporation. Also, the bottom of the pot should be flat, not concave. Pots that have an aluminum core between layers of stainless steel will also give better performance by providing more uniform heat distribution.

If these limitations give you a moment of pause and you're not willing to take the leap completely, that's understandable. However, let me suggest that the only thing cooler than having a homebrewery . . . is having two homebreweries! Imagine it: a production system out in the shed, cranking out large batches of proven recipes for three seasons, and a smaller 2.5-gallon (9.4-L) pilot system for when the north winds start to blow, with you tinkering away in front of a roaring fire and perfecting the next season's beers. For about $200, you can add an induction-powered secondary or pilot system to your brewing capabilities.

The Induction Brewing Process

Here I will detail a step-by-step guide to my brewing process, using two induction elements (primary at 1800W, secondary at 1300W — though you can easily use the single burner/pot and go to a no-sparge or extract method). "Temperatures" on the elements available in the US are usually measured in watts rather than degrees Fahrenheit, and are usually adjustable to 100 or 200W increments. (More advanced models have external temperature probes that can be placed in the pot. They will maintain your mixture at a precise temperature automatically, regardless of the liquid volume.) This process is for a 5-gallon (19 L) boil, 4.5 gallons (17-L) into the fermenter, with a cooler mash tun, a 1-gallon (3.7-L) mash out, and a batch sparge.

Pre-Heat Mash Tun

- 1 gallon (3.7 L) in primary at full power, boils in under four minutes.
- While heating, measure out mash water volume.
- Add to mash tun.

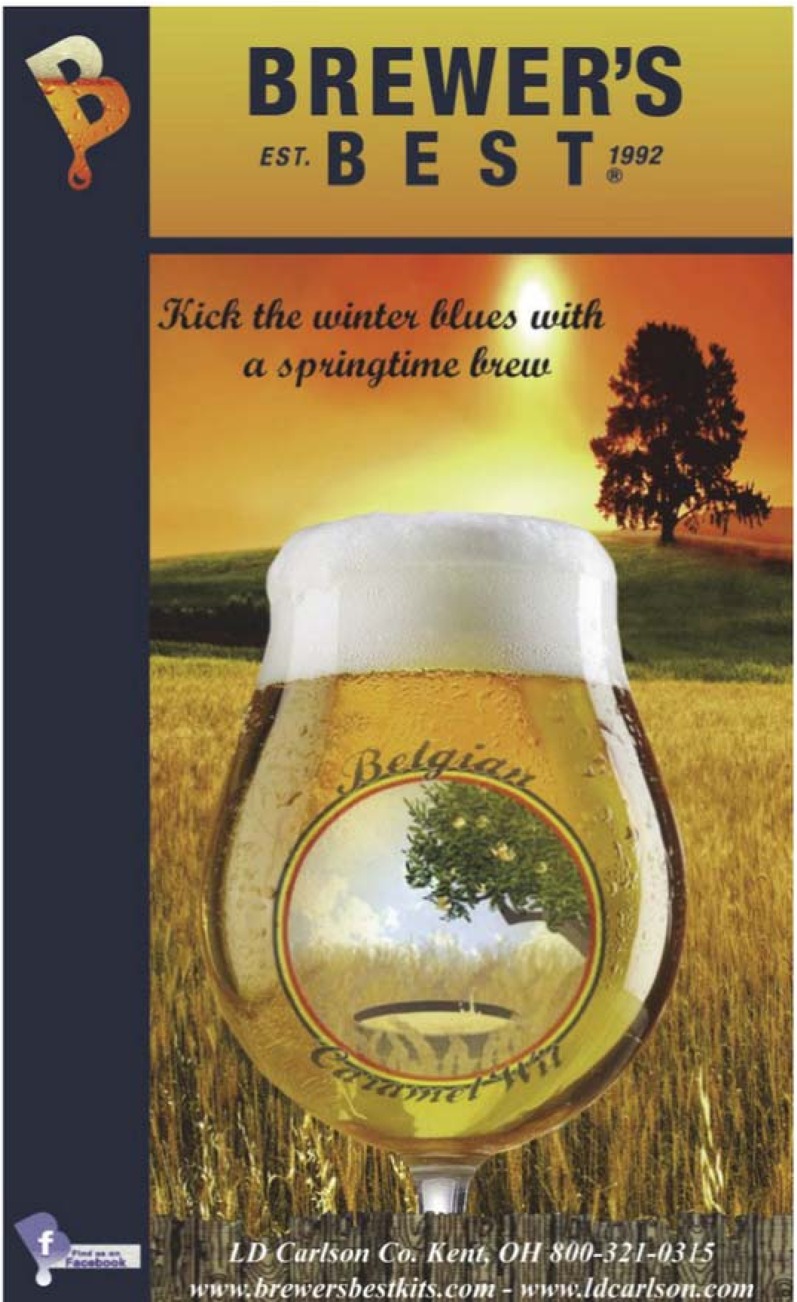
Mash Water

- Mash volume into primary at full power.
- Heats to strike temperatures 10-12

minutes (128 °F to about 162 °F/ 53 to 72 °C).
• Drain pre-heat water, and add mash volume and grain.

Mash
• Stir every 20 minutes.
• At 40 minutes into the mash, put 1 gallon (3.7 L) mash out over 1200W in primary, sparge volume into secondary over 600W.

Mash Out
• Add 1 gallon (3.7 L) of mash out water to cooler.
• Increase the temperature on the sparge water in secondary to 1300W.
• After 10 minutes, turn off the power to the secondary, vorlauf (pour the cloudy, husky wort back into the top of the lauter to clear the wort) and drain cooler into primary. Turn on primary element to 1200W.



Sparge
• Add sparge water, stir, and wait 10 minutes.
• Vorlauf and drain into primary, increasing temp to 1800W.

Boil
• Maintain heat at 1800W.
• Cover kettle to bring to a boil (usually about the time it takes to clean the mash tun).
• When boiling, remove lid.
• Boil for 60 minutes.

Post-Boil
• Turn off heat.
• Stir to create whirlpool, and allow sediment/protein cone to form (about eight minutes).
• Use wort chiller.

Finish Up
This process is not only efficient, it saves you time. Total active time using a direct-fire mash tun with a hot element is four hours. Using the same element but with a cooler-based mash tun saves you thirty minutes of inactive time, for a total of three hours and thirty minutes. The induction-based process, on the other hand, requires only two hours of active "brewing" time.

Final Word
This process works. I started using induction about four years ago, and in that time I've brewed nearly 100 beers across more than 30 sub-styles — ales and lagers, sour ales and IPAs, specialty, you name it. I just finished my second year on top of the leader board for the Eastern Pennsylvania Homebrewer of the Year competition. Better than 90% of my induction-processed beers have won medals in competition (see my award-winning alt recipe on page 31), and those that didn't failed in conception, not in process. There have been no concerns about precursors hanging around after a weak boil in any of my beers; no concerns about hop isomerization; no lack of melanoidin or caramelization in bocks or Scottish ales. Induction homebrewing is safe, cheap, and effective. It works, and you should try it! BYO

by **Ashton Lewis**

ProAm Brewing with the Wizard

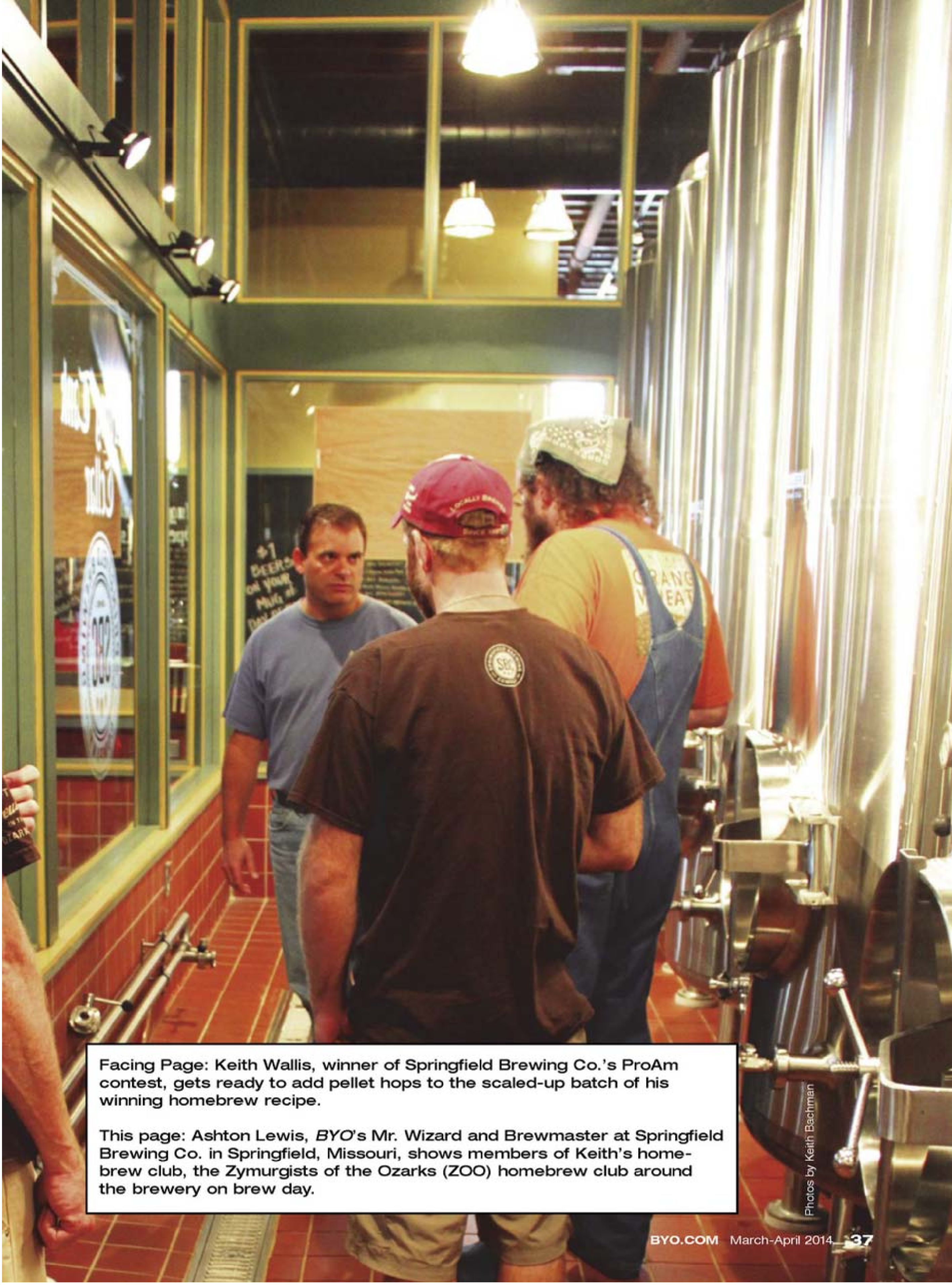
Ashton Lewis hits GABF with a homebrew collaboration

For several years I wanted to participate in the ProAm competition at the Great American Beer Festival (GABF), but was not sure how to go about teaming up with an award-winning homebrewer. A classified ad in the local paper or posting a sign in our brewery seemed a little desperate. Coordinating a special competition for the sole purpose of finding a teammate did not really seem to fit my idea about the best way of selecting a partner. Too much like *Millionaire Matchmaker*! And chatting up homebrewers in the pub seemed too much like trolling the singles scene.

Fortunately for me and my brewery, Springfield Brewing Company in Springfield, Missouri, a friend proposed a great idea. Ben Stange, a member of the Zymurgists of the Ozarks homebrewing club, better known as "ZOO," and host of the radio show Beer Buzz Radio, made a proposition in early 2013. I would participate as a judge in the upcoming Hoppy St. Patty's Day homebrew competition and the beer that won Best of Show would be considered for a ProAm collaboration — if the beer was something that the brewing team at Springfield Brewing Company would want to brew and sell. This sounded like a great plan and the journey began!

What is the ProAm?

The ProAm Competition is a special category at the GABF. All ProAm beers begin their journey as award-winning homebrewed beers judged in an American Homebrewers Association (AHA)-sanctioned event. Somehow the brewer collaborates with a commercial brewery to brew their award-winning recipe and sell this beer as a commercial offering. Beers that fit these criteria are then eligible for entry into the ProAm category. There are some other rules that are important, for example the homebrewer cannot also be employed by a commercial brewery. The homebrewer also has to be a member of the AHA and the commercial brewery



Facing Page: Keith Wallis, winner of Springfield Brewing Co.'s ProAm contest, gets ready to add pellet hops to the scaled-up batch of his winning homebrew recipe.

This page: Ashton Lewis, *BYO*'s Mr. Wizard and Brewmaster at Springfield Brewing Co. in Springfield, Missouri, shows members of Keith's home-brew club, the Zymurgists of the Ozarks (ZOO) homebrew club around the brewery on brew day.

Photos by Keith Bachman

Springfield Brewing Co.'s 585 ESB clone

(5 gallons/19 L, all-grain)
OG = 1.048 FG = 1.010
IBU = 30 SRM = 12 ABV = 5%

Ingredients

9.25 lbs. (4.2 kg) floor malted Maris Otter pale ale malt
8 oz. (0.23 kg) crystal malt (60 °L)
5 AAU Kent Goldings hops (60 min.) (1.0 oz./28 g at 5% alpha acids)
5.5 AAU Cascade hops (10 min.) (1.0 oz./28 g at 5.5% alpha acids)
4.5 AAU Fuggle hops (5 min.) (1.0 oz./28 g at 4.5% alpha acids)
0.5 oz. (14 g) Cascade hops (dry hop)
0.5 oz. (14 g) Fuggle hops (dry hop)
⅛ tsp. Irish moss (5 min.)
Wyeast 1945 (Neo Britannia)

Step by Step

Mill the grains and dough-in targeting a mash of around 1.5 quarts (1.4 liters) of water to 1 pound (0.45 kg) of grain (a liquor-to-grist ratio of about 3:1 by weight) and a temperature of 154 °F (68 °C). Hold the mash at 154 °F (68° C) until enzymatic conversion is complete. Sparge slowly with 170 °F (77 °C) water, collecting wort until the pre-boil kettle volume is around 6.5 gallons (25 L). The total wort boil time is 60 minutes, with hop additions at 60 minutes, 10 minutes and 5 minutes before the end of the boil. Irish moss is added with the third hop addition. Chill the wort to 65 °F (18 °C) and aerate thoroughly. Pitch wort with 2 qts. (2 L) of starter to provide a pitching rate of about 10 million cells per mL and ferment at 65 °F (18 °C). After fermentation is complete add dry hop additions and hold beer for seven days for a combination diacetyl rest and dry hop rest period. Rack beer to bottling bucket and carbonate the beer to approximately 2.5 volumes.

must be a member of the Brewers Association (BA). But other than these main guidelines, any beer that wins an award in an AHA-sanctioned event may find its way to the ProAm judging.

Hoppy St. Patty's Day

It had been many years since the last time I judged in a brewing competition and I was a little nervous. Since a judge or two ended up with some last minute conflicts the panel of judges ended up with more cases on their afternoon dockets than originally planned! We each ended up judging all five categories, with over 31 beers in total.

At the end of the day we finally made it to the best of show round and one of my fellow jurists did a great job of helping the group sort through the category winners to determine the Best of Show beer along with the runner-ups. The beer we selected was an English-style pale ale brewed by a local homebrewer named Keith Wallis. So if we were going to do this thing, Keith would be our partner.

First Contact

I consulted with the brewing team at Springfield Brewing Company to make sure we were all on board with the plan. Bringing a stranger into the brewery for a collaboration brew was a little weird when we all started to think about it. What if we did not hit it off? What if Keith did not dig our beers? We started thinking that a "get to know each other meeting" should have been one of the conditions we had included in our commitment to this journey. But we had agreed to work with Keith on this project and there was no turning back. It was time to make first contact.

We pulled our team together and asked Keith to come to the brewery for a meet and greet. If we were a bit anxious about this meeting, I have to think that Keith was really anxious! It was like a really weird blind date about to happen. As it turned out, our meeting was more like an interrogation than an informal conversation. We wanted to know about Keith! What he did, where he worked, how long had he been homebrewing, what he wanted to name his beer, what his favorite beers were, what hobbies did he have outside of brewing, and on and on. At some point in the process we ran out of prying questions and adjourned to the bar for a beer. I am sure Keith was relieved when this ordeal was over.

Planning for the Big Day

Our group decided that if we were going to do this right that the brew day should be a special day and we wanted to include Keith's homebrewing buddies from the ZOO homebrew club. We would include the group in the brew day, give a tour of our brewery, have a Q&A session, taste some beers and maybe even sneak away from the brewery for a little bit to see some big tanks being built across town by my employer, the Paul Mueller Company. Of course we also needed to scale up Keith's recipe from a 5-gallon (19-L) batch to a 500-gallon (1,892-L) batch.

Keith used an English ale yeast in his homebrew recipe that we don't use in our brewery, so we would need to bring in this strain and then propagate before use. Keith used floor malted Maris Otter malt, so we would need to buy some of this malt for the big day. And he also used Kent Goldings hops. This was going to be a fun day indeed!

We also wanted to create some chalk art and a T-shirt to commemorate this special brew. We knew from our initial interrogation that Keith was a jeweler by trade and our team wanted something clever. He named his beer "585 ESB" after the three-digit abbreviation that jewelers use for 14 karat gold. A fitting name for a Best of Show beer! The logo we ended up developing looked like a jeweler's hallmark. It included a crown design because Springfield is called the Queen City, the alchemical symbol for gold and the beer's name.

The brew day went great. Fermentation was smooth, filtration not a problem and the finished product looked and tasted great. It was especially exciting that our patrons really liked this beer and did their best to drain the tank as quickly as possible. All signs were positive for a great showing at the ProAm in Denver.

The Trip to Denver

The finale to all of this was, of course, the Great American Beer Festival. The GABF is the largest beer festival in the world. It also has more volunteers coordinating all aspects of the festival than any other event in the nation, surpassing the Rose Bowl as the leader in this metric. We went out to Denver early so we could visit some breweries before the madness began. Our road trip included visits to Odell, Funkwerks and New Belgium in Fort Collins and Prost, Breckenridge and Stranahan's in Denver. We also took Keith to the Falling Rock on Tuesday night where we saw some high profile brewers. While we were sitting outside I saw Tomme Arthur and Vinnie Cilurzo standing a few feet behind Keith, and I said something like "Hey Keith, Tomme and Vinnie are right behind you," and when he looked over his shoulder it was like a kid seeing something new and exciting for the very first time.

Keith's beer was one of the featured ProAm beers during the Friday evening session and it was really exciting to see him so pumped up for the tasting. The awards ceremony for the GABF was held on Saturday morning with what looked like 2,000 people anxious to hear the fate of their beers. Although the 585 ESB team was bummed out that our entry did not win a medal, we were all very proud that we had taken the journey. Keith and the 585 ESB Team got some good feedback from the judges that made us all happy with our entry.

Next Year

After having a great experience competing in 2013 with Keith, Springfield Brewing Company will participate in the GABF ProAm again this year. We may have never participated in this great event if Ben Stange had not made the proposal, so my advice to other homebrewers and homebrew clubs who would like to participate in the ProAm competition is to approach a local brewery like the ZOO approached me. Chances are that you will be able to find a brewery looking for a ProAm collaborator — they just don't know where to find you!

by Derrick Hakim

BREW IN A BAG

GET MASHING WITH LESS EQUIPMENT AND STEPS

Brew-in-a-bag (BIAB) is the easiest and most economical way for an extract brewer to step-up into all-grain brewing. What makes this method (which was made popular by Australian homebrewers) unique is that you can basically do with one kettle what traditional all-grain brewers do with three separate and distinct vessels. With a single-large brew kettle, and the help of an inexpensive grain bag, you have the equipment that's needed to brew your first all-grain masterpiece.

I began brewing BIAB out of necessity when I had a brew session planned, but my local homebrew supply didn't have all the extract I needed in stock for my recipe. The homebrew shop staff calculated how much in grains I would need for a partial mash to substitute for the missing extract, and gave me a couple of food-grade 5-gallon (19-L) buckets. They also told me to look in *The Complete Joy of Homebrewing* on how to make a Zapap lauter-tun.

With my drill in hand, ready to make a whole bunch of holes in the bottom of one of the buckets, I decided that this might be the perfect time to try brew-in-a-bag instead. So I ran up to my local home center, went to the paint aisle, and grabbed a 5-gallon (19-L) paint strainer bag.

In my 5-gallon (19-L) kettle, I basically steeped 6 lbs. (2.7 kg) of crushed grains (as you would with specialty grains) in 3 gallons (11 L) of water for about an hour, pulled the bag out and continued the normal extract brewing

Photos by Derrick Hakim

process. I really wasn't following any written procedure, but at the time, it seemed to do the job.

Why Would You Want To Brew BIAB Anyway?

If you are considering BIAB, there are a few reasons why it is a good option.

1. You want to get into all-grain brewing, but at a lower cost.
2. You don't have enough space for the additional vessels required for a full all-grain set-up.
3. You want to have more control of your ingredients right from the start.
4. You don't want to clean much more equipment than you already do with extract brewing.

The Cons of BIAB:

There are a few considerations to keep in mind with BIAB, however.

1. You'll need a larger kettle than you most likely have for extract brewing, to brew a standard 5-gallon batch.
2. That kettle's going to need a valve to move your cooled wort into your fermenter. You will be transferring about 5.5 gallons (21 L), so either invest in a health club membership or just install a ball valve on your kettle instead.
3. It takes more time to create your own wort rather than opening a couple containers of extract. About three more hours will be added to the brew day.
4. Compared to traditional all-grain brewing, your pre-boil efficiency can be lower. Extract brewers don't calculate pre-boil efficiency since they don't start their process from the grain. But when you do, you want a measurement of how well you did in extracting what sugars were available to you, from those grains, and what you actually collected in your wort. This will help you become more consistent from batch-to-batch.

Some BIAB brewers compensate by adding more grains to the grain bill, having their grains double-crushed, mashing longer, performing a mashout to aid in efficiency, or a combination of these. Currently, I have my grains double-crushed, mash for 90 minutes, and perform a mashout for 10 minutes at 170 °F (77 °C).

Additional Equipment Needed For BIAB

Large Brew Kettle

This one single vessel is going to act as the hot liquor tank (HLT), mash/lauter tun, and brew kettle from a traditional all-grain system. If you are going to brew a typical 5-gallon (19-liter) batch, you're going to need a good sized kettle and a way to heat a lot of water.

In extract brewing, you're typically working with 2 to 3 gallons (7.5 to 11 L) of water in your kettle and adding the concentrated wort to your fermenter, where it's diluted with additional water to reach your 5-gallon (19-L) batch size. This is very manageable with a 5-gallon (19-L) pot and most kitchen stoves, although a larger pot will give you more space.

With BIAB, we need to have the full volume of water required to mash the grains, boil the wort, fill our fermenter with about 5.5 (21 L) gallons of

A good kettle is the foundation for brew-in-a-bag. A good rule of thumb is to have a kettle that is at least twice the batch size intended for the fermenter; so for a 5-gallon (19-L) batch, you would like to have at least a 10 gallon (38-L) pot (or larger).

Top: Two large grain bags suitable for BIAB. You can buy these bags from many homebrew suppliers for around $8.00 each.

Bottom: A steam basket that fits in your kettle is very convenient as both a false bottom as well as for removing the grain bag.

wort, and account for all the loss along the way, so we can package our target 5-gallons (19 L) of beer. Depending on your grain bill, that's going to require a 10+ gallon (38+ L) kettle and a burner with plenty of BTUs. The larger your kettle, the larger the grain bill or batch size you'll be able to accommodate. But if you go too big, brewing indoors on a stovetop will not be an option, and you'll need a large burner with not only enough BTUs but also a sturdy frame to support all the weight.

My brew kettle was converted from a steam stockpot that's 44-quarts (11 gallons/42 L) (see a photo of my kettle on page 42). It has a removable stainless-steel basket that keeps the grain bag off the bottom of the kettle during heating, and also provides additional support to the bag when it's time to remove the spent grains from the wort (see photo above). Some BIAB brewers use the steam baskets with simple hoists to raise the bag out of the wort and let it hang over the kettle while it drains off.

If you occasionally want the flexibility and have the capacity to brew indoors, then you won't want to be much bigger than a 10- to 11-gallon (38- to 42-L) kettle, depending on the burners on your stove. I successfully brew 13-lb. (5.9-kg) grain bills with about 8 gallons (30 L) of water, indoors, on our natural gas cook-top with a 17,000 BTU burner. It takes longer to get to temperature, and the boil isn't as vigorous as my propane burner is outside, but it beats brewing only when weather permits. It's a very tight fit as well, but works in a pinch. That extra gallon (3.8 L) of head-space from the 11th gallon is nice to have too.

Large Grain Bag

This is what makes it all happen, and you have a few options to choose from (see photo, left). You can buy these pre-made from any homebrew supply, custom higher quality bags from online sources, or simply make your own.

Step 1: Add the properly-calculated amount of strike water to your brew kettle and heat it to temperature. Use the calculator to convert water depth in inches to gallons. Here I'm using stainless steel hose clamps secured to the handle of a mixing paddle, adjusted to strike water, pre-boil, and post-boil depths.

Most are coarse mesh, made of nylon, and can be had for less than $8.00. They are typically 24-in. x 24-in. (61-cm x 61-cm) or 24-in. x 36-in. (61-cm x 91-cm) in size.

If you're looking for a higher quality-long lasting bag, you can get a handmade polyester bag with reinforced seams, proper stitching, special thread, and sewn-in handles for easier lifting. These are available online for about $35.00 and may be a great option if the other bags just aren't cutting it.

If you're careful not to snag or overload your bag, either choice should do. The less expensive bags aren't going to last a lifetime but will last longer if you use a steam basket in your rig. I've used them multiple times without issue.

Water Requirements

It is important to calculate the correct amount of water required to get through the entire process from the mash to the finished beer. This was probably the most difficult part for me to get right when I first started using BIAB because your equipment will directly impact the calculations. Most common brewing software now incorporates BIAB in their calculations, which can help a great deal, but you'll still need to know a bit about your individual setup to get it perfected, and that will take some trial and error.

You certainly can use almost any brewing software of your choice that has a BIAB or single-infusion mash option, or one of the many free calculators available online. We will be using a BIAB water calculator that's easy, accurate and free. It can be found, along with links to other great calculators and software, under "Brew Day Prep" at http://BiabBrewing.com.

To get started with calculating our water requirements, you'll need the following basic information to enter into the BiabBrewing.com calculator:

- Finished batch size (gal.)
- Total weight of the grain bill (lbs.)
- Total weight of the hops (oz.)
- Boil time (minutes)
- Equipment boil off rate (gal/hour)
- Expected fermentation trub loss (gal)
- Grain absorption rate (default=0.125 gal./lbs.)
- Hop absorption rate (default=0.0365 gal./oz.)
- Grain temperature (°F)
- Mash temperature (°F)
- Interior kettle diameter (inches)

If you use software like BeerSmith, Brewer's Friend, etc., be sure to set-up your equipment profile properly by editing the default values that most closely match your set-up, or by using more accurate information that you may already have. We're going to use the profile information that I use with my BIAB setup for this example session. Yours will most likely be different, but these figures will get you started.

Information You Need From a Beer Recipe

There is a list of specific information you will need to brew an all-grain recipe with BIAB. To explain this, we're going to look at Northern Brewer's American Wheat Beer all-grain recipe. This recipe calls for a single infusion mash schedule and a mashout. Here's what you'll need to gather from the recipe:

Add Up the Total Grain Bill
4 lbs. (1.8 kg) Rahr white wheat malt
4 lbs. (1.8 kg) 2-row pale malt
= 8 lbs. (3.6 kg) total

Add Up the Total Amount of Hops
1 oz. (28 g) Willamette
1 oz. (28 g) Cascade
= 2.0 oz. (57 g) total

Boil Time
60 minutes

Mash Temperature
152 °F/67 °C

Equipment and Other Information You'll Need

Equipment Boil-Off Rate

You'll have to estimate this number your first time and adjust as you brew each batch. You could get a more accurate starting point by filling your kettle with a measured amount of water, like 5 gallons (19 L). Once it reaches a rolling boil, set your timer for 60 minutes. After the water cools, measure what's left. The difference is your boil-off rate per hour. This should give you a good baseline to start from. For reference and for the calculations in this story, my setup is 0.5 gal./hr.

Finished Batch Size You Want to Bottle or Keg

This is what we want to package, not what's going into the primary. In the case of this recipe, it is 5 gallons (19 L).

Expected Fermentation Trub Loss

This could vary from recipe to recipe,

Step 2: Once the strike water comes up to temperature, insert the false bottom in your brew-pot and insert the grain bag in the pot. Secure it to the pot with some binder clips.

but I usually keep it constant. 0.5 gallons (1.9 L) is what I typically use.

Grain Absorption Rate (gal./lbs.)

This is the amount of water soaked-up by the mashed grains. I typically use 0.125 gallons (0.5 L), but this number is affected by squeezing the grain bag. (Read more about squeezing the grain bag on page 46.)

Hop Absorption Rate (gal./oz.)

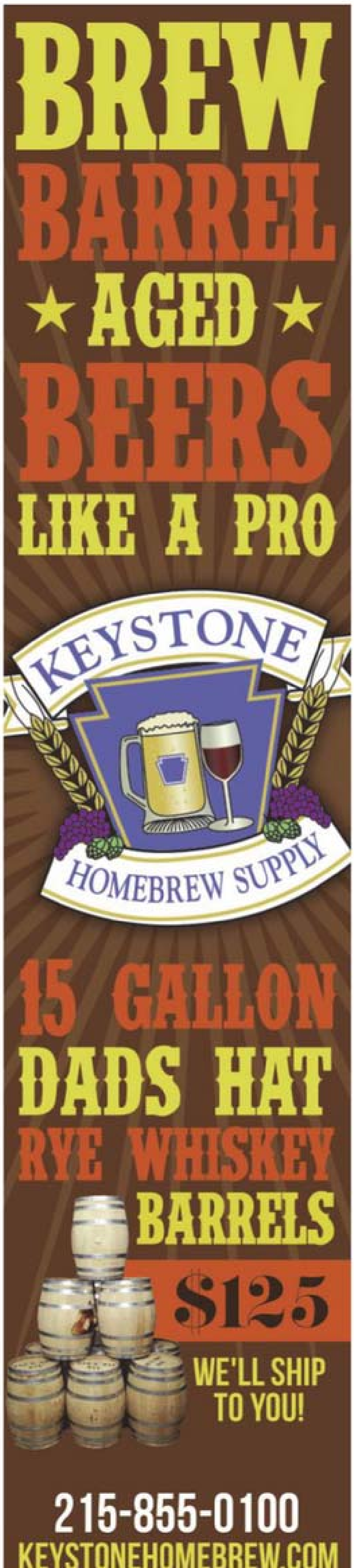
This is the amount of water soaked-up by the hops and hop bags. I use 0.0365 gallons/oz., but like the grain bags I just mentioned, this is affected by squeezing the hop bags.

Grain Temperature

Grab your temperature probe and stick it into your bag of crushed grains to get a measurement on brew day. This will help calculate what temperature to heat the strike water to, so when you add the cooler grains, you'll be close to your mash temperature. For example, when I brewed for this story, my temperature was 71.2 °F (22 °C).

Interior Kettle Diameter

This is great if you have a symmetrical, flat-bottomed kettle and want an easy way to measure your volumes. If you measure your kettle's interior diameter and enter its value, the BiabBrewing.com calculator will give you the strike water depth (in inches), and how many inches each gallon is in your kettle. You can use a stainless steel ruler, yard stick, or I use stainless steel hose clamps secured on the handle of a long mixing paddle adjusted to



To Squeeze or Not to Squeeze, That is the Question

There's a lot of discussion as to how much, if any, you should squeeze the grain bag to get every possible ounce of sweet wort out of your mash. Tannins, which are found in the husks of the grains, can cause beer haze. So if you over-squeeze your bag, you could introduce more tannins into your beer. Squeezing can also introduce more extra particles, or trub. When brewing a regular (not BIAB) batch of all-grain, brewers tend to recirculate the wort back through the mash a few times until the wort starts to run clear. With BIAB, there is no recirculating, so what you squeeze from the bag stays in the wort unless you use finings during brewing. I do squeeze my brewing bags (pressing the bag against the bottom of the steam basket that I use with my setup, using a small lid from another pot works great) and don't have much issue with clarity, but I also use finings when I brew. In my experience, I have not had to adjust my water volumes due to how much I squeeze my bag. You'll need to experiment to find out what works best with your particular set-up. Try a batch of the same beer a few times — squeezing the bag for one, not squeezing for the other — and compare the difference between the two finished beers. If you like the beer with the squeezed bag, go ahead and sqeeze next time. If not, you know what not to do next time!

these measurements. My interior diameter is 13.625 inches (35 cm).

After you calculate your results, you are ready to brew. Now comes the easy part.

Brew Day

Brew-in-a-bag is very simple once you get the math out of the way. The only difference between this method and brewing with extract is what we do before the boil begins. Get your ingredients and equipment together to begin the mash. Here is what you will need before you start:

1. Brew kettle
2. Large grain bag
3. Thermometer
4. Burner or heat source
5. Mash paddle or long-handled spoon
6. Long stainless steel ruler
7. Five or more binder clips
8. Blankets or other brewpot insulator
9. Kitchen timer
10. False bottom, stainless steel or aluminum colander or basket strainer (to

Step 3: Add the grains to the bag in the kettle, stirring the grains to prevent clumping. If you have a second pair of hands, one person can pour while the other stirs.

Step 4: Mash the grains for 90 minutes, insulating the kettle to prevent heat loss. A longer mash (as compared to traditional all-grain brewing) can help increase efficiency.

place on the bottom of the kettle to protect the bag from direct heat)

11. Double crushed grains
(This will allow us to keep our grain bill as stated in the recipe without adding any extra to increase efficiency. If you order your grains online, put a note in the order form, otherwise have your local homebrew supply do it or mill them yourself. I've never been charged extra for double-crushed grains.)

12. All other ingredients needed to complete your brew day

Step 1 - Add Strike Water and Heat

Per our calculated results, we need to fill our kettle with about 7 gallons (26 L) of strike water and heat it to about 156.6 °F (69 °C). If you decided to go with the measured route, just fill your kettle to that point (11.2 inches/28.4 cm in this example), otherwise measure your volume with another method. Be as accurate as you can, but don't worry too much about it. Remember, it will be heavy, so it may be best to fill it right on the burner. See the photo on page 44.

Step 2 - Insert Bag

Once we reach the strike temperature of 156.6 °F (69 °C), insert whatever you're going to use as a false bottom to keep your bag away from direct heat. This can simply be a metal kitchen colander placed upside down in the bottom of the kettle. Next, place your large grain bag into the kettle and secure it to the edge of the pot with the binder clips. See the photo on page 45.

Step 3 - Add Grains

Slowly pour your grains into the bag (see top photo at left). If you can, stir as you pour to keep the grains from clumping. If a helper is available, then one person can pour while the other stirs. Once all the grains are in, give it a good stir to be sure there are no clumps. Reach to the bottom of the bag so you can mix it thoroughly, being careful not to snag the bag.

Step 4 - Mash For 90 Minutes

Check the temperature and cover the kettle. Per our recipe, we should be mashing at 152 °F (67 °C). Add a little heat, if needed, to get to the mash temperature. Once there, cut the heat and either place some folded blankets on top of the kettle, or put an old winter coat around it for added insulation (see bottom photo at left). Be sure to remove any insulators before turning on your burner.

The recipe calls for a 60-minute mash, but always mash for 90 minutes when using BIAB to increase efficiency, being sure to set your timer. You are now officially brewing all-grain!

Step 5 - Check Temperature and Stir

Periodically check your temperature to be sure you're maintaining the mash temperature as consistently as you can. This is where it's nice to have a thermometer on the outside of the kettle so you don't have to keep removing the lid and losing heat while checking temps.

Whenever you remove the lid, give

Step 5 and 6: Check the temperature of the mash periodically and stir the grains. Stirring will help with conversion. When the 90 minutes of mash time is over, remove the insulation from the brewpot, raise the heat to 170 °F (77 °C), stir the mash and cover for 10 minutes.

Step 7: Once conversion is complete, give the grains a final stir and then remove the grain bag. Let the wort drain from the bag by setting it on a colander over the kettle or a bucket. When you have collected all the wort, you will proceed as you would with an extract brew.

your mash a good stir. This will help to evenly distribute the heat and help with the conversion process (see top photo above). It will take practice to know how much heat to add and when to cut it. You'll be +/- a couple of degrees throughout the process, and that's OK. As you gain more experience you'll become more consistent.

Step 6 - Mashout

Remove any blankets or other insulators and raise the temperature to 170 °F (77 °C). Once you reach temperature cut the heat and give the mash a good stir, then cover for 10 minutes. We are performing this step to help increase our efficiency.

Step 7 - Remove The Grain Bag

Remove the cover and give the mash one last stir, then remove the binder clips. Slowly lift the bag out of the wort, allowing the wort to drain from the bag. It's going to be hot, so wear some rubber gloves to help protect your hands. After most of the bag has drained, you can set the bag on a large colander and place it over a bucket to allow it to drain further. Once it's drained off, simply add it to the boil. Also, be sure to fish-out the colander you may have used as a false bottom before you start the boil.

If your kettle happens to have a steam basket then you can lift the steam basket with the bag out of the kettle and set it on top (partially on its side) of the brew kettle so it's supported by the rim of the kettle itself. Then you can let the bag drain directly into the kettle.

Once you have finished that process, you can properly dispose of your spent grains, record your pre-boil volume, and collect your pre-boil gravity sample. Next, prepare for your boil by following your recipe, as you normally would. When you have a moment, be sure to rinse your bag clean and hang it to dry for next time if you plan to use it again.

Final Thoughts

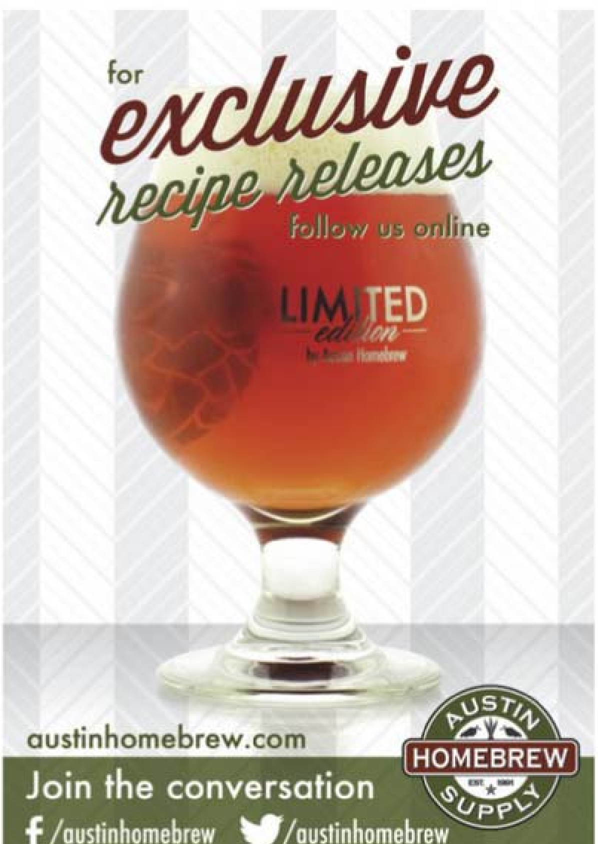
As you can see, once you've prepared your water calculations, the steps for BIAB are pretty simple. When people ask, I tell them that brewing beer is pretty easy and very forgiving, as long as you keep things clean and sanitized. But brewing great beer is a bit more difficult and time consuming. Brew-in-a-bag can help get you on the road to brewing great beer more easily. BYO

Related Links:

• Get Derrick's BIAB calculator, which is designed to give you the essential water calculations needed to get your BIAB brew session started quickly: http://biabbrewing.com

• Looking for other easy all-grain techniques? Use more grain and simply drain: The "no-sparge" method of mashing and lautering makes brewing easier and produces a rich, smooth, pH-stable wort.
http://byo.com/story1375

• What do you get when you combine partial mashing, batch sparging and the extract late method of extract brewing? An easy, flexible way to brew better beer on your stovetop — countertop partial mashing:
http://byo.com/story507



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SIMPLE SPARGE

by **Brad Smith**

Batch Sparging Basics

For homebrewers first getting into all-grain brewing, the terminology, technology and wide variety of methods can be confusing. Simplifying the process, especially for the first few all-grain batches, is important.

All of the technical jargon hides two pretty simple steps: mashing and lautering. Most homebrewers use a single infusion mash, which means you add some hot water to your crushed grains to achieve a target temperature of somewhere around 152 °F (67 °C) for the mixture, and then hold it there for an hour or so. Heating the grain-water mixture up and holding it allows some natural enzymes in the grains to break down long unfermentable sugar chains into short ones (maltose) that yeast loves.

The second step is technically called lautering, though it is often loosely referred to as sparging. Lautering is the "larger" term encompassing the entire three-step process of a mash out, recirculation and sparging. The purpose of lautering is to extract the sugary liquid we call wort from the spent grains so we can boil it with hops to brew beer.

The mash out, which is optional, involves the addition of more hot water to raise the temperature of the grain mixture to 168 °F (77 °C). The purpose is mainly to reduce the viscosity of the mixture to help it flow through the grain bed better. It is primarily used when working with high portions of cereals such as wheat or oats, or when working with very thick mashes (below 1.5 quarts/1.4 L of water per pound of grain).

Recirculation consists of taking the first few quarts (first runnings) of wort as they drain from the mash tun and adding them back to the top. These "first runnings" often have a lot of grain husks and other debris, which don't belong in your wort.

Finally we come down to sparging, which is the process of running hot water down through the grain bed to extract sugars from the grains. There are several possible sparging methods, though we'll be focusing in on batch sparging for this particular article.

Sparging Methods

Some homebrewers may be surprised to find out there are at least four sparging methods you can use to extract sugary wort from your grains after the mash. The most traditional is fly sparging, though we're going to go into detail in this article on batch sparging as it is probably the most popular option for homebrewers.

Fly Sparging: A fly sparge involves continuously adding hot water to the top of the mash tun as it is drained from the bottom. This is the method most commercial brewers employ, often using fixed nozzles used to spray water in a cone pattern over the bed, or sometimes (although not near-

Batch sparging is a method where hot water is added in large batches to the mash tun during the sparge and then drained fully to extract sugars from the grains. Each time a batch of water is added to the grains in the mash tun and then drained it is considered a "step." The number of steps required depends on both the size of your mash tun as well as the amount of grains you are using in your homebrew recipe.

Photos courtesy of Denny Conn

ly as often since the 1980s) with a spinning arm at the top of the lauter tun that sprays water over the top of the grain bed. The flow of water is carefully managed so that the same amount of water is flowing into the grain bed as is draining out.

No Sparge: In a "no sparge" technique, a larger mash vessel is used and enough water is added to the mash tun to account for a "full boil" volume when drained. Since all of the water is already in the mash tun, no sparge water is added, and instead the mash tun is simply drained off into the boiler after mashing.

Brew-in-a-Bag (BIAB): Brew-in-a-bag is a variation of no sparge, except that there is no separate mash tun. Instead the mash is done inside of a bag placed within the boil vessel. Like no sparge, enough water is added to achieve a full boil volume after draining the grains. So instead of sparging or adding water, for BIAB you just lift the grain bag out of the boiler after the mash leaving enough wort behind to brew. (Read more about the brew-in-a-bag technique in this issue on page 40.)

Batch Sparging: Batch sparging is a popular technique with many homebrewers, and is a bit of a hybrid approach. This method uses a normal sized mash tun, but water is added in large batches to the mash tun during the sparge and then drained fully at each step (see photos on pages 51 and 52). Batch sparging has some advantages in terms of time, equipment required and efficiency, which is why it has become a very popular method.

The Advantages of Batch Sparging

Batch sparging has some advantages over fly sparging or

Batch sparging requires very little equipment that most all-grain brewers already have. All you really need is a 5-gallon (19-L) cooler mash tun to brew 5-gallon (19-L) batches.

Photos courtesy of Denny Conn

A stainless steel braid made from a water supply line inside of a mash tun will separate the wort from the grains when you drain the cooler. See additional photo on page 54.

The Batch Sparging Method

1. Add hot water (if needed) to the top of the mash tun. Stir up the grain bed very thoroughly but gently and do not foam.

2. Drain the first few quarts from the mash tun (the recirculation, also called the "vorlauf") and add it back to the top of the mash tun.

3. Now open the spigot and drain the rest of the wort from the mash tun into the boiler. Open your tap as much as you are comfortable.

4. Once it is empty, add a second batch of hot water to the mash tun, stir as you did in step 1, and drain it as well.

5. Repeat as needed until you have the desired volume of wort for boiling.

Each time you fill and drain the mash tun, it is considered a "step." For most beers, two steps are sufficient, but the exact number of steps will depend on the size of your mash tun and how much grain you are using for a given batch.

even BIAB or no-sparge techniques. These include:

Minimal Equipment. You don't need a separate fly sparge arm, and you don't need the larger mash tun or pot associated with no-sparge or BIAB methods. For most batches, a 5-gallon (19-L) cooler with a false bottom is sufficient for a 5-gallon (19-L) batch of beer.

Simplicity. You don't have to manage the continuous flow of water and wort as you would in a fly sparge.

Traditional Water to Grain Ratios. You can batch sparge with just about any desired water to grain ratio, including the traditional ranges of 1.25-1.5 quarts/lb. BIAB or no-sparge methods require the full volume of water in the mash tun, so you would have to mash at a much higher water to grain ratio.

Efficiency. If properly done, batch sparging can be nearly as efficient as fly sparging.

Time Saving. Because you simply pour and then drain water in the mash tun, batch sparging generally takes less time than fly sparging.

Batch Sparging Calculations

You can perform a batch sparge with minimal calculations. Assuming your mash tun size is not overly large, simply fill up the mash tun with hot water after the mash and drain it. Measure what you have so far in the kettle, and then add enough water to the second batch to achieve your desired pre-boil volume. For lots of homebrewers who aren't worried about the math, that's all you need to know. See the process for batch sparging in the sidebar on the facing page.

However, if you want to be more specific, sparging with unequal batches is not optimal, and will generally result in lower extract efficiency. To achieve the highest possible efficiency you need to size your batch steps so each one has equal runnings — i.e. you draw the same amount of water from the mash

You can attach the stainless steel braid in the mash tun with a bung placed in the drain hole of the cooler.

Photos courtesy of Denny Conn

On the outside of the cooler, the braid is attached to a valve that will regulate the flow of wort when you drain the mash tun.

tun at each step.

I'll describe the manual steps to calculate the volumes below, though you can easily make a spreadsheet or use brewing software to do these calculations for you. If you are interested in the math, however, here are the steps:

1. Estimate your pre-boil volume — how much wort you need to collect from sparging.

2. Determine how much of your mash water is absorbed by your grains.

3. Calculate the sparge volume available for mashing based on both your mash tun volume and grain bill.

4. Divide your pre-boil volume by the sparge volume available to determine how many batch steps are needed (typically two to three steps).

5. Evenly divide the water in the mash plus sparge water added to create equal runnings for each batch sparge step.

The first number you need to determine is your desired pre-boil volume, which is the amount of wort you need going into the boiler after sparging. Typically you get this by taking your batch size and adding in your trub loss and boil off losses. For a 5-gallon (19-L) batch you might lose a few quarts (liters) to trub and a few more to boil off, so your pre-boil volume would be in the 6.5-gallon (24.6-L) range.

$$\text{Pre\_Boil\_Vol} = \text{Batch\_size} + \text{Boil\_losses} + \text{Trub\_losses}$$

Grain Absorption

Next we need to know how much wort we already have in the mash tun that can be drawn off during the sparge. This we can calculate from the water added for the mash, minus a portion that gets absorbed by the grains. The grain absorption can be estimated as 0.12 gallons/lb. or 1 liter/kg of grain.

$$\text{Grain\_absorb} = 0.12 \text{ gal/lb.} \times \text{lbs.\_of\_grain}$$

So let's pretend we have 10 lbs. (4.5 kg) of grain in our recipe, and mash in with 1.5 quarts/lb. or 15 qts. of water (3.75 gal.). The water absorbed by grains is then 0.12 x 10 = 1.2 gallons of water. So the most wort we can draw from the grain bed after mashing is 3.75 - 1.2 = 2.55 gallons without adding more water.

Mash Tun Volume Available and Sparge Steps

The next step is to determine how many batch sparge steps are required to achieve our boil volume. Sparging with fewer batch steps is most efficient (two works for most beers) but if you are brewing with a lot of grains or a small mash tun, more steps are sometimes required. It depends on how large your mash tun is and how much grain you are using.

The grain itself occupies a certain volume in the mash tun — roughly 0.312 qt./lb. (0.652 l/kg) in addition to the water absorption we calculated above. If we add these together we get 0.792 qts./lb. (1.652 l/kg) that the wet grain occupies. So for a batch with 10 lbs. (4.5 kg) of grain, the wet grains take up 7.92 quarts (about 2 gal. or 7.5 L). This means if we are using a 5-gallon (19-L) mash tun to mash 10 lbs. (4.5 kg) of grain, we have slightly less than 3 gallons (11 L) of usable volume left per step.

$$\text{Grain\_volume\_used} = 0.312 \text{ qt./lb.} \times \text{Lbs.\_of\_grain}$$

$$\text{Sparge\_vol\_available} = \text{Mash\_tun\_vol} - \text{Grain\_volume\_used}$$

We can now see how the mash tun size and amount of grain drives the number of steps. We simply divide the pre-boil volume by the sparge volume available to figure out how many sparge steps are needed. If we truly want 6.5 gallons (25 L) of wort pre-boil, we would be unable to get that in two batch sparge steps of less than 3 gallons (11 L) each, and would be forced to go to a third sparge step.

Number_sparge_steps = Pre_boil_volume / Sparge_vol_available

However, if we had slightly less grain, a larger mash tun or perhaps needed less wort in the boil, we could then fit our batch sparge into two steps.

Calculating Batch Sparge Additions

From the previous calculations, we now have everything we need to determine the water needed for each step, as well as the number of batch sparge steps needed. Using the example we followed earlier, we would need three batch steps to get 6.5 gallons (24.6 L) of pre-boil wort.

To maximize efficiency, you generally want want the same amount of wort drawn from each batch step. So what we will be doing now is evenly spreading the water already in the mash tun plus the sparge water we will add across the three steps. The first step is the one where things are different, since you already have wort in the mash tun from the mashing process.

Desired_batch_step_vol = Pre_boil_volume / Number_sparge_steps

From our example, we determined our pre-boil volume was 6.5 gallons (24.6 L), and we need three steps. So the desired batch step volume to draw from each step is 6.5 gal/3 = 2.16 gallons (8.2 L). However, we already added 3.75 gallons (14 L) of water for the mash itself, of which the grain absorption was 1.2 gallons (calculated earlier). So 2.55 (9.6 L) gallons of wort is available in the mash tun, leftover from the mash itself.

So the 2.55 (9.6 L) gallons in the cooler is sufficient to cover the first batch step — we can simply draw the wort off the mash for our first step to collect the 2.16 (8.2 L) gallons desired. This leaves 2.55-2.16 = 0.39 gallons of wort in the mash tun.

So for our second batch step we want to draw the desired 2.16 gallons (8.2 L) off again, but already have 0.39 gal (1.48 L) in the mash tun, so we only need to add 2.16 - 0.39 = 1.77 gallons (6.7 L) of water to the second batch and then drain it fully.

For the third batch step, we again add the desired batch volume of 2.16 gallons (8.2 L) and drain it to finish collecting the wort for our boil. So even though we add different amounts of water for each step (zero, 1.77 gal./6.7 L and 2.16 gal./8.2 L) we are always drawing the same 2.16 gallons (8.2 L) of wort from each batch step.

As I said before, you can use brewing software or a spreadsheet to simplify batch sparging calculations. Also, you don't have to be super-precise with each addition if you are not as concerned about maximizing efficiency. You should just strive to draw about the same amount of wort from each batch step, and try to hit your target pre-boil volume so you have sufficient wort to finish your batch.

Considerations and Pitfalls

Some people are concerned about the efficiency of batch sparging, where efficiency is simply the percentage of potential sugars you can extract from the grains. Some brewers report slightly lower efficiency when batch sparging than they get with a slow fly sparge. My personal experience is that the efficiency for batch sparging is comparable to the numbers I get from fly sparging. However if you do get lower efficiency with batch sparging, you can compensate by adding a bit more grain to the recipe or lowering your brewhouse efficiency in your brewing software.

A second concern is a stuck sparge, which can occur when your grain bed gets compacted and actually stops the flow of wort from the mash tun. This is usually not a concern with barley based recipes but can occur when you are using a large percentage of cereal adjuncts such as wheat or oats. It is a higher risk with batch sparging than fly sparging, since you completely drain the mash tun for each step, and the grain bed is no longer floating. A potential remedy is to use rice hulls in the mash (which are flavor neutral) to maintain flow, or in worst cases to stir the mash to reopen channels in a stuck sparge.

Conclusion

Batch sparging is a great way to get into all-grain brewing, and may also be a time saver. With a simple spreadsheet or some brewing software, you can achieve an efficient batch sparge with two to three steps of equal runnings using your existing equipment. BYO

Related Link:

- Mr. Wizard discusses a question about batch sparging and how it may increase yield: http://byo.com/story176

ANCIENT NORDIC GROG

Building a 3,500-year-old recipe

"I'm lucky I get to do this," Sam Calagione, Dogfish Head Craft Brewery Owner and Brewmaster states in no uncertain terms when asked about one of his latest "archaeobeer" projects: Kvasir. This 3,500-year-old "Nordic grog," is the seventh beer in a series of brewing collaborations between Calagione and famed fermented beverage archeologist Dr. Patrick McGovern of the University of Pennsylvania Museum of Archaeology and Anthropology.

"In the late '90s we started doing some historic beers on our own," Calagione continues, "which led to our collaboration with Dr. Pat."

Dr. Pat, as he is oft-referred, is the world's leading authority on ancient fermented beverages. His exact title is something of a mouthful: Scientific Director of the Biomolecular Archaeology Project for Cuisine, Fermented Beverages, and Health. So for most purposes, Dr. Pat works just fine. Titles aside, McGovern and Calagione have worked together to bring ancient libations back to life since meeting at a Pennsylvania Museum dinner hosted by renowned beer enthusiast and author Michael Jackson in 2000. During the course of dinner, McGovern announced his intentions to recreate an ancient brew, offering any of the assembled brewers the chance to work with him. Calagione's approach to brewing made it clear to McGovern that the brewers at Dogfish Head would go to any lengths to recreate these long-lost beverages, which is why their collaborations have continued for more than a decade.

"Sam will put the investment into it even when we don't know if it's going to work," McGovern explains. "He genuinely wants to do something with antiquity and take a chance and experiment. A lot of brewers have passion, but he's really willing to go much further."

"When we started brewing beer in 1995 our purpose was, 'Off-centered ales for off-centered people,'" Calagione says. "The definition of off-centered then is considering the entire culinary landscape for potential beer ingredients, not just the relatively recent beer ingredients of using just water, yeast, hops and barley."

Together, McGovern and Calagione devised a recipe for Midas Touch, a beer synthesized from organic matter isolated from some of the hundreds of drinking vessels found in King Midas' 700 B.C. tomb discovered near Ankara, Turkey. The pair also created Chateau Jiahu, a combination of rice, honey, wild grapes and hawthorn deduced from the world's oldest known fermented beverage, unearthed from a Chinese archeological site dating back 9,000 years, and Ta Henket, an Egyptian ale favored by the Pharaohs. A chocolate drink from Honduras, Theobroma, and an Andean chicha have also been recreated.

Where to Start

The process for turning these ancient drinks into modern brews goes back, in some cases, many thousands of years, and typically begins where the life of an important person ends. Burial sites or tombs "offer extremely good preservation" of organic residues perfect for analysis, McGovern says, and were typically filled with various vessels holding libations to help sustain the deceased on his or her journey to the underworld.

McGovern looks for commonly shaped drinking vessels, ones with narrow necks that could be stoppered, but also buckets that could have contained fermented liquids. Within by **Glenn BurnSilver**

Dogfish Head Craft Brewery's Sam Calagione sits with Dr. Patrick McGovern of the University of Pennsylvania Museum of Archaeology and Anthropology. The pair have collaborated on a new addition to Dogfish Head's "Ancient Ales" series of beers — a Nordic grog.

these vessels McGovern looks for "tide lines" — rings around the edges where liquids have evaporated and left residue — but also colors, stains or organic accumulations in the bottom that may indicate some aspect of a beverage has been left behind.

"Even if nothing is visible, sometimes the best organics are what's absorbed into the vessel," McGovern adds.

In the case of Kvasir, "mounds" of organic matter resided in the bottom of birch buckets in the oaken burial chamber of an important woman, someone McGovern speculates was a, "priestess or dancer of upper class," based on items discovered in the tomb, including the grog bucket.

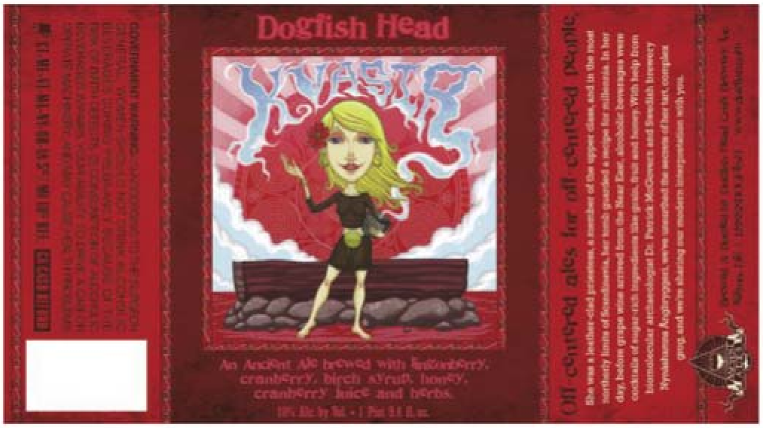
Once identified, McGovern harvests samples, which are then taken to his lab for a chemical breakdown of the molecular and biological components that make up the residues. Using such techniques as infrared spectroscopy, liquid chromatography, and an orbitrap detector, he first begins searching for the usual suspects: "Fingerprint compounds" known to exist in fermented drinks brewed thousands of years ago. Beeswax, for instance, indicates a presence of honey, a common fermentation agent in both wine and beer since the sugars turn to alcohol during fermentation. For beer, McGovern looks for calcium oxalate, which is present in many grains and may indicate the presence of barley. The whitish substance is generally referred to as beer stone.

"You have to have some notion of what you're looking for," he says.

With his data, McGovern begins piecing together an ingredient list. Eventually, it will be up to Calagione to determine the proper ratios, but before that happens, ancient ingredients must be sourced in modern times. That's where Calagione's "culinary landscape" looms large. Sometimes substitutions have to be made, but the pair have practically gone to the ends of the earth in search of proper ingredients in an attempt to remain as true and accurate to what they believe most represents an original recipe. Together, they have scoured foreign markets for ingredients, harvested wild yeast in date farms and vineyards, gathered quarry dust believed to have inoculated the Egyptian brew, and more.

Developing Kvasir has worked in this same way. While less difficult and extreme in the overall ingredient hunt, Calagione admits, "With this one we had some challenges." With some of the ingredients being so different from each other, the concern was how to determine the proper ratio. Calagione consulted with Swedish brewery Nynäshamns Ångbryggeri to see how these brewers would handle a local ingredient list they possibly would be familiar with — cranberries, lingonberries, yarrow, bog myrtle, honey, and meadowsweet.

"We thought it would be fun . . . to reach out to a local Swedish craft brewery and see how they would brew with these ingredients," he adds. "They handled the European



Dogfish Head's Kvasir clone

(5 gallons/19 L, extract with grains)

OG = 1.087 FG = 1.011
IBU = 18 SRM = ~23 ABV = 10

Ingredients

7 lbs. (3.2 kg) Briess Bavarian wheat dried malt extract
0.5 lbs. (0.23 kg) caramel malt (40 °L)
0.5 lbs. (0.23 kg) Maris Otter malt
0.6 lbs. (0.27 kg) fresh or frozen lingonberries
0.3 lbs. (0.14 kg) fresh cranberries
0.3 gallons (1.1 L) cranberry juice (preservative free)
0.7 lbs. (0.32 kg) birch syrup
2 lbs. (0.9 kg) honey
0.25 oz. (7 g) meadowsweet
0.1 oz. (2.8 g) yarrow
10 oz. (283 g) Myrica gale
Pectinase
2.64 AAU Hallertau, Spalt or Tettnang hops (0.6 oz./17 g at 4.4% alpha acids) (60 min.)
0.8 AAU Hallertau, Spalt or Tettnang hops (0.18 oz./5 g at 4.4% alpha acids) (10 min.)
Wyeast 1338 (European Ale) or White Labs WLP011 (European Ale) yeast

Step by Step

24 to 48 hours before brewing: Crush the lingonberries and cranberries in 0.5 gallons (1.9 L) of water and treat with pectinase per the manufacturer's instructions.

Brew day: Preheat 1.5 gallons (5.7 L) of water to 154 °F (68 °C). Place the caramel and Maris Otter malt in a steeping bag in the water. Steep the grains at 153 °F (67 °C) and hold for 15 minutes. In a second vessel, heat approximately 1 gallon (3.8 L) of water to 175 °F (79 °C) for rinsing. After the steeping time has elapsed, place the steeping bag with malt into a colander and let it drain into the brewpot. Rinse the grains with the 175 °F (79 °C) water and increase the heat. At 200 °F (93 °C) mix in the dried malt extract and raise to a boil. Add the first hop addition at the start of the boil. Boil time is 60 minutes.

At 50 minutes into the boil add the birch syrup, honey, and cranberry juice and the second hop addition. If you have lost the boil, return to boiling for another 10 minutes. After returning to a boil add the meadowsweet, yarrow, and Myrica gale.

After 60 minutes have elapsed, turn off the heat, add the lingonberry and cranberry mixture. Let the mixture sit for 10 minutes. Chill the wort to a 62 °F (17 °C) and transfer to a sanitized fermenter. Try to leave most of the fruit behind. Pitch the yeast. Ferment at 62 °F (17 °C). After primary fermentation has completed, rack to secondary fermenter and mature for at least 21 days. Bottle or keg and enjoy.

test brew."

The results were not surprising for McGovern, given his historical knowledge. The grog tasted sour from the fruits used in the recipe, something more akin to a Belgian lambic, which, he says, made perfect sense given the northern location where the drink was created 3,500 years ago.

"A lot of our recreated beverages have been on the sweet side, and sweet is not bad, but in this case for the Nordic grog we're shooting for a more sour beverage, more of a Belgian lambic," he explains. "The idea was, if you're in a northern climate you don't have a lot of sugar resources for fermentation and you take whatever you've got and you mix it together, get the fermentation going somehow, and come up with this hybrid mixed beverage or grog that takes you through the cold dark winters. You're really pushing the limits of the resources you have to make a (sweet) fermented beverage."

Uncles Sam's Headaches

Satisfied with the results, scientist and brewer returned to the United States hoping to begin the brewing process on a larger scale. However, new problems presented themselves, namely that two of the three herbs used in the combination of ancient bittering agents better known as gruit — bog myrtle, yarrow and meadowsweet — were disallowed by the US Food and Drug Administration. Yarrow, the government said, contained thujone, a hallucinogenic compound also found in wormwood, which is used to make Absinthe, a banned substance. Consumption of thujone has been regulated for use below 35 milligrams per liter. The amount needed to brew a 50-barrel batch raised the alarm with the FDA, and they needed to get approval.

"It was a long process," McGovern says, some exasperation in his voice, "but we did get approval."

Less fortunate were attempts to use meadowsweet, which contains salicylic acid, which is the active component of aspirin — another substance regulated by the FDA. "They said we were making up a medicine," McGovern says. "We ended up substituting clover. I don't like the aroma so much for clover as I do meadowsweet," which, he adds was a typical ingredient in mid-evil meads.

Given all the unknowns in the brew — alcohol content, exact proportions and ratios, etc., the pair take a few creative liberties in bringing Kvasir into the 21st century.

"Usually we start with the botanical, molecular and historic data that Dr. Pat provides, but that's really just a laundry list of natural ingredients," Calagione says. "Modern brewers are given the liberties to decide what the ratios of those ingredients would have been; if the beer would have been filtered, what the alcohol content would have been, if it would have been carbonated. We still have a lot of creative leeway."

While McGovern's testing revealed traces of honey — probably used to balance the tartness from the cranberries and lingonberries — that leeway includes the addition of Alaska birch syrup, along with wheat and barley. The latter two add body and color, but all contribute fermentable sugars to drive up the alcohol content for modern tastes while creating a more drinkable product.

"The lingonberries and cranberries add a lot of tart, sour notes. They contribute some fermentable sugars, but not like strawberries or blueberries," Calagione says. "So we bump up the alcohol with honey and birch syrup in addition to wheat and barley."

Yeast is also a necessary modern ingredient. McGovern speculates that given the age of the original grog, only wild yeast strains or bacteria would have fermented the beverage as the understanding and use of yeast in brewing and other applications only dates back approximately 800 years to Louis Pasteur. Thus, whatever fermented the beverage left in the bucket designated to help the priestess' in her journey to the underworld, remains a mystery.

"It's not as mild tasting as something like Midas Touch," Calagione adds, "but if somebody likes lambics or (sour) styles, this could be their favorite ancient ale."

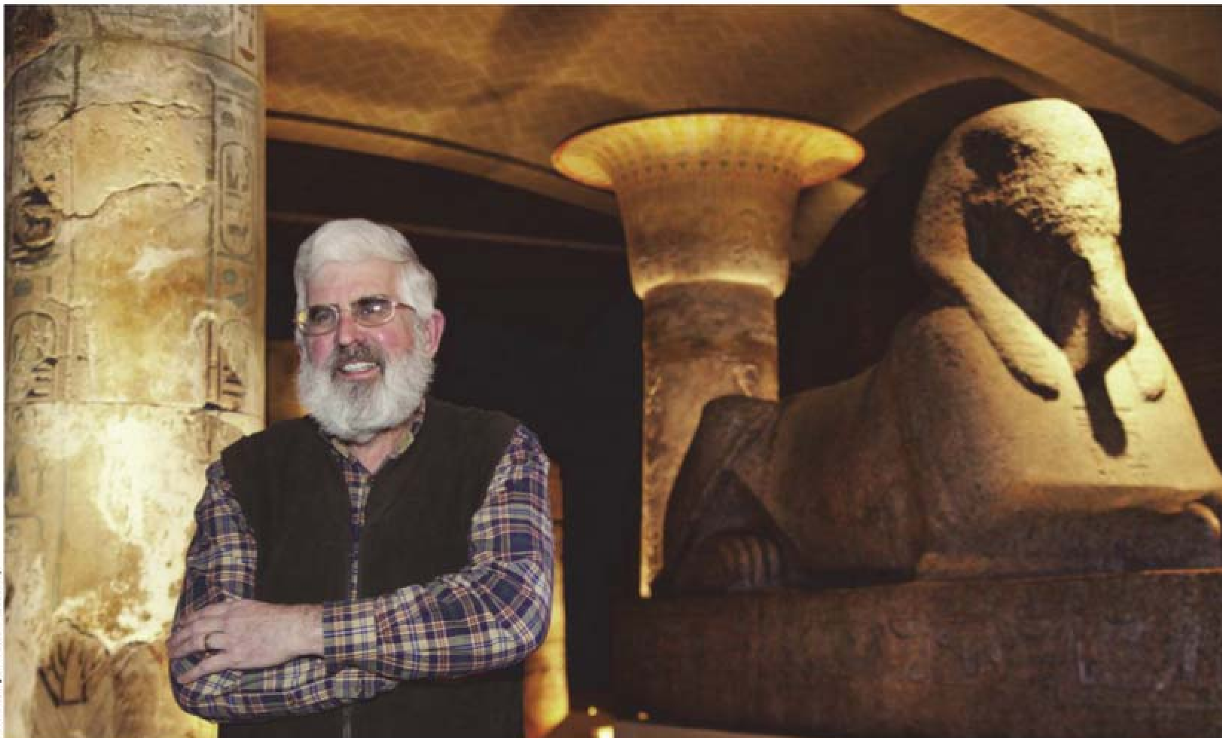


Photo by Alison Dunlap

Dr. McGovern stands in the Lower Egypt gallery of the Penn Museum, next to the third largest sphinx in the world. His work in his particular niche of archaeology has earned him the unofficial title of the "Indiana Jones of Ancient Ales, Wines, and Extreme Beverages."

Uncorking McGovern's Past

McGovern, whose books on the subject of ancient libations include *Uncorking the Past: The Quest for Wine, Beer, and Other Alcoholic Beverages*, and *Ancient Wine: The Search for the Origins of Viniculture*, cites his discovery that, "beer was cheaper than Coca-Cola" during a high school trip in Europe as the turning point in his interest in fermented beverages. "We started drinking lots of Bavarian beer," he says with a light laugh. "That was a formative experience."

He later worked at a winery in the Mosel region of Germany, before returning to the US and pursuing an archeological career. It was when people brought to McGovern what they thought were beer or wine samples that he, "had a natural inclination to look into it," he says. "As we got deeper and deeper into this, I was working with other scientists and we just started getting more and more involved in these fermented beverage studies."

McGovern's pursuit has included the discovery of the world's oldest known barley beer (from Iran circa 3400 B.C.), oldest grape wine (also from Iran, circa 5400 B.C. and the oldest fermented beverage of any kind — a grog — unearthed in China, circa 9000 B.C.). Relatively speaking, the Kvasir is not very old, but its ingredient list and sour flavor certainly make it different from most other ancient fermented concoctions.

Bring the Past Home

If early man could brew beer with only the most basic tools and ingredients, the modern homebrewer should have no problem replicating the past.

"Basically, these were early brewers in early civilizations, so their equipment was at least as simple or primitive — more simple and primitive actually — than what modern homebrewers use," Calagione says.

Those creative liberties mentioned previously also extend to the homebrewer recreating ancient ales.

"What we learned is that almost all these were fermentable hybrid beverages. That is, something between mead, wine, and beer. Grain and honey and fruit," Calagione says. "These are pretty easy to attack at the homebrew level. You don't have to be a world-class, all-grain brewer to replicate ancient ale because they have so many more accessible sugars than a simple all-grain version. There are a lot to play with. These ales are a lot of fun to brew at home because you have all these partial mash syrups. They are almost easier to brew in terms of time than traditional all-grain batches. You can steep grain in a bowl with water as a partial grain batch, then add honey or (birch) syrup."

As noted above, wild yeast most likely fermented the Nordic grog, yet for a modern day application, a clean yeast strain is recommended. To find the best one for this application, Calagione brewed a single batch of Kvasir, then broke it down into smaller proportions and experimented with different yeasts.

"At Dogfish we have pretty sophisticated yeast growing room with seven

1,200-gallon tanks," he explains. "We have the great latitude in keeping multiple yeast strains active and ready to pitch at any time. So when we run with new recipes we can put them into six or seven small carboys and test how that recipe works with six or seven different yeasts."

The same process can be accomplished at home with half-gallon (1.9-L) growlers. Brew your ancient ale and rack off into as many growlers as desired. Leave some headspace for the yeast and foam expansion and then pitch several different strains to see which best fits your palate.

Again, Calagione cautions homebrewers to use a clean yeast strain.

"Ancient brewers probably would not have known of wild yeast or bacteria, what they were or if they were present," he explains. "That's why we recommend that homebrewers who are using very expensive ingredients like birch syrup and want it to really shine through the brew use a neutral yeast strain so nothing competes with the funky flavors of the wild yeast and bacteria present."

Future of the Past?

"Back when we started doing the recreations, no one was really familiar with these hybrid beverages," McGovern says. "Now people perk up their ears and want to know more. People are just fascinated by this idea of ancient beverages."

So is there something new in the works from some long forgotten time?

"Dr. Pat and I are hard at work at our next ancient ale," Calagione says.

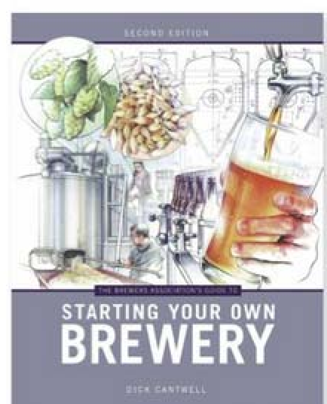
Can we get a hint of what that might be, the continent it hails from? The tomb it was found in?

"No clue what it is," Calagione says, keeping the secret to himself.

Whatever the ancient fermented beverage, if it's already been non-existent for hundreds, maybe even thousands of years, then it's only logical that we can wait a little longer. BYO

Related Link:

• Read more about Dr. McGovern: http://www.penn.museum/sites/biomoleculararchaeology/



by **Michael Dawson**


Photo by Kevin Margulieux

Using Yeast Nutrients

When I was a kid, my grandma would buy sampler packs of single-serving boxes of Kellogg's cereal for my brothers and me. Remember those? Invariably, the last one to get eaten was always Product 19 — the one with all the essential vitamins and minerals. Those nutrient-rich but sugar- and cartoon character-deficient flakes may have been the pariahs of the morning table, but they provided us with extra fortitude to jump on couches and race around the backyard for the rest of the day.

Maybe that's a bit of an exaggeration (couches were going to get jumped on no matter what was for breakfast), but the same thing is going on at a cellular level in our fermentations: our yeast cells need their Product 19. In this elegant analogy, the couch and backyard represent the wort, the jumping around is fermentation, and the poorly-regarded-by-eight-year-old-me cereal is yeast nutrient.

Yeast Nutrient: A Working Definition

"Yeast nutrient" (sometimes even called "yeast food" in some texts) is a bit of a catchall for the various vitamins, minerals, ions, and other compounds required for cells to function properly in a fermentation — we'll continue to use that umbrella term here. Basically, yeast nutrients help yeast reproduce to produce healthy cells. If yeast nutrient levels are deficient then the cell reproduction will be reduced and daughter cell health will be compromised. To help us keep it sorted out, here are some quick definitions:

Vitamin: An organic substance essential in small quantities for normal metabolism.
Mineral: A naturally-occurring and usually inorganic substance.
Ion: An electrically charged atom or group of atoms.

Better beer starts with breakfast

A number of enzymes within the yeast cell require these various nutrients in order to carry out the basic functions of life. The tricky part is that the right amount of nutrients can vary based on yeast strain, wort composition, and other batch-to-batch conditions. What's more, too much of any one of these nutrients can become problematic for the fermentation and its resulting beer.

Real Talk: Do I Gotta?

Disclaimer up front: Most all-malt worts will contain almost everything a yeast cell needs in terms of vitamins and minerals. For that reason, given the beer styles which homebrewers and craft brewers commonly prefer to brew, most of the time it's perfectly possible to turn out a good beer without tinkering with a nutrient addition.

Second Disclaimer: Fine-tuning wort nutrient levels isn't as important as adding a healthy population of viable cells at an appropriate pitching rate, ensuring a proper fermentation temperature, and supplying the cells with adequate levels of O_2 — our yeast wants us to see to that stuff first.

But having said that, here's where an ounce of prevention really beats a pound of cure: high-gravity fermentations, grists with a high percentage of unmalted adjuncts, and when propagating yeast. And even in an all-malt wort, yeast cells may not be getting a well-rounded breakfast.

Ounce of Prevention #1: Chelation and Limited Availability

In an all-malt wort where all systems should be "go" in terms of yeast health, vital nutrients can be lost or made unavailable to the cells through normal brewing processes.

One example of this is chelation, which is the chemical term for a bond formed between a metal ion and another molecule. In the course of boiling wort, zinc — a vital component for the conversion of wort sugars to alcohol by the cells — can become bound to wort proteins and precipitated with the break material. Any beer wort will lose zinc to this process and may be deficient by the time it reaches the fermenter.

On top of that, an overabundance of one nutrient can limit yeast cells' access to another nutrient. For example, calcium and magnesium are both important to cell function in a beer fermentation, helping to regulate flocculation and metabolism, respectively; but a high level of calcium ions will inhibit uptake of magnesium by the cells.

Supplementing the yeast nutrient content of even all-malt worts can help coax more performance out of our yeast pitches and maximize fermentations — as insurance goes, it's pretty cheap.

Ounce of Prevention #2: Propagation and Stressful Fermentations

Any homebrew could fall victim to the decreased viability of a yeast pack that's spent a long time in storage or in transit. In that situation, preparing a starter culture with the necessary environmental factors — malt sugars, oxygen, and nutrients — to help the cells recover and rebuild is the first critical step to a successful batch.

In any stressful fermentation — whether the high osmotic pressure and ethanol levels of a high-gravity fermentation, the nutrient-poor wort of a high-adjunct lite lager, or when culturing up depleted cells from a pack after storage or shipping — a few pennies' worth of nutrient can fix problems before they start.

If you're a brewer who's already aware of the importance behind proper pitching rate and yeast health, fermentation temperature, and O_2, then you're aware of the cascading problems that a hiccup with those processes can create; in much the same way, a scarcity of nutrients can trigger its own cascade of woe.

Vitamins and minerals by definition can't be created within the cell — they must be supplied by the environment. Without an adequate supply of the trace elements that help regulate some really basic functions of the yeast cell, brewers can experience sluggish or incomplete fermentations, low or inconsistent attenuation, and decreased viability.

Let's Add Some Nutrient

Enough chemistry and scary what-ifs - let's talk practicalities and healthy fermentations. Depending on the individual batch, your system and gear, personal preference, or the manufacturer's directions, you may have some options to consider for when and how to add nutrient.

Add to Starter Wort

In my opinion, a yeast starter is never a bad idea for homebrewers, and adding nutrient to a starter is also never a bad idea — it helps revive cells depleted by time in storage or by shipping conditions, and ensures the health and viability of the culture going into those crucial first hours of a fermentation.

Whether you can starter wort in a pressure cooker ahead of time to stockpile, or prepare it flask by flask as needed, adding nutrient is as simple as dosing it out alongside the malt extract - adjust nutrient dose as per manufacturer's or supplier's instructions.

Add During Boil

This is probably the most common technique, and arguably the easiest for dosing an entire brew length - just add the required amount of nutrient to the wort in the kettle, as per the manufacturer's instructions. Nutrient additions are typically done near the end of the boil — usually during the last 10 or 15 minutes. If using a nutrient in powder form, it may be beneficial to dissolve it in warm water first.

Remember chelation — some zinc will be lost to break material, so the usable amount delivered to the fermenter will be somewhat less than what went into the boil. It may take a bit of trial-and-error to fine-tune the dosage, but bear this in mind, citizens: discretion is still the better part of nutrient additions. Too much of a good thing can lead to as many problems as not enough.

Add Post-Boil

It's certainly possible to add nutrients to wort post-boil: ideally at the same time as the yeast is pitched, although obviously that won't be an option if trying to kickstart a sluggish or stuck fer-

Know Your Nutrients

A brief primer for the lay homebrewer on what's in the wort and what it does:

Calcium: Perhaps better known as a mash additive for pH adjustment and enzyme performance, its role in the fermenter is as an aid to yeast flocculation, but too much (over 250 ppm) can inhibit cell growth and fermentation.

Copper: Trace amounts (in *Principles of Brewing Science*, Fix lists 0.01 ppm) are necessary for cell growth and function; but at too high a concentration it becomes toxic to cells. Primarily finds its way into wort through a brewery's water source.

Iron: As with copper, trace amounts (0.075 ppm, as per Fix) are beneficial for viability and too much becomes toxic. As with copper, brewing water is the primary contributor.

Magnesium: A critical factor in the complex reactions of yeast metabolism; an excess of Mg can cause unpleasant flavors in the finished beer (and a laxative effect on the drinker). All-malt worts generally supply adequate magnesium for yeast function, but high levels of calcium can limit its availability even if present.

Nitrogen: Essential for yeast nutrition and a proper fermentation. Malt is a rich source of organic nitrogen in the form of amino acids, but as the malt load decreases (whether in a low-gravity all-malt wort, or a wort of any gravity with a malt bill diluted by unmalted adjuncts) so does the amount of nitrogen available to cells, which inhibits growth and disrupts fermentation.

Phosphate: A building block of DNA as well as cell membranes, and also important as a component of adenosine triphosphate (ATP), the primary source of energy in cells. Phosphate is prevalent in malt, but worts with sugars and adjuncts may be phosphate-poor, which can limit cell reproduction and lead to stalled or incomplete fermentations.

Potassium: Another ion with significance for metabolizing wort sugars and other cell processes, but it can actually inhibit yeast metabolism in excess quantities.

Zinc: Vitally important for cell reproduction and conversion of wort sugars to alcohol at trace levels of 0.1-0.5 ppm; higher concentrations become toxic to yeast. Levels can and will be reduced through chelation in the boiler.

Field Guide to Nutrient Blends

An informal and non-comprehensive survey of what you might find on the shelf at your local homebrew shop. Information taken from manufacturer's/supplier's websites:

There are a number of nutrient blends, both generic and name brand, with different formulations and applications available to homebrewers today. Since everyone's wort compositions, yeast strain selection, fermentation conditions, and brewhouses will be a little bit different, the common wisdom is to find one that works for you at the right dosage and stick with it.

Brewer's Choice Yeast Nutrient
Wyeast Laboratories
A blend of vitamins, minerals, inorganic nitrogen, organic nitrogen, zinc, phosphates and other trace elements that will benefit yeast growth and complete fermentation. Additional nutrients are most valuable during yeast propagation and sluggish or stuck fermentations. Supplementing with nutrients will reduce lag time, improve viability and provide consistent attenuation rates.

Usage: ½ tsp (2.2 Grams) per 5 gallons (19 L) of wort. Dissolve in warm water. Add solution to kettle 10-15 minutes prior to end of boil.

Fermax
BSG HandCraft
A balanced blend of minerals, proteins, amino acids and vitamins to improve yeast activity during fermentation. Improves attenuation and speed of fermentation. Use 1 teaspoon per gallon prior to fermentation beginning.

Servomyces
White Labs
Servomyces is a nutritional yeast supplement (GMO free) that was originally developed by Weihenstephan and Munich University. It conforms to the restrictions of Reinheitsgebot. Servomyces enables any yeast strain's ability to incorporate essential nutrients into its cellular structure.

Usage: Add 1 capsule 10 minutes prior to the end of the boil. OR, If your fermentation does not require a boil, open the capsule and pour in the Servomyces, since the capsule requires boiling to melt.

Yeast Nutrient
LD Carlson
A mixture of diammonium phosphate and food-grade urea that nourishes yeast, ensuring that it remains healthy throughout fermentation. One teaspoon per gallon is recommended.

mentation that is already underway.

An advantage to post-boil additions of nutrient is that it helps minimize zinc loss to chelation, since the conditions for zinc chelation are most favorable in the boiler, before the break material is separated.

The challenge of post-boil additions is ensuring the dose is thoroughly diffused into the wort while timing and executing the addition without increasing the risk of unwanted oxygen pickup — not as much of a concern if nutrients are added right away along with the yeast, but a bit more complicated if the fermentation is in progress.

For purposes of even distribution throughout the fermenter, it's advisable to dissolve the nutrient dose in warm water before gently stirring it in — but refer to the manufacturer's instructions, which may override that rule of thumb. If you're concerned about sanitation, a brief boil may not be out of order.

In Conclusion

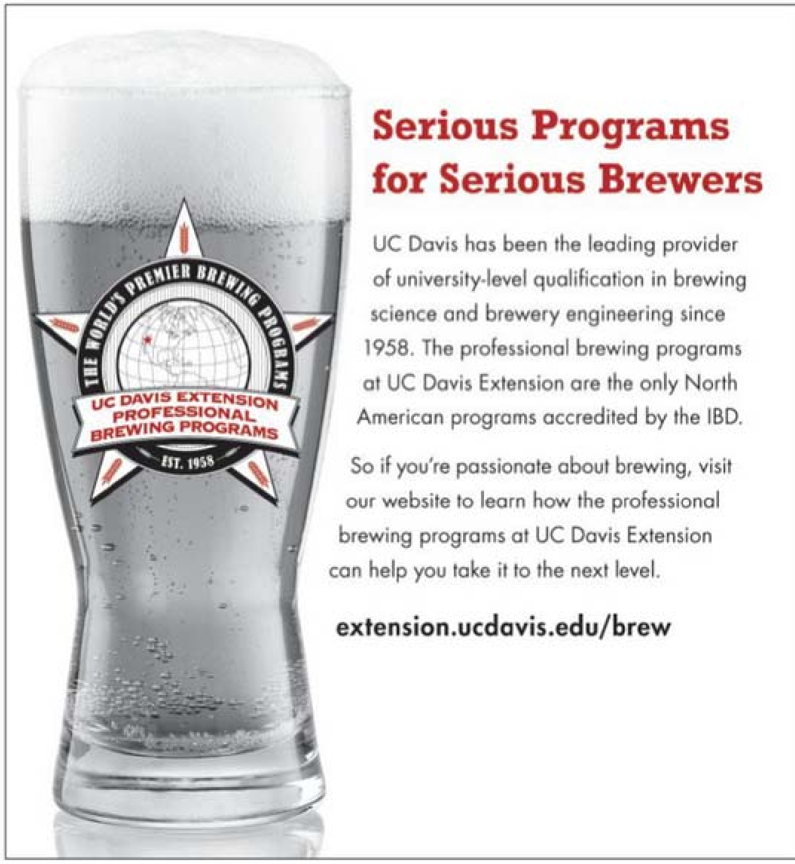
Breakfast, as many nutritionists have said, truly is the most important meal of the day; it's our first, best, and possibly only chance for vital macronutrients like bacon, pancakes, and coffee. And, if you're like me, you know how difficult it can be to carry out basic functions in an environment deficient in one or a combination of these vital macronutrients.

As brewers, we're stewards of the yeast cells in our care, and it would be against their best interests to send them off to the carboy or bucket without a well-rounded and balanced diet, the microbiological equivalent of Kellogg's Product 19. BYO

Related Links:

• High gravity beers don't follow all the fermentation rules. Find out how to handle the big numbers:
http://byo.com/story1882

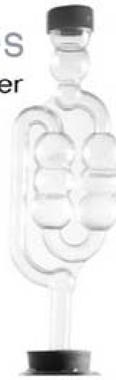
• Yeast is a carbon-based lifeform just like you and me and has many of the same requirements for a healthy, productive life. Find out how to keep your yeast happy and healthy:
http://byo.com/story950



Sparging

Three methods to extract from the mash

by Terry Foster



My apologies to extract brewers, but today is solely about all-grain brewing, and how we get the extract out of the mash when conversion of starch is complete. Three techniques are practiced by homebrewers, namely fly-sparging, batch-sparging, and no-sparging. In the first, hot water is sprinkled over the grain bed, while wort is run off from the bottom. In the second, wort is run off, then further water is added, and a second wort is run off, while in the third no water is added after the mash, and only the wort run off from the mash is what goes to the kettle.

As soon as I wrote that paragraph, my hackles started to rise at those three terms. They just seemed an incorrect way to describe these procedures, and another instance of brewers introducing meaningless jargon, such as "liquor" for "water," and "knockout" for "finish." You see, the term "sparge" has a quite precise meaning, which is to "sprinkle." My *Webster's Dictionary* is specific to brewing, for it defines it as sprinkling the mash with hot water. In short, fly-sparging is meaningless, since sparging is all we need to call it. And batch-sparging is not sparging at all, but merely re-mashing, and no-sparging is a back-formed negative term for single or dilute mashing.

Or am I merely being pedantic? I don't think so, because there is no point in inventing new words or phrases unless they enable us to express ourselves more clearly, and I just don't see that these new terms do that. In fact, they do the reverse by implying that all three procedures are related to sparging when only one of them is. So in what follows I shall use the terms I have described here, and desist from further pontification.

Extract recovery

Let's suppose you are brewing 5 gallons (19 L) of beer at an original gravity (OG) of 1.048 (11.9 °P), which would require 10 lbs. (4.5 kg.) of pale malt, since at our 65% efficiency pale malt yields 24 gravity points per lb./gallon. A normal infusion mash is carried out with about 1.25 qts. (1.2 L) of water per pound of grain, so in this case we would want 12.5 qts. (11.8 L) of water. As a rough guide, the grain will hold up to 0.1-0.125 gallon of wort per pound of grain, so in this case the holdup will be 1-1.25 gallon (3.8-4.7 L) of wort. Therefore, straight run off will give you less than 2 gallons (7.8 L) of wort, or even less if you have a significant dead volume under the run-off outlet. In other words, you have lost a third of your extract, and your expected OG will only be a maximum of 1.032 (8.1 °P) if you diluted that 2 gallons down to the brew length of 5 gallons (19 L).

"Three techniques are practiced by homebrewers, namely fly-sparging, batch-sparging, and no-sparging."

So you have therefore got to do something to recover that lost one gallon (3.8 L) yield, and the obvious way to do so is to rinse out the grains with more water. You can't do so just by adding one more gallon of water to wash it out, because there will be a partitioning of extract between the added "free" water and the wort in the grain. To get all the extract into your wort you will have to add considerably more than one gallon (3.8 L) of water; just how much is going to depend upon the method by which the water is added.

Sparging

As I have mentioned above, sparging means sprinkling hot water over the grain and allowing it to trickle through the bed. This involves balancing the

Photo by Les Jorgensen

rate of sparging with the rate of wort run-off so that there is always an inch or so of water on top of the bed. Higher water levels will increase the pressure drop across the bed, which could pack the grains down tightly and slow the process considerably. If the bed dries out at all, it will crack open channels and the sparge water can run right through the bed without picking up any of the retained wort.

Therefore, sparging takes some attention on the part of the brewer, and some extra equipment. I have seen it done successfully with a china plate placed carefully on top of the grain bed, and the "sparge" water carefully run onto this plate from a vessel held just above the plate. However, a more common way is to use a sparge arm, which can either be made yourself, or bought from a supplier for $20-$40 depending upon the model. A sparge arm consists of a piece of tubing with a second tube at right angles to it; perforations on this latter mean that it swivels about the former when hot water passes through it. The upper tube is connected to the hot liquor tank; the valve on that is opened as you start run-off and the hot water is sprinkled gently over the bed by the rotating perforated arm.

Generally you would use an amount of sparge water up to the volume of the finished beer (5 gallons in this case). It should be at a temperature of around 170 °F (77 °C), since this will keep the bed at a reasonable temperature and the wort at a low viscosity so that the water will flow freely through the bed. Sparging in this way is quite an efficient process, as all the water has to pass from top to bottom of the bed allowing good contact between water and grain. The more slowly sparging is carried out, the better that contact will be, and many believe 1-2 hours duration to be optimal, though that does depend upon how finely the grain has been ground. For many of you that extra time on your brew day may be unacceptable, and I must say I usually only sparge for about 30 minutes.

There are some other points about sparging, the first being that the sparge water should ideally be treated (that is with whatever added salts) the same way as the mash water. If it is not, then as the sparge continues, the pH of the liquid in the tun will increase as the gravity drops and unwanted materials such as silica and tannins may be leached out into the wort. For the same reason, it is normal practice to stop sparging when the liquid from the tun has reached a specific gravity (SG) of about 1.008-1.010 (2.1-2.6 °P). By that time you should have collected 5.5-6 gallons (21-23 L) of wort, and be ready for the boil.

Re-mashing

This is an old, traditional procedure that was widely used until the invention of sparging sometime in the early 19th century. Brewers would run off from the first mash, then re-mash with hot water, collect a second wort, then maybe mash one or two times more, to give a total of up to four worts. Often the first, or the first and second together would go to make a strong beer, while the third might make a table beer, and the fourth a small beer. We wouldn't do a re-mash (batch sparge) that way, but would simply mash a second time after collecting the first wort.

This is obviously simpler and quicker than sparging, for it requires no extra equipment and the second mash can be run off quickly, with the spigot wide open. There are some difficulties with this approach, for you have to stir the bed and second mash water very thoroughly, which means you must recycle the first running of the wort to ensure there is no carry-over of grain particles or unconverted starch. You also have to calculate how much water to use in the second mash in order to hit your target volume of wort, which we'll look at later. The biggest problem is that this procedure is not as efficient as sparging in removing extract from the spent grain. You may see that intuitively from the fact that, unlike sparging, not all the second mash water travels all the way through the grain bed. That may mean that you will find it difficult to reach your target OG the first time you adopt this approach. The simple remedy for this is that the next time you do a brew you add a little extra malt, 10% being a common amount for many homebrewers. However, this is a factor that militates against consistency in your brewing, if that is what you want to achieve.

> "Sparging is the 'classical' technique and consistently gives the best yields, and is very versatile in terms of making beers of different original gravities."

The strike water for the second mash should be about the same temperature as the strike water for mashing, or about 176 °F (80 °C), and should be adjusted for mineral content as for the first mash. As stated above, this second mash water must be thoroughly mixed with the grain – any unmixed clumps of the latter will result in loss of extract. How much water you use depends on how much wort you collect from the first mash. In the example above we got 2 gallons (7.6 L) this way, so you would need to collect another 3.5-4 gallons (13-15 L), and this is what you would use in the second mash, although you should allow a little extra for any dead space below the faucet in the tun. It is probably wise to use a little more than you think you will need, and boil for a little longer if necessary, whereas you are stuck if you do not collect enough wort. (For more about batch sparging techniques, see page 50.)

Single or dilute mash

This procedure is the oldest, simplest and quickest of the three methods, for it consists of simply collecting the wort after mashing. It is obviously very inefficient as I discussed earlier. You can improve the efficiency in several ways. The first is to use much more water in the mash, but there is a limit to this if you want to get good starch conversion and to avoid the wort being highly fermentable, leading to thin beers. So the second is to increase the amount of grain, which may take as much as 20% or more extra grain. The third is to add an infusion of water at the end of the mash before run-off. The fourth way would be to add both more grain and use a more dilute mash. Calculating the amounts of grain and water required to do this is difficult to do with any accuracy, and is beyond the scope of this article. If you want to know how to do it, see John Palmer's "Skip the Sparge!" story from the May-June 2002 issue of *BYO*.

However, the intricacies of these calculations mean that this procedure gives quite variable results, and makes it just about impossible to brew in a consistent manner. It is also more expensive than sparging, in terms of ingredient costs, and requires more vessel space, so it may not be practical for making high gravity beers. In fact, if you are going to do more than one brew this way, you will very soon spend more money on extra ingredients than it would cost to buy a sparge arm. However, some commercial brewers do make strong beers this way by taking this first run wort, which will be at a high gravity. Some claim this gives a superior flavor, while others may simply want to make a very strong beer in a smaller batch size than their regular beers.

Wrap-up

Sparging is the "classical" technique and consistently gives the best yields, and is very versatile in terms of making beers of different original gravities. It takes the longest time of the three methods, and requires buying a further piece of equipment. Re-mashing is quicker, but it results in lower yields, is somewhat inconsistent, and involves higher ingredient costs. Single mashing is simple to do and the quickest to carry out, but is expensive in ingredient costs, and may require a much larger mash vessel than the other two techniques.

It seems to me that if you plan to do all-grain brewing on a regular basis, then sparging is the way to go, and is my preferred choice. But your choice of method will depend upon your own preferences and circumstances. In the end, it is your beer you are brewing in your brewery, and not mine! BYO

Bubbles and Beyond

The science of the pour

advanced brewing
by Chris Bible

One component of beer quality that is important to our enjoyment of beer is the foam head associated with the initial pour of beer into our glass.

Foams are a dispersion of a relatively large amount of gas in a relatively small amount of liquid. Foam can be thought of as an agglomeration of gas bubbles separated from one another by thin liquid films. Each gas bubble is enclosed in a film of compounds derived from the bulk of the beer (see Figure 1 below). Foams can be produced either by condensation (foam gas phase is initially present within the liquid phase) or dispersion (gas originally exists in the bulk surroundings outside of the liquid phase). Foam in bottled or kegged beer is generated by the condensation method. Dissolved carbon dioxide exists within beer at an equilibrium concentration that is dependent on the pressure within the closed system. More pressure equals a higher equilibrium concentration of CO_2 dissolved within the beer.

The pour

When a beer bottle is opened or a tap handle is pulled, the pressure within the sealed system is reduced to atmospheric pressure and the amount of dissolved carbon dioxide within the beer is no longer in equilibrium with the surroundings. The beer/carbon-dioxide solution becomes a "supersaturated" solution. The carbon dioxide solute then forms a dispersed gas phase and rushes out of solution. This rapid rush of carbon dioxide from solution forms the head of foam that rests atop a homebrew.

The perfect pour is characterized by R.J.H. Emrich (see references on page 78) as having the correct amount of foamy head relative to the volume of beer in the glass. This "ideal" amount varies by stye and region. For example, very little foam head is generally considered ideal for English ales, while German wheat beers may have a larger, longer-lasting head of foam.

The physics of the foam associated with the pour takes place in a consistent way. The steps for foam formation that occur during the pour are: head formation, creaming, foam stabilization (or foam hardening), and head decay. Head decay is further broken down into two steps: drainage and foam coarsening.

Head formation

In order for a bubble to form it must begin formation at a nucleation site. A nucleation site can be any form of solid irregularity in the dispensing system or glass, or any microscopic solid particle within the gas-saturated liquid. The characteristics of the nucleation site have an effect on the initial size of the bubble formed at a particular nucleation site. This relationship is described by the following equation:

> "Foams are a dispersion of a relatively large amount of gas in a relatively small amount of liquid."

$$R_{bubble} = \left[\frac{3R_{nuc}\gamma}{2\rho g}\right]^{\frac{1}{3}}$$

Where:

R_{bubble} = radius of initially formed bubble (m)

R_{nuc} = effective radius of the nucleation site (m)

γ = the surface tension of the liquid (milliNewtons/meter, mN/m)

Figure 1: Aqueous Foam Structure

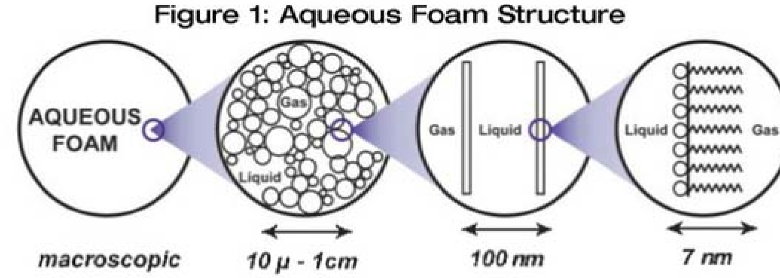


Illustration by Chris Champine

ρ = density of the liquid (g/cm^3)
g = acceleration due to gravity (9.81 m/s^2)

Typical ranges for values for these variables are R_{nuc} = 0.05-0.1mm, ρ=1.005-1.020, γ = 42-47. When values of 0.1mm, 1.010 and 45 for nucleation site radius, liquid density and surface tension respectively, are used to calculate initial bubble radius, a value of about 0.9mm is obtained. Reducing the nucleation radius to a value of 0.01mm results in an initial bubble radius of about 0.4mm. **Key takeaway**: smaller foam bubbles form at smaller nucleation sites.

Creaming

A beer that has just been poured should have streams of bubbles originating and rising from numerous points inside of the glass. This is known as creaming or beading, and is the result of bubble formation occurring at nucleation sites on the glass. The gas content within the beer is one of the most important factors that impacts the rate of initial bubble formation and activity at these nucleation sites on the beer glass. An empirical equation that describes this is:

$$a_{n0} = 3.11C + 0.0962\,\gamma - 218\,\rho + 216$$

Where:
a_{n0} = initial activity at a nucleation site
C = carbon dioxide content in beer (volumes CO_2/volume beer)
γ = surface tension of beer
ρ = density of beer
Key takeaway: higher carbon dioxide content, higher surface tension, and lower beer density favors initial bubble formation at a nucleation site within a glass of beer.

Foam stabilization

As bubbles float up from nucleation sites toward the surface of the beer, proteins within the beer that are attracted to CO_2 become stuck to the surface of the bubble. These proteins "stiffen" the bubble surface by forming a kind of shield around it, and stabilize the bubble. A bubble surface comprised of a larger amount of proteins is better able to resist the forces that will eventually conspire to collapse the bubble. **Key takeaway**: higher protein content makes stronger, more stable bubbles.

Head decay

Head decay begins to happen as soon as the foam bubbles are formed and agglomerated at the top of the glass. The decay and collapse of the foam is ultimately brought about by drainage of liquid from the surface of the bubbles and coarsening of the foam (little bubbles becoming bigger) which leads to thinning of the bubble walls. This thinning eventually reaches a point such that the bubble wall is no longer able to contain the internal gas pressure, and the bubble breaks.

Drainage

As soon as bubbles emerge from within the bulk of the liquid, drainage begins. Due to the complex contents of the bubble film (water, proteins, dissolved ions, etc.) many variables play a role in describing this drainage. The rate of liquid removal from foam is given by:

$$Q = \frac{2\rho g q \delta}{3\eta}$$

Where:
Q = flow rate of liquid (m^3/s)
η = viscosity of the film liquid
ρ = density of the film liquid
q = length of the plateau border (m)
g = acceleration due to gravity (9.81 m/s^2)
δ = film thickness (m)

The plateau border, q, refers to the border formed by the intersection or the meeting of three bubbles within the foam matrix. Foam bubbles within a matrix always join together in such a way as to have three bubbles touching, and the length of the border formed at the intersection of the bubbles is called the plateau border.

Foam coarsening

As foam drainage happens, smaller bubbles are becoming larger. The redistribution of bubble sizes is caused by the dependence of the CO_2 gas pressure within a bubble upon the curvature of the bubble walls. CO_2 preferentially diffuses through the bubble film from smaller bubbles into larger bubbles because the pressure of the CO_2 within the smaller bubbles is higher than the CO_2 pressure within larger bubbles. Small bubbles become smaller and large bubbles become larger (the foam structure "coarsens"). Larger-bubbles-becoming-larger leads to film thinning and, ultimately, rupture of the individual foam bubble. Eventually, the overall foam head "collapses" due to draining and coarsening. The action of foam coarsening can be described by the equation:

$$r_t = \left[r_0^2 - \frac{RTDS\gamma t}{P\theta}\right]^{\frac{1}{2}}$$

Where:
r_t = the bubble radius at time t
r_0 = initial bubble radius
R = ideal gas constant (8.314 J/(K · gmol))
T = absolute temperature, K
D = gas diffusion coefficient (m^2/s)

S = solubility of the gas (gmol/(m^3 · Pa))
γ = surface tension
t = time (seconds)
P = Pressure
θ = film thickness between the bubbles

Key takeaways: Viscous beer drains more slowly than less viscous beer and has better foam stability. Warmth, higher gas diffusivity, higher gas solubility, and higher liquid surface tension causes foam coarsening to happen faster.

Improving foam formation and head retention at home

1. Use Carapils® or add maltodextrin to beer to increase viscosity. More viscosity = slower drainage.
2. Use crystal, chocolate or other kilned malts to ensure low proteolytic activity and that melanoidins are present.
3. Obtain a rolling boil for 1-1½ hours. This ensures that iso-humulones are properly isomerized and extracted from hops.
4. Use sufficient hops to provide iso-humulones in your beer. Iso-humulones are substances that have been shown to have a positive effect on foam stability.
5. Use wheat malt, flaked wheat or flaked barley in your beer. These substances are high in proteins, and proteins are important for foam stability.
6. Do not oversparge. Oversparging can result in the extraction of compounds from the malt that can have a negative impact on foam stability.
7. Ferment at lower temperatures using appropriate yeasts to minimize production of higher alcohols. Higher alcohols diminish foam stability by reducing surface tension of the beer and affecting the strength of the foam bubble wall.
8. Beware of lipids or surfactants. These types of compounds negatively impact surface tension and reduce the integrity of the bubble walls.
9. Achieve optimal carbonation levels. Adequate carbonation is necessary for initial bubble formation.
10. Carbonate finished beer with a CO_2/N_2 mixture if appropriate for the beer style. This will lengthen foam life by decreasing rate of foam coarsening due to the decreased solubility of and diffusivity of the N_2 in the gas mixture. BYO

References:

1) Emrich, R.J.H., "The Perfect Pour: Beer Foam Physics and the Art of Dispensing Beer," University of Waterloo, Ontario, Canada, July, 2006

2) Bamforth, C.W., "The Relative Significance of Physics and Chemistry for Beer Foam Excellence: Theory and Practice," *Journal of the Institute of Brewing*, 110(4), 259-266, 2004

Stir Plate

by Todd Huizingh

Increase the yeast cells in your starter culture

One of the most useful tools for making a yeast starter is the stir plate. A stir plate is a device that contains a strong magnet just beneath its surface that spins in a circular motion. A container of liquid sits on top of the stir plate, and placed inside the liquid is a coated magnet called a stir-bar. The spinning magnet of the stir plate causes the stir-bar in the liquid to spin as well, providing a continual stirring of the liquid. When used for building yeast starters, the continual stirring of the stir-bar provides constant agitation and aeration of the yeast. The result is less time needed to build more yeast cells.

With a few tools, a little scavenging, and a touch of creativity, you can make your own stir plate rather inexpensively. Without any of the parts on hand, this project costs about $40, but many DIYers will probably have some of the materials lying around already.

The basic concept of this project utilizes a small muffin-type DC fan, like the kind found in computer cases, as the drive motor. Computer case fans work well because they are inexpensive, easy to mount, and easy to attach a magnet to.

To power the fan, you will need an AC/DC wall adapter, like those used to power or charge small electronic devices (sometimes referred to as "wall-warts"). I keep a box of these in my workroom that I have saved from old cordless phones and such.

Once you've determined the fan and power supply you'll be using, it's time to figure out what size potentiometer you will need to control the speed of the fan. To do this, first calculate the resistance of the fan using Ohm's law: Resistance = Volts/Amps. For voltage, use the measured value of the power adapter. Calculate the wattage by multiplying the volts by the amps. Now select a linear potentiometer with a max resistance somewhat near the resistance you have calculated and a watt rating higher than the wattage you calculated. For example, the resistance of my fan calculated to be: 16 V/0.07 A = 228 Ohms, and the wattage was 16 V x 0.07 A = 1.12 watts. I was able to find a 250 Ohm, 2 watt potentiometer online for under $4 that works very well.

> "The result is less time needed to build more yeast cells."

Rare earth magnets such as neodymium magnets work well. Just make sure that the magnet (or stack of magnets) has its poles opposite each other in the longest dimension. This ensures that when the magnet is attached to the fan, its polarity will alternate as it spins.

Finally, you will need some kind of enclosure to house everything safely and securely. You could purchase a project box or electrical enclosure, but why not be creative and use something like a wooden cigar box or a plastic storage container? I've even seen one made out of a coffee can. You will probably need to use some standoffs or spacers to properly space the fan away from the top surface. For my enclosure I used an old metal housing reclaimed from an industrial control panel and made the lid from a scrap sheet of Plexiglas.

Parts and Materials

- DC fan
- AC/DC wall adapter
- Potentiometer
- On/off switch
- Control knob
- 4-pole terminal block
- Electrical wire
- Strain relief bushing
- Magnets and spacers
- Stir-bar
- Enclosure
- Epoxy

1. SELECT YOUR EQUIPMENT

Any size case fan will do — the one I used in my stir plate is an 80mm fan pulled from the case of a decommissioned computer. Once you've located your fan for the job, make a note of the rated volts and amperage printed on the fan for use later on.

An adapter with a rating anywhere between 6 to 12 volts should work fine, but I recommend measuring the actual DC voltage with a voltmeter, since many times this differs from its rating. The one I'm using is rated at 12V, but it measures closer to 16V. That's a little on the high side, but it has been working well for me thus far.

For the magnets, make sure the total length is as long as or longer than the stir-bar you will be using. I suggest a stir-bar that is 1½ inches (3.8 cm) or shorter. The magnet will probably be strong enough to prevent the fan from operating properly, so it will be necessary to find a non-metallic spacer to mount in between the two. For my stir plate, I used a stack of three magnets, each ⅜-inches in diameter and a ½-inch long (0.95 cm by 1.25 cm), epoxied onto a stack of two wooden nickels.

2. TEST YOUR EQUIPMENT

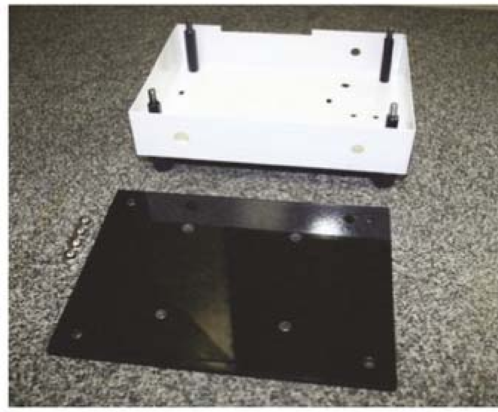
It's a good idea to test your electrical components before you get started on the assembly process. Connect one wire of your adapter directly to one wire of the fan. Run the other adapter wire to one tab of the on/off switch, then run a wire from the other tab of the on/off switch to the center tab of the potentiometer. Finally, connect the other fan wire to a side tab of the potentiometer. You may find that you have to reverse the wires of the adapter or use the other side tab of the potentiometer to get the fan to work properly.

3. ATTACH THE MAGNET

Attach your magnet to your spacer and your spacer to your fan. For this job, I used a two-part, 5-minute epoxy. The key here is to try to get your magnet as centered as possible on the fan, which keeps the fan well balanced and also helps reduce the chances of your stir-bar being thrown off. I spun my fan by hand several times in the process of adhering the magnet until I was pleased with its position.

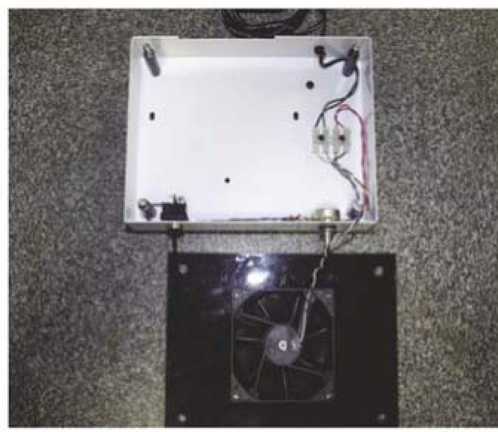
4. PREPARE THE ENCLOSURE

Whatever you have chosen for your enclosure will need some prep work. Drill holes for the potentiometer, on/off switch, strain relief bushing, and terminal block mounting screws. Also figure out how your fan will mount, and drill the necessary holes for that. Finally, give your enclosure a coat or two of paint if needed.



5. INSTALL AND WIRE THE COMPONENTS

Once the enclosure is ready, begin installing your components. It is easiest to solder the wires onto the potentiometer and the on/off switch prior to installing them. Install your fan to either the underside of the top surface, or to the bottom of the enclosure. Just make sure that when everything is closed up the magnet is as close as possible to the top surface — without touching it of course! Cut the wires to the appropriate length and strip the ends. Route the wires neatly and out of the way of the fan. Make sure your circuitry is the same as it ended up being in Step 1 to ensure that the fan will run properly. It may be helpful to label your wires or use different color wires like I did.



6. TAKE IT FOR A TEST SPIN

With everything installed and tightened up, place a container of water with a stir-bar inside on top of the stir plate. The stir-bar should align itself with the magnet on the fan. Now plug in the adapter, and with the speed control on the slowest setting, turn on the switch. The stir-bar should start turning slowly and now you should be able to turn up the speed. You might want to experiment with various speeds and let it run for a while to make sure the stir-bar doesn't get thrown off. After that, you're ready to propagate some yeast! BYO

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last call

by Doug Jordan

Golden Years

Homebrewing in a retirement home

How old is too old to learn to brew? Well, if you live at the Aspen Ridge Retirement Community (the Ridge) in Bend, Oregon there is no such thing as too old. Aspen Ridge Life Engagement Coordinator Sandie Nowell was challenged to "think outside the box" to provide residents with lifelong learning opportunities to expand their minds and experiences beyond what most would consider "normal." Sandie responded, half in jest, "OK, well how about we brew beer? Because everyone in Bend brews beer."

Management loved the idea, so in February 2012, Sandie posted an ad on craigslist for someone to teach them how to brew. Local Bendite, Ali Sandiford, who had been homebrewing for 7 years, answered the ad and soon started the Aspen Ridge brewing project. The interested residents met with Ali, talked, and tasted a few beers to see what they wanted to brew, then purchased the ingredients at the local brewing supply store. They began brewing 5-gallon (19-L) batches from extract, with some occasional specialty grain batches. When Ali moved to Portland four months after the project started, the Ridge brewers suddenly found themselves on their own.

Not deterred by losing their instructor, the brewers at the Ridge appointed Joe Reeves — the youngest brewer at 74 — Brewmaster, and with each batch their confidence grew. They got wild and crazy, adding flavors and special ingredients into the secondary fermenter such as chocolate, coconut, mint and cherries to their porters and stouts, sour or sweet cherries to their cream ales and hefeweizen, and of course lots of hops to their IPAs.

In 2012, the Aspen Ridge brewers entered their stout in the Central Oregon Homebrewers Organization (COHO) "Spring Fling" competition, but won only slight nods of approval. Not discouraged, they continued to work to perfect their techniques, resulting in two first place medals and one third at the 2012 Deschutes County Fair. The following year they took "Best of Show," along with a slew of other medals.

Each of their brews gets a unique name such as Machine Gun Maggie, Dublin Dew, Hopped Up Hippie and Coconut Bra, to name a few. Once the beers are named, resident-artist Roy Eskilden creates some really wild hand-drawn labels for their bottles.

> "Each of their brews gets a unique name such as Machine Gun Maggie, Dublin Dew, Hopped Up Hippie and Coconut Bra, to name a few."

Aspen Ridge management and the resident brewers take their brewing very seriously. They have two lagering refrigerators, a separate temperature-controlled fermentation room, a kegging system, and an in-house pub. Currently they brew 10-gallon (38-L) extract batches twice a month and are working on purchasing an all-grain system in order to brew 15-gallon (57-L) batches. That may seem like a lot of beer for a retirement community, but their beer is well received by the residents in the pub and at special events like their Oktoberfest and St. Patrick's Day celebrations.

COHO Vice President, Tim Koester, who teaches homebrewing at Central Oregon Community College, dropped in at Aspen Ridge on a brew day last fall after reading an article about Aspen Ridge's brewing in the local paper. As an organization, COHO has a commitment to community outreach, and he thought the club could possibly lend some practical and technical assistance. When Sandie learned COHO wanted to help the residents hone their craft, she was thrilled and a deal was struck to allow the club to use the Ridge's meeting room in exchange for the coaching. COHO now meet at Aspen Ridge with several of the residents participating in the club meetings and the COHO members enjoying the interaction with the residents. BYO

Doug Jordan is the COHO Secretary.

Photo courtesy of Doug Jordan

Pictured from left to right are Carolyn Grogan, Bill Howard, Joe Reeves, COHO VP Tim Koester, Sandie Nowell and Larry Barnes.


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