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Brew YOUR OWN

THE HOW-TO HOMEBREW BEER MAGAZINE

SEPTEMBER 2014, VOL.20, NO.5

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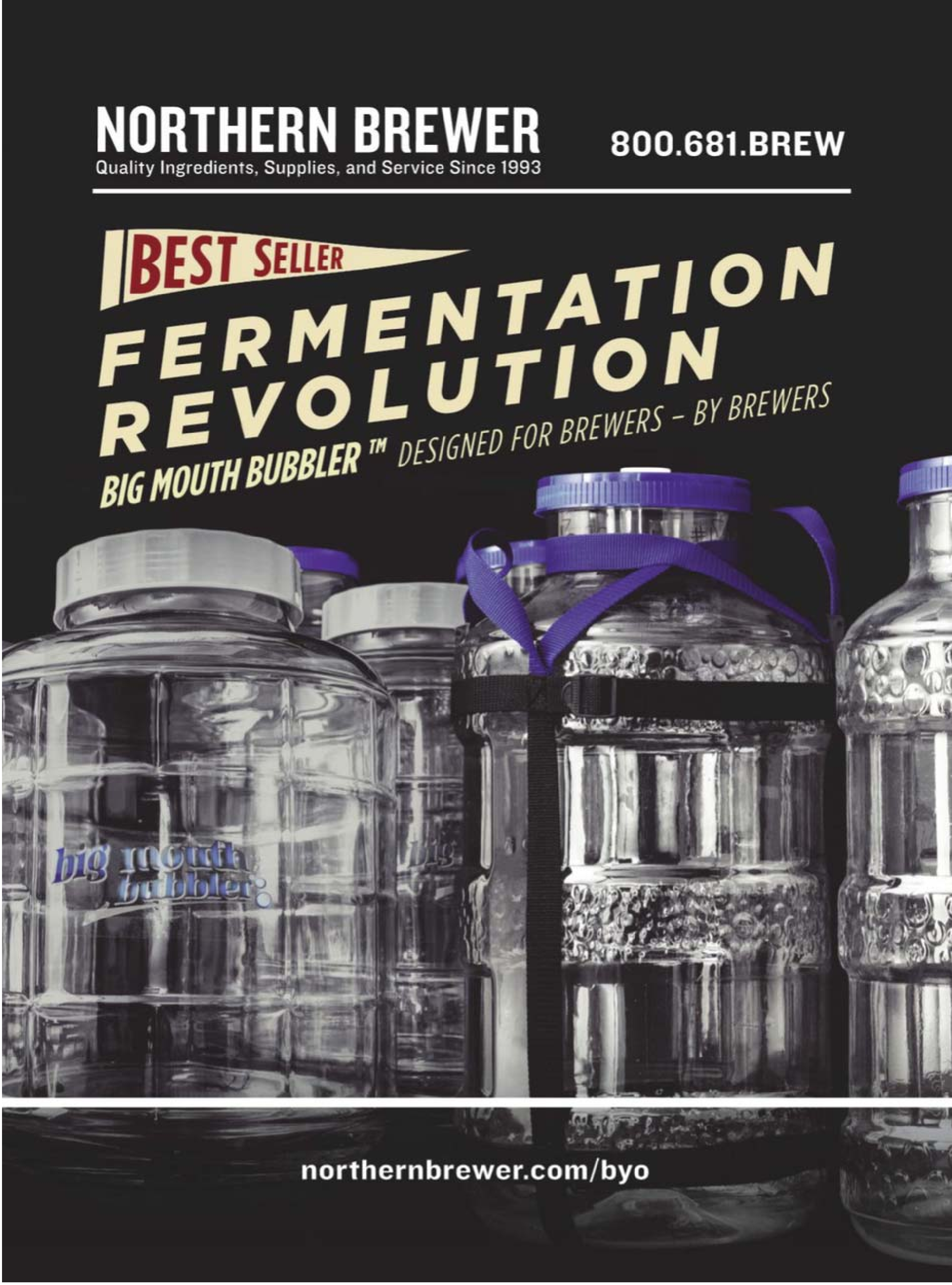
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RECIPE INDEX

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 US 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.

Gallons:
We use US gallons whenever gallons are mentioned.


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what's happening at BYO.COM

Hop Stands

Mr. Wizard talks about late hop additions on page 15. Learn more about a technique that is well established in the professional brewing world but just recently began gaining traction with homebrewers: Hop standing or whirlpool hopping.
http://byo.com/story2808

Hop Chart

After you read the "Techniques" column on hop pairing and substitution (which begins on page 79,) check out our hop chart to get a better feel for more than 100 different hop varieties, their characteristics, and substitutions.
http://byo.com/resources/hops

Brewing with Pumpkin: Tips from the Pros

Use this advice from the brewers of Lakefront Brewery, Buffalo Bill's Brewery, and New Holland Brewing Co. to brew a perfect pumpkin beer this fall.
http://byo.com/story324

Yeast Strains Chart

If you want to perform your own yeast experiment like the one detailed in "Operation Strain" (pg. 66), then begin with familiarizing yourself with the many yeast strains available to homebrewers. http://byo.com/resources/yeast

Cover Photo: **Charles A. Parker/Images Plus**

Brew Your Own — THE HOW-TO HOMEBREW BEER MAGAZINE

EDITOR
Betsy Parks

ART DIRECTOR
Coleen Jewett Heingartner

ASSISTANT EDITOR
Dawson Raspuzzi

TECHNICAL EDITOR
Ashton Lewis

CONTRIBUTING WRITERS
Chris Bible, Christian Lavender, Marc Martin, Terry Foster, Glenn BurnSilver, Kristin Grant, Forrest Whitesides, Jamil Zainasheff

CONTRIBUTING ARTISTS
Shawn Turner, Jim Woodward, Chris Champine

CONTRIBUTING PHOTOGRAPHERS
Charles A. Parker, Les Jörgensen

PUBLISHER
Brad Ring

ASSOCIATE PUBLISHER & ADVERTISING DIRECTOR
Kiev Rattee

ADVERTISING SALES COORDINATOR & RECIPE EDITOR
Dave Green

EVENTS & MARKETING COORDINATOR
Jannell Kristiansen

BOOKKEEPER
Faith Alberti

SUBSCRIPTION CUSTOMER SERVICE MANAGER
Anita Draper

NEWSSTAND DIRECTOR
Carl Kopf

SUBSCRIPTIONS ONLY
Brew Your Own P.O. Box 469121 • Escondido, CA 92046
Tel: (800) 900-7594 • M-F 8:30-5:00 PST
E-mail: byo@pcspublink.com • Fax: (760) 738-4805
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EDITORIAL & ADVERTISING OFFICE
Brew Your Own
5515 Main Street
Manchester Center, VT 05255
Tel: (802) 362-3981 Fax: (802) 362-2377
Email: BYO@byo.com

ADVERTISING CONTACT: Kiev Rattee (kiev@byo.com)
EDITORIAL CONTACT: Betsy Parks (betsy@byo.com)

FACEBOOK: www.facebook.com/BrewYourOwn
TWITTER: @BrewYourOwn

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Volume 20, Number 5: September 2014

mail

Brewing fruit beers

I enjoyed the article "Brewing Fruit Beers" in the "Techniques" section of the July-August 2014 issue of *BYO*. There is one bit of inaccurate information I would like to point out, however. The author states that adding fruit to a beer will always raise the alcohol level. This is however not always true. The fruit will raise or lower the alcohol slightly depending on the gravity of the fruit itself. Fruit is not pure sugar, so it will not simply up the alcohol across the board. Most fruit have a similar gravity to a standard gravity wort, so it will have little to no effect beyond being somewhat more fermentable. In a big high-gravity beer it will actually bring the % alcohol down. A regular contributing author to *BYO*, Mike Tonsmeire, has written a good article about this topic on his blog: http://www.themadfermentationist.com/2010/10/adding-fruit-to-beer-increases-alcohol.html

Chris Bryan
Winnipeg, Manitoba

Brett IPA

I had a question from the May-June 2014 article in *BYO* "Brewing All *Brett* IPA" by Derek Dellinger. In the article it mentions making a starter at least a week in advance because *Brettanomyces* is slower to grow than *Saccharomyces*. My question is: Should I keep the starter on a stir plate for the whole week, or should I make a starter without a stir plate? Not sure what would be better? Any help would be appreciated. I have been getting *BYO* for 20 years and have learned a tremendous amount. Keep up the GREAT work.

Kevin D. Rich
Rural Hall, North Carolina

Story author Derek Dellinger replies: "That's a great question, Kevin. Personally, I would definately recommend keeping your Brett *starter on a stir plate if possible. Intermittently shaking the starter will also work, but that method may add another few days of propagation time, possibly another week depending on the strain, as most go*

contributors

Dave Green is *Brew Your Own*'s Advertising Sales Coordinator and resident ranking homebrewer. When he's not at work or chasing after his two children, Cooper and Palmer, *BYO* often convinces Dave to do some writing, including his past feature stories about hop stands, whirlpool hopping and "hop bursting" (in the March-April 2013 issue. http://byo.com/story2808) as well as "Vermont Cult Clones" in October 2013.

In this issue, Dave leaves the hops behind and brings us out to the pumpkin patch to explore the many approaches to making a pumpkin beer, and also shares his tales of making his own pumpkin beers — stuck sparges and all. His story, complete with five commercial clone recipes, starts on page 54.

Christian Lavender is an Austin, Texas area homebrewer who runs kegerators.com, a site devoted to finding the best prices on kegerators. You can also ask kegerator-related questions on the site and he will answer them.

Christian is a frequent contributor to *BYO*, including a story about how to build a homebrew bar with everything a homebrewer would want in the November 2011 issue. He also wrote "Perfect Pour" — a story about kegging tips — in the November 2013 issue. In addition, he has contributed several installments of our "Projects" column in the past couple of years. In this issue, on page 38, Christain discusses the important subject of homebrewing safety.

Walter Diaz is a chemist and biosystems engineer by day and works as the Plant Process Engineer at a biodiesel manufacturing plant in Tucson, Arizona. By night Walter is a mad engineer and homebrewer who likes to put brewing theories to the test, especially if new tools can be built in the process. He has been making his contribution for a better world by helping other small-scale brewers improve process control and efficiency. He has written frequently for *Brew Your Own* with both feature stories as well as contributions to the "Projects" department. He last wrote about building an electronic control panel in the December 2013 issue. In this issue, on page 30, Walter discusses the relationship between your equipment and your mash temperatures.

through a multi-stage growth cycle. However, with Brettanomyces, *initial cell count is even more of a variable than with brewer's yeast, particularly between suppliers. For example, White Labs' vials of* Brett *contain approximately 2 to 3 billion cells, while Wyeast's pack considerably more at around 75 billion cells. If you are starting from scratch with a White Labs' vial, you will need to do a multi-stage starter to reach a sufficient cell count for pitching.*

I have seen some homebrewers express concern that the aeration provided to Brett *while on the stir plate will lead to excessive tartness, as some strains produce limited amounts of acetic acid if given access to oxygen. After propping up dozens of* Brett *strains over the years, however, I have never noticed an appreciably different character from growing* Brett *on a stir plate first.*

Thanks for the question — I hope that helps!"

Etch your kettle

I just did the kettle etching project in the July-August 2014 issue ("Etching Stainless Steel") and am more than pleased with the results. Now my kettle is even cooler. I am going to do this to all my kettles as well as maybe even some other items. My only problem is with the explanation of the chemical reaction. I believe the gas that is being given off is chlorine (at least that's what it smelled like) and not carbon dioxide. This project should be done in a ventilated area, preferably outside. Just want to warn folks before they spend an hour or more with their heads in a kettle full of chlorine gas.

Josh Miller
via email

BYO *Editor Betsy Parks replies: "Thanks for writing in, Josh. I ran your letter past our Technical Editor, Ashton Lewis, and he confirmed your suspicions about chlorine. We somehow missed that in our review process of the story manuscript. Your warning to work in a well-ventilated area is sound — and actually would be the same if the gas were* CO_2 *as that's not good to inhale either."*

Corrections

The author of the "Projects" column in the July-August 2014 issue, "Etching Stainless Steel," was improperly identified. The author of the story is Matt Bates. Read Matt's story online at http://byo.com/story3113

In the 2014 Homebrew Label Contest (July-August 2014), the label "Hoptopuss" on page 42 was submitted by Larry Bartholf and Peter Bickel of Pittsburgh, Pennsylvania.

homebrew nation

READER PROFILE:

Brewer: Paul Hiebing

Hometown: Jonesboro, Arkansas

Years brewing: 7

Type of brewer: All-grain

Homebrew setup: 5-gallon (19-L) batches using 18-gallon (68-L) mash tun and 10-gallon (38-L) kettle. Almost everything gets kegged.

Currently fermenting, on tap or in the fridge: Proprioceptive Tongue Habanero Mango Cream Ale, Spotty Past Classic American Pilsner, Helles Other People, Intelligenti Pauca Alcohol IPA, Dog-a-bone's Porter

How I started brewing: Like many, I got a Mr. Beer kit as a gift and immediately realized I needed to go bigger.

My blog/website: Jonesboro Area Brewers website: https://www.facebook.com/groups/JABrewers/

Favorite/unique recipe: Uncle Yarbles Nut Butter Porter (recipe to the right). I have had a running deal with my friends: Give me a beer style and description of what you're looking for, I will do my best to replicate that and give you a twelver. From my friend Tod came my biggest (and longest running) brewing challenge: Something that tasted like a peanut butter cup — a rich, chocolaty peanut butter porter. It has taken me years to crack this nut. I tried everything: De-oiled natural peanut butter in the mash, boil, and fermenter; crushed peanuts in the mash, boil, and fermenter; peanuts in the bottle; peanut butter powder — after years of trying to get in-your-face peanut butter flavor, I was at a loss and nearly peanuted out. Every one of these ingredients has benefits and drawbacks. For instance, natural peanut butter gives you great flavor if added to the fermenter, but it's impossible to get enough oil off that it doesn't degrade the beer after a couple weeks. I had about given up until Tod got engaged and requested a keg of it at the wedding. I was close to offering to brew something else when my fiancée suggested I try peanut butter extract. I skeptically ordered a few 2-ounce bottles and was delighted to have found my peanut butter mecca. I usually avoid extracts but if you want some real peanut butter bombast, extract is your best ticket. It was a huge hit at Tod's wedding and will be on the tap list at my own reception.

reader recipe

Uncle Yarbles Nut Butter Porter

(5 gallons/19 L, all-grain)

OG = 1.063 FG 1.022
IBU = 39 SRM = 40 ABV= 5.4%

Ingredients

7.25 lbs. (3.3 kg) 2-row pale malt
1.5 lbs. (0.68 kg) chocolate malt
1 lb. (0.45 kg) flaked oats
10 oz. (0.28 kg) crystal malt (10 °L)
2 oz. (57 g) black patent malt
2 oz. (57 g) Watkins peanut butter extract
12 oz. (0.34 kg) lactose sugar (10 min.)
10.9 AAU Magnum hops (60 min.) (0.75 oz./21 g at 14.5% alpha acid)
White Labs WLP013 (London Ale) or Wyeast 1028 (London Ale) or Lallemand Nottingham yeast
Priming sugar (if bottling)

Step by Step

I average about 75% efficiency. If your efficiency is 65%, add an additional 1.5 lbs. (0.68 kg) of 2-row pale malt. Mash at 152 °F (67 °C). Hold for 60 minutes. Boil, adding hops and lactose sugar as indicated. Ferment at 66 °F (19 °C) for two weeks until fermentation has finished. At bottling or kegging, add peanut butter extract to entire batch and gently stir until it is thoroughly mixed. Condition for one week or until carbonated, and enjoy while the beer is young.

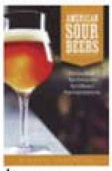
byo.com brew polls

Do you make pumpkin beer?

No, but I would like to 28%
No, I am not interested 27%
Yes, from canned pumpkins 24%
Yes, from fresh pumpkins 21%

what's new?

American Sour Beers



Dive into the wide array of processes and ingredients in American sour beer production in the newest Brewers Publications title, *American Sour Beers: Innovative Techniques for Mixed Fermentations*. Written by Michael Tonsmeire, who has written many articles on the subject for *BYO*, this provides inspiration from the country's best known sour beer brewers as well as detailed methods, practical applications for all brewing levels, advice on barrel-aging and blending programs, and fruit and vegetable additions. It also includes details on spontaneous fermentation techniques, microbe selection and culture maintenance, aging and blending information, safety and sanitation practices, and more. Available at major booksellers.

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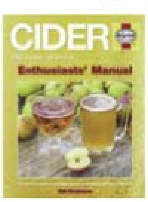
BREWER'S BEST Kegging Equipment Kits

Brewer's Best® is now offering convenient and portable kegging equipment kits. Choose from either the standard kit, without a regulator, or deluxe kit with a premium Taprite dual gauge regulator. These kits are complete with a detailed set of instructions and all the basic start-up equipment you will need to begin creating the draft system of your dreams! Ask for it at your local supply shop.

The Home Brewer's Lab Book and Home Brewer's Labels

Keep a record of your homebrewing in *The Home Brewer's Lab Book* with prompts to help you record detailed notes about your brewing process, ingredients, discoveries, and triumphs. Sold separately, *Home Brewer's Labels* includes labels for 40 bottles of beer to allow you to personalize your homebrew that are designed to give you space to write the beer's name, style and bottle date. Available at major booksellers.

Cider: The Practical Guide to Growing Apples and Cidermaking



This enthusiasts' manual by Bill Bradshaw gives you all there is to know about growing apples and making cider, including the history and origins of cider, detailed apple profiles, recommended cider-making equipment, and a straight-forward guide on making cider. It provides you with a timeline on what a cider-maker's year will be like — discussing growing seasons, and the cider-making schedule. With information on traditional and modern approaches to making cider, regulations for publicly selling cider, and tons of recipes that use cider as an ingredient, this guide will make your relationship with cider an easy

calendar

August 29
Commander SAAZ Interplanetary Homebrew Blastoff
Cocoa Beach, Florida

The 20th annual Commander SAAZ Interplanetary Homebrew Blastoff will be held September 19-20, but all entries must be received by August 29. This is one of the largest AHA-registered events east of the Mississippi and will be open to all BJCP categories. Winners receive medals and prizes from sponsors, and the best of show beer and mead/cider winners will also be awarded the Commander's Cosmic Trophy. An awards ceremony, dinner and party will be held September 20.
Entry Fee: $7
Web: www.saaz.org/cms/?page_id=1850

September 12
MoB Beau's Oktoberfest Homebrewing Competition
Vankleek Hill, Ontario

The Members of Barleyment host this annual event that features a BJCP-sanctioned competition as well as a People's Choice competition. The sanctioned event is open to all BJCP beer styles, as well as a category for black IPA. Each brewer may submit a maximum of one entry per subcategory. The Grand Prize winner will get to brew the recipe at Beau's All Natural Brewing Co. Medals and other prizes will also be awarded. The Entry deadline is September 12.
Entry Fee: $7 for the first entry, $5 each additional entry
Web: www.mob-competitions.tumblr.com

September 13
HAZtober Fest
Erie, Pennsylvania

Entry into the second annual HAZtober Fest, organized by H.A.Z.A.R.D. Homebrewing, is open from August 1 to September 13. Judging for this AHA and BJCP sanctioned event will take place September 27 at The BrewErie at Union Station. The entry limit for this competition is 200, so get your entries in early.
Entry Fee: $7 per entry
Web: www.brewcompetition.hazardhomebrewing.org

homebrew drool systems

A Growing Hobby

Shane Butner • Norman, Oklahoma

In 2008, I wandered curiously into a brand new homebrew supply shop, Learn to Brew, a few doors down from where my girlfriend was shopping. Next thing I knew, I was signed up for a homebrewing class and my life was forever changed. My first setup was just a 5-gallon (19-L) pot and a turkey fryer, where I brewed extract batches from kits. Before long, I moved to all-grain, using the same pot and turkey fryer, a cooler mash tun, and a larger boil kettle. I started working part-time at Learn to Brew to support my hobby and I have not since stopped improving on my homebrew setup.

My buddy, Christian Churchwell and I (both metal fabricators by trade) fabricated my brew rig from 1½-inch square tube. It has three banjo burners, two March pumps, and a plate chiller. I used braided vinyl tubing and put stainless quick-disconnects on the hoses and valves.

I have two 14.5-gallon (55-L) Blichmann Fermenators, each with its own temperature-controlled freezer. They also have quick-disconnects so I can pump wort straight from the kettle to the fermenter without having to lift big volumes of liquid.

I've dedicated a spare bedroom to storing my brewing gear. It also contains my commercial beer fridge, and a small temperature-controlled freezer for lagering and cold storage and my kegerator made from a 21-cubic-foot freezer with a 2x6-inch (5x15-cm) stained red oak collar.

CRUSHING GRAINS

by dawson raspuzzi

Whether it is grains, hops or adjuncts used in brewing, the freshness of your ingredients makes a huge difference. When it comes to grains, you can order them pre-crushed, but if you want the freshest taste, and can spare some cash to buy a grain mill or build one yourself, crushing your own grains is the way to go. Oils in the grains begin to oxidize and the grains absorb moisture from the air immediately after they are crushed. The best way to avoid those negative qualities is to hold off until brew day before crushing your grains (or the day before if you want to save time on brew day).

If you don't have a mill, you can always bring your grains to be crushed at your local homebrew shop, often free of charge. This can save you money, cleanup, and space if your brewing headquarters are already tight without a mill. However, if you want to do it in the convenience of your own home, there is a right way and a wrong way to crush grains.

The purpose of crushing your grains, whether brewing an all-grain batch or just crushing specialty grains for an extract recipe, is to crack the outer husk so you can process and extract what is inside; the embryo, and the endosperm.

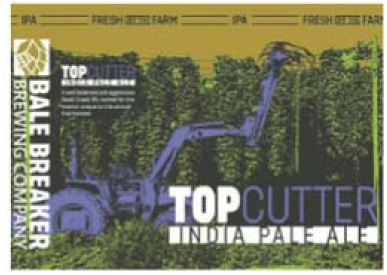
When all-grain brewing, the greatest impact on your conversion efficiency is going to come from how your grains are crushed — the finer the crush, the greater the extraction of the starch. The goal is to split the husk into a few pieces to expose the starch and enzymes that live beneath the husk. The broken husks will act as a filter bed when brewing all-grain to allow for an even, problem-free sparge. Make sure not to over-crush the grains — turning the barley into flour is not the goal and will turn your sparge into a paste or gum-like substance (think adding water to flour) and result in a stuck sparge. Over-crushing, while resulting in a higher yield, will also extract tannins from the husks, which will add unwanted astringency and harsh flavors to your homebrew. You need to find a balance between the desire for higher efficiency and the difficulty you will face in the sparge. The method in which you brew will make a difference in your crush: If you employ the brew-in-a-bag method, or are just crushing specialty grains for your extract batch, you can go on the finer side of the crush as you don't have to worry about a stuck sparge, but you still want to avoid destroying the husks so you don't get all the tannins.

Finding the right setting of your mill to achieve that balance will take some trial and error at the beginning to determine the space between the rollers and the ideal speed to crush. Roller spacing will depend on the grain you are milling too. Specialty grains are often smaller kernels than base malts, so to compensate you will need to tighten the mill for these smaller husks. Running a handful of grain through the mill as a trial and inspecting the results will give you a good idea of whether adjustments need to be made to your roller spacing or milling technique.

Unhulled grains, such as wheat or rye, can be problematic even if you are careful not to overcrush them. With recipes that call for a high percent of unhulled grains (anything over 60%), you can use rice hulls (at a rate of about 5 percent of the malt bill) to act as a filter bed and help avoid a stuck sparge. Used in the same way, rice can also come to the rescue if you do accidentally overcrush your grains.

A perfect crush is the first step to a perfect beer. And isn't that what we're all aiming for?

by marc martin



DEAR REPLICATOR, I RECENTLY VISITED SEATTLE. ONE BEER ESPECIALLY CAUGHT ME AS SOON AS I OPENED THE CAN WITH A WONDERFUL HOP AROMA THAT KEPT MY ATTENTION UNTIL THE LAST DROP. CAN YOU PROVIDE A CLONE RECIPE FOR BALE BREAKER BREWERY'S TOP CUTTER IPA?

ISAAC BELCHER
DANVILLE, INDIANA

Every year one the largest hop brokers in the country, Hop Union, holds a two-day seminar called Hop and Brew School with a session for pro brewers and one for homebrewers. This seminar coincides with hop harvest season and includes a trip to a local Yakima Valley hop farm. Most years that farm is Loftus Ranches, owned by third generation hop grower Mike Smith and his family. This is one of the largest hop farms in the U.S. and is responsible for some of those proprietary hops we all love — Simcoe®, Citra®, and Mosaic™. Mike's children, Patrick, Meghann, and Kevin, now represent the fourth generation. Patrick is heavily involved on the farming side and Kevin always wanted to be the one to put the hops to use.

Kevin's dream became a reality with the grand opening of Bale Breaker Brewing Co. in April 2013. To showcase their new operation they hosted the 2013 Hop and Brew School students at the new brewery. To say we were all amazed would be an understatement. The 11,000 square foot facility houses a state-of-the-art 30-barrel brewhouse with fermenters that are over twice as big. Most impressive was the gigantic, 12-barrel hop back. When your brewery is surrounded by hop fields it is easy to fill!

Kevin's sister, Meghann Quinn, is in charge of administration and marketing. She homebrewed alongside her brother and attended brewing courses at Siebel Institute and UC-Davis. As did her husband, Kevin Quinn, who handles sales and distribution and is the Assistant Brewer.

After six years of making very small batches, Kevin decided it was time to step up to larger volumes. In 2011 a Sabco half-barrel system was purchased. This is the system with which they actually obtained their licensing. He took his 5-gallon (19-L) recipes, scaled them up and perfected the styles that he preferred — hoppy pale ales and IPAs. Over 100 experimental batches were brewed on the system, including the first Top Cutter IPA and the recipe remains the same today.

In the eight months they were open in 2013, Bale Breaker sold 2,400 barrels but the projection for 2014 is 5,500 barrels.

The Top Cutter IPA is a classic example of a West Coast style American IPA. A clean, white head tops this almost clear, light amber ale. Strong grapefruit and subdued orange are exhibited in the nose but caramel scents are still present. The flavor is hop-forward but a nice grain profile is not completely overpowered. The finish is clean and leaves a somewhat resinous pine flavor lingering.

Isaac, you don't have to return to the Northwest to get your favorite IPA because now you can "Brew Your Own." For more information on Bale Breaker Brewing Co. visit www.balebreaker.com. BYO

Bale Breaker Brewing Company's Top Cutter IPA clone
(5 gallons/19 L, extract with grains)

OG = 1.058 FG = 1.008 IBU = 70 SRM = 7.2 ABV = 6.8%

Ingredients

3.3 lbs. (1.5 kg) Briess light, unhopped, liquid malt extract
2 lbs. (0.9 kg) light, dried malt extract
1.75 lbs. (0.79 kg) two-row pale malt
12 oz. (0.34 kg) Munich malt (8 °L)
4 oz. (0.11 kg) Vienna malt
4 oz. (0.11 kg) Carapils® (dextrin) malt
4 oz. (0.11 kg) caramel malt (40 °L)
4.6 AAU Simcoe® hop pellets (first wort) (0.35 oz./10 g at 13.2% alpha acids)
12 AAU Warrior® hop pellets (60 min.) (0.75 oz./21 g at 16% alpha acids)
6.6 AAU Simcoe® hop pellets (15 min.) (0.5 oz./14 g at 13.2% alpha acids)
0.75 oz. (21 g) Simcoe® hop pellets (0 min.)
0.75 oz. (21 g) Citra® hop pellets (0 min.)
0.75 oz. (21 g) Mosiac™ hop pellets (0 min.)
1 oz. (28 g) Citra® hop pellets (dry hop)
1 oz. (28 g) Ahtanum™ hop pellets (dry hop)
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 gallons (7.6 L) of water at 149 °F (65 °C) for 30 minutes. Remove grains from the wort and rinse with 2 quarts (1.8 L) of hot water. Boil 60 minutes, adding ingredients as per the schedule. When done, add the wort to 2 gallons (7.6 L) of cold water in the sanitized fermenter and top off with cold water up to 5 gallons (19 L). Cool the wort to 75 °F (24 °C) and pitch your yeast. Hold at 68 °F (20 °C) until fermentation is complete. Transfer to a carboy, add the dry hops and allow the beer to condition for 1 week and then bottle or keg.

All-grain option:

This is a single step infusion mash using an additional 9 lbs. (4.1 kg) two-row pale malt in place of the malt extracts. Mix all of the crushed grains with 4 gallons (15 L) of 170 °F (77 °C) water to stabilize at 149 °F (65 °C) for 60 minutes. Sparge slowly with 175 °F (79 °C) water. Collect 6 gallons (23 L) of wort runoff to boil 60 minutes. Reduce the 60-minute Warrior® hop addition to 9.6 AAU (0.6 oz./17 g) to allow for the higher utilization factor of a full wort boil. The remainder of this recipe is the same as the extract with grains recipe.

Pumpkin Alternatives

tips from the pros
by Dawson Raspuzzi

Sweet potatoes, yams, and squash

BREWERIES ACROSS THE COUNTRY ARE TURNING TO PUMPKINS FOR THEIR FALL SEASONALS. HOWEVER, A FEW BREWERS ARE TREADING THEIR OWN PATHS AND FINDING SEASONAL ALTERNATIVES SUCH AS SWEET POTATOES, YAMS, AND SQUASH. HERE ARE SOME TIPS SO YOU CAN BREAK THE MOLD TOO.

Jefferson Stout was inspired by pumpkin stouts, but we like to try new things so we decided to try sweet potatoes in a sweet, light-bodied stout. Additionally, we try to highlight and celebrate Southern culture by using local ingredients and of course sweet potatoes are a part of traditional Southern gardening and cuisine. Pumpkins, not so much.

Sweet potatoes are not a major source of sugar, but they do have a big impact on flavor and body. We use cooked, pureed, canned sweet potatoes because it is easy to work with and very consistent from can to can. We have experimented on the amount we use, but found too much caused huge headaches in the lauter tun and filtration. We have dialed in the amount so that we use the maximum that our equipment can handle.

We do not add any spices — this is a sweet potato stout, not a sweet potato pie stout. We do add a small amount of lactose to ensure a sweet, creamy background to enhance the sweet potato flavor. We use Nugget hops to provide bitterness, but any clean high-alpha hop will do for this style.

If you want to brew a beer like this at home, know that sweet potatoes can gum up the lauter tun if you're not careful. Some rice hulls and glucanase enzyme helps to thin things out and keep it flowing. Keep the mash as close to 170 °F (77 °C) as possible during run-off to maintain low viscosity. Another tip: Don't even think of using uncooked sweet potatoes. My first batch was with shredded potatoes, and it was a huge mess to clean up. I'm willing to bet you could use cooked sweet potatoes for up to 50% of the fermentables, but you'd need lots of rice hulls. Sweet potatoes are such a mild flavored vegetable that should fit nicely into many different styles of beer.

Leslie Henderson is Co-Founder and General Manager of Lazy Magnolia Brewing Company, Mississippi's oldest packaging brewery. With ten years of experience in the brewing industry, she provides daily oversight, management, and support for all departments. Leslie holds a master's degree in chemical engineering from Mississippi State University. She also graduated from the American Brewers Guild Technical Brewing Program.

We brew our fall seasonal Autumn Maple in 15 barrel batches using 17 pounds of yams per barrel. For the most part we have always used fresh yams. We hand roast them on our barbecues and puree them with some sweet wort from the mash. We've tried pre-packaged puree once and really liked the results. I thought we would have had a big difference in flavor since the puree wasn't roasted, but it seems everyone liked these batches more than the others.

I'm not a fan of having to describe "base styles" of certain beers we make. When we're developing a new specialty beer I'm not thinking of what classic style can we make and add ingredients to, I'm thinking what does this beer need to taste like and then I build the recipe around that. When you're confined to styles you limit yourself; when you don't have boundaries anything is possible.

We're currently using Magnum hops for bittering but have used Columbus in the past. There's only one hop addition at 60 minutes because we want the spices (cinnamon, nutmeg, allspice and vanilla bean), maple syrup, molasses, yams and Belgian yeast to shine through, not the hops.

When developing a recipe like this at home, taste your ingredients while creating the recipe; you control how much of that flavor is going to end up in your final product. You can always add more, but you can't take it out once it is in. Finally, always use temperature-controlled fermenters. No matter your system, your beer is going to suck if the yeast isn't happy.

Tyler King is the Senior Director of Brewing Operations at The Bruery in Placentia, California. Developing an interest in craft beer at an early age, Tyler had to convince a brewery to hire him at the age of 17. After completing his bachelor's degree at California State University Fullerton he went on to help open The Bruery and hasn't looked back since.

Phil Wymore is the Brewmaster and Co-Founder of Perennial Artisan Ales in St. Louis, Missouri. Phil studied brewing at the Siebel Institute and got his start in the industry as a Brewer, and later the Cellar Manager, at Goose Island in 2006. In 2009 he became the Head Brewer at Half Acre Beer Co. before returning to Missouri to build Perennial Artisan Ales in 2011.

We use fresh, locally grown cushaw squash in Peace Offering because they are naturally sweeter and more flavorful than pumpkins. Our reliance on fresh squash is why the beer comes out in October. Most producers of pumpkin beers seem to be trying to beat each other to the market, which means they have to use last year's pumpkins to make this year's beer. Pumpkins and squash are ready to harvest when they're ripe — not when marketing says so.

The base beer for Peace Offering is an American brown ale that is 6.3% ABV and 42 IBU. We thought this would be a good vehicle for the squash and spices. The idea for the beer is to be reminded of the flavors of Autumn and due to the timing of its release, I also like to think of Peace Offering as a great Thanksgiving table beer. We bitter Peace Offering with Warrior® and use Cascade and Columbus for the late kettle additions. We don't want it to be perceived as a particularly hoppy beer, but we also don't shy away from them on this one.

We use 10 pounds (4.5 kg) of squash per barrel of beer, or about 5 oz. per gallon (0.14 kg per 4 L). To prepare the squash we peel, cut, de-seed, and bake the squash until the sugars start to seep out of the flesh and caramelize. After cooling, we puree them with maple syrup (0.8 oz. per gallon/6.3 mL per L), using an immersion blender, and add the puree to the primary fermentation. This can be a little messy, but I personally feel that it yields a greater flavor impact than adding it to the mash.

After fermentation, we steep the beer on cinnamon and clove. For cinnamon, we use about 2 grams per gallon. For clove, we use about 1 gram per 5 gallons. Those rates seem small, but the spices (clove in particular) are very impactful. Our goal is for Peace Offering to be perceived as a beer first, not a spice bomb. BYO

Late Hop Additions

Food-grade CO_2, cloudy blueberry weizen

help me mr. wizard
by Ashton Lewis

Q I HAVE MADE THE MISTAKE OF ADDING POST-BOIL HOPS TO THE BOILER AT 104 °F (40 °C). ACCORDING TO THE RECIPE THAT I AM FOLLOWING, I SHOULD HAVE ADDED THE FINAL HOP ADDITION AT 176 °F (80 °C) AFTER FLAME OUT. WILL ADDING HOPS AT 104 °F (40 °C) SPOIL THE BEER? IF NOT, WHAT AFFECT WILL ADDING THE LATE HOP ADDITION TO THE KETTLE AT A LOWER TEMPERATURE THAN WHAT WAS CALLED FOR HAVE ON MY BEER?

MARK WINDMILL
VIA E-MAIL

A The one very important thing that all brewers should know about hops is that they are not a source of beer spoilage organisms when added to normal beer. My definition of normal beer means that the beer contains at least 3% alcohol by volume and some hops to add bitterness. Normal beer is prone to spoilage by certain organisms generally called "beer spoilers," including *Lactobacillus* and *Pediococcus* bacteria (both lumped together as lactic acid bacteria) and wild yeasts like *Brettanomyces*. But normal beer is not a good growth medium for the microflora that is found on hops. In practical terms this means that brewers can feel free to add hops to wort or beer at any stage of the process used to produce normal beer without having to worry about introducing beer spoilers.

This does not mean that brewers simply add hops without any real plan. In fact, it is quite the contrary. If you want to impart bitterness to your beer it is important to add hops to wort and boil for at least 45 minutes. During the boil, alpha acids present in hops dissolve into wort and isomerize into the much more soluble and bitter iso-alpha-acids.

Hops added later in the boil are usually added for their aroma contribution because the shorter boil time limits isomerization, yet the heat of the wort does extract hop aromatics. There is also some aroma removal when hops are added to hot wort and many of the "high notes" that you smell when hops are added to the kettle are lost to the environment. This is why brewers wanting those pungent and fresh hoppy notes add hops after the boil either to their hot wort or to their beer as "dry hops."

". . . brewers can feel free to add hops to wort or beer at any stage of the process used to produce normal beer without having to worry about introducing beer spoilers."

In this instance, it sounds to me that your recipe called for some late kettle hops that were intended to impart some of these high notes, but maybe not as much of the hop high note as one would get from dry hopping. Or perhaps the person who wrote the recipe did not like messing around with dry hopping and formulated their recipe so that all of the hops would be added on the brew day. I do not think that adding hops to 104 °F (40 °C) wort will do anything to this beer that you will be able to detect upon tasting, unless you brewed a few batches of the same beer with the only change being the time of your last hop addition. Even in the event of this unlikely example, I bet that the differences between the two brews would be minimal.

Q

FOOD-GRADE CO_2; IS THAT A THING? HOW DO YOU KNOW WHAT YOU'RE BUYING?

ALEX SHEETS
PERU, VERMONT

A

This is an interesting question that has a less than satisfactory answer. When brewers discuss carbon dioxide purity the elephants in the room often include oxygen, oil and sulfur compounds. While all of these compounds may have no effect on food safety (oils may if they are derived from petroleum distillates, for example) they do all have the potential to damage beer. So in practical terms there is a very real difference between food-grade and high purity carbon dioxide.

The fact is that all companies I know who sell carbon dioxide carry one stock gas and sell this gas to various customers who in turn use the gas in a wide variety of applications, brewing and soda dispensing being just two of many. When it comes to food grade, the primary difference lies not in the gas, but the gas container. If liquid carbon dioxide is transported from a gas supplier to a brewery that in turn adds the gas to beer, the supply chain from the gas company to beer must all be clean, sanitary and compliant with standards that are consistent with "food grade." If this last clause seems ambiguous, it is. Since local health codes differ across the world, and often times within the confines of small regions, there is not a great definition of food grade.

In the broadest sense of the term, food grade simply means that a product is processed, handled, stored, transported and used in a manner that does not permit spoilage or the introduction of substances that may be injurious to the consumer. So let's look at this from a practical point of view. Bottles used to transport compressed/liquid gases can potentially be used for multiple purposes. A bottle used to transport liquid propane could subsequently be used to transport carbon dioxide. This practice is not acceptable because the residual propane would contaminate the carbon dioxide. One very important thing that is done to prevent this sort of contamination is defining what types of gases are filled into bottles.

Another thing that goes along with handling gases intended for human consumption is cleaning of containers and the segregation of tools, fittings and hoses that may serve as vectors. Again, this is all fairly approximate from what I have seen. When it comes right down to it, I really doubt there is much oversight by US health inspectors when it comes to carbon dioxide because this ingredient does not have a history of causing health problems and does not draw the attention from regulators. In my opinion, this is a good thing.

But your question is really about brewing and we still have the elephants lurking in the corner. Let's start with oxygen. Oxygen is ubiquitous on planet earth, is detrimental to beer and is almost always present in carbon dioxide gas at some level. Typical levels are between 0.05–0.5% and this amount of oxygen is sufficient to oxidize beer. This is a very broad topic and I will resist commenting more about oxygen and carbon dioxide. The important thing is for brewers to recognize this fact. Carbon dioxide can also contain sulfur compounds because of some of the sources that gas suppliers use for carbon dioxide. Fuel ethanol, fertilizer and petroleum processing all yield carbon dioxide as a byproduct and most of the carbon dioxide gas that we buy originates from these sources, and all of these sources can contain sulfur contaminants that brewers do not want in beer. And finally, there are oils from compressors that may be present in carbon dioxide.

Larger breweries treat carbon dioxide like any other ingredient and carefully monitor carbon dioxide purity for a number of obvious reasons. As with water, carbon dioxide is often filtered to remove flavor-active compounds. This is often performed as a prophylactic measure to simply guard against the possibility of stinky gas causing a problem. A common place to use these filters is between carbon dioxide bottles and beer kegs tapped in bars and restaurants.

I recently attended the 2014 Brewing Summit in Chicago, a joint meeting of the Master Brewers Association of the Americas (MBAA) and the American Society of Brewing Chemists (ASBC). During a break between meetings I had a great conversation with a fellow brewer about some of the hoopla stirred up by bloggers regarding ingredients in food and beer. My friend made a great point about carbon dioxide. In a nutshell, his point was that many brewers have a lackadaisical approach to carbon dioxide. For example, when asked to talk about the "four ingredients" of beer most brewers could easily gnaw the ear of most beer consumers. But the same brewers often times do not know anything of substance about their carbon dioxide supply. My friend's point was that the carbon dioxide supply question is very easy to answer when beer is naturally carbonated during tank or bottle conditioning.

Thank you for asking this question. I feel like a captain who just felt a little bump on the bow and peered into the water to see a great berg lying beneath the surface. This topic is one that is infrequently discussed among homebrewers and small craft brewers, and it also lacks any real coverage in most of the books, magazine articles and blog posts written for this group of brewers. Hopefully a future issue of *Brew Your Own* will explore this topic in greater detail.

Q I AM WORKING ON AN ALL-ELECTRIC HEAT EXCHANGE RECIRCULATING MASH SYSTEM (HERMS) FOR MY HOMEBREW SETUP. ONE OF THE COMPONENTS I HAVE READ ABOUT ON SOME SETUPS INVOLVES UTILIZING A MASH STIRRING MOTOR. I'VE SEEN SOME GUYS PULL THEM OUT OF BREAD MACHINES OR ICE CREAM MAKERS (HIGH TORQUE, LOW RPMS).

DO YOU THINK THERE IS ANY BENEFIT TO THIS? I WAS CONSIDERING DOING THIS AND THEN STIRRING DOWN TO A CERTAIN LEVEL, BUT LEAVING THE BOTTOM 4-6 INCHES (10-15 CM) UNSTIRRED SO AS NOT TO DISTURB THE FILTER BED. SOME BREWERS I'VE SEEN STIR FOR THE DURATION OF MASH, AND THEN STOP THE STIRRER FOR A FINAL RECIRCULATION PERIOD BEFORE DRAINING, BUT I WOULD THINK THIS WOULD PROMOTE CHANNELING ALONG THE STIRRING MECHANISM.

ONE MORE CONSIDERATION: DO YOU THINK THERE IS CONSIDERABLE RISK OF HOT SIDE AERATION USING A STIRRING MECHANISM DURING THE MASH, AND SHOULD A HOMEBREWER BE CONCERNED ABOUT THIS?

BENJAMIN STANGE
SPRINGFIELD, MISSOURI

A This is a pretty weighty topic because stirring the mash does a few things to the mash. To avoid a geeky treatise I will cover this from a treetop level.

So why are mashes stirred? Like all brewing subjects the answers to questions like this almost always involve commercial practices because brewing technology was developed for commercial brewing, not homebrewing. Mashes are stirred in commercial breweries because that is the method that allows brewers the most flexibility with ingredient selection and with mash temperatures.

The most flexible brewhouse configuration in my view of brewing includes a mash mixer and a lauter tun. While I do not believe there are many tangible reasons to use decoction mashing using today's malts, there were certainly some real benefits to this mashing method when poorly modified malts with less than stellar enzymatic strengths were the norm. Decoction mashing, even the revered triple decoction, can be mastered if the transfer piping between the mash mixer and lauter tun is designed to permit mash to be pumped from the lauter tun to the mash mixer.

As malt quality improved over last century through the successes of barley breeding programs, advances in farming practices, and a better understanding of the biochemistry of malting, the need for intensive mashing methods waned. Exceptional beers are brewed today using step mashing or infusion mashing methods. Indeed, many of the great European lager breweries no longer use decoction mashes, and have replaced these methods with step mashing techniques. Step mashing gives brewers more control over the enzymatic reactions that occur during mashing in comparison to infusion mashing. And if a brewer wants to use step mashing in a commercial-sized brewery, a stirred mash is required.

Another reason to stir during the mashing process is to improve extract yield. Stirring has a pronounced effect on yield and for this reason many breweries using single temperature holds for conversion use mash mixers. What is essentially an infusion mash is further improved when conducted in a mash mixer because the mash temperature can be increased following conversion. This "mash-out" or "mash-off" step has the primary benefit of reducing wort viscosity and improving extract recovery during wort collection. Another benefit to the mash-off step is the ability to stop enzymatic conversion.

When you build a system based on external mash heating with a heat exchanger, there are a few key changes to how the mash behaves during mashing in comparison to stirred mashes. The most significant difference is how the heat is transferred into the mash. With a HERMS system you are pumping wort from the mash tun, through a heater and back into the mash tun. In a mash mixer, the heat is applied to the mash from the exterior surface of the vessel. Since the goal of step mashing is to exert control over the conversion of starch into fermentable and unfermentable sugars, it is vital to uniformly heat the mash, not just a part of the mash. I believe stirring the mash is really quite important for these systems to properly function and have the intended effects on the finished beer.

I understand why you are considering not stirring the entire mash, but my concern is that if you only stir the upper half of the mash that the lower portion will not have a uniform temperature and this will result in inconsistency between batches. While consistency between batches is not important to all homebrewers, I do believe that it is an important consideration for those who want to build more complex mashing systems. Consistency with this process allows brewers who want to perform mashing experiments the ability to evaluate their data with confidence.

Regarding hot side aeration … my answer is no. I do not believe that stirred mashes contribute to hot side aeration. My primary justification for this belief is that the design of most mash mixers allows for mashing without splashing.

Q I RECENTLY MADE A BLUEBERRY WEIZEN. AFTER A BIT OF RESEARCH, WE MADE THE DECISION TO ADD THE BLUEBERRIES TO THE SECONDARY FERMENTER. WE DEFROSTED THEM, RAN THEM THROUGH A BLENDER, AND THEN POURED THE CRUSHED BERRIES INTO THE SECONDARY. THE RESULTING BREW IS NICELY BLUISH-PURPLE, TASTES NICELY OF THE BLUEBERRIES, AND IS A VERY REFRESHING BEER. I LIKE IT A LOT. THE ISSUE IS THAT THE BEER IS VERY CLOUDY WITH MILLIONS OF TINY PARTICLES OF BLUEBERRIES IN THE LIQUID, IN SPITE OF DRAINING THE BERRIES THROUGH A MUSLIN BAG TO STRAIN OUT THE SOLIDS. I SUSPECT THE PARTICLES I SEE ARE TOO TINY TO BE CAUGHT IN THE BAG. WE ADDED IRISH MOSS DURING THE BOIL, BUT WONDER IF THERE'S SOMETHING WE SHOULD DO DIFFERENTLY NEXT TIME TO GET A CLEARER RESULT?

JAMES BIEHLE
BALLWIN, MISSOURI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TEXAS BREWING INC.
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INGREDIENT KIT
BRAZOS BLONDE
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Wyeast 1057
ABV% 5.5
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A nice crisp, smooth and malty beer that goes down easy. Mild on the hops but big in taste. A great session beer to share with your friends that drink BMC. Great beer to brew for parties, weddings and get togethers. A great crowd pleaser.
Yeast, B Caps And Priming sugar not included.
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A I think the problem with this beer is that you placed your blueberries into a blender. By doing this you broke down insoluble compounds in the blueberry skins into millions of tiny bits that have a density not much greater than beer. The result is fairly stable, hazy emulsion that is difficult to filter and not effectively removed by straining or fining (Irish moss helps with wort clarity in the kettle, but has no effect on ingredients added after the boil). Some fruit beers, like Abita's Purple Haze, are intended to be hazy and using fruit purees help achieve this sort of appearance. But if you want clearer beer, different techniques work better than the one you employed in your blueberry weizen.

I suggest taking a lesson from winemakers and begin with crushed, not pureed, fruit. Add the crushed fruit to the secondary and allow the yeast to completely ferment the fruit sugars. During this process the fruit pulp tends to break down and the insoluble fruit matter associated with the skins and pulp will sink to the bottom of the beer after activity has ceased. You are still likely to have some haze because tannins from the berries react with proteins in the beer. These hazes may settle over time, but if you want to move things on a bit finings like Bentonite, PVPP and silica gel can work quite well.

Another method that is appealing to food geeks like me is to make blueberry juice syrup from your fresh fruit. If I did this I would be very tempted to add pectinase to the juice before reducing to prevent gelling. This sort of syrup will have nice color, flavor and sweetness. Add it to your weizen for a sweeter, fruitier preparation than adding fruit to the secondary. I hope these simple tips help you out in your quest for great fruit beer. BYO

"I suggest taking a lesson from winemakers and begin with crushed, not pureed, fruit."

Related Links:

• Want to learn more about mash mixer efficiency? Mr. Wizard addressed that topic in the September 2013 issue. A link to his insight is here: http://byo.com/story2852

• Mr. Wizard has answered a lot of questions about brewing with fruit over the years: Addressing what to add, how much to add, and when to add it. Here is a link to an answer that will give you tips on the basics of brewing with fruit: http://byo.com/story2988

Bière de Garde

A French ale with many variations

style profile
by Jamil Zainasheff

It was over a decade ago and I was still perfecting my brewing of the entire Beer Judge Certification Program (BJCP) style guide. My process was to read everything about a style, drink as many commercial and homebrew samples as I could find, and then brew the beer repeatedly until I was able to get a first place medal in one of the larger competitions. As I am sure you can imagine, this took time. Some styles were easy, because there were lots of good examples and plentiful information. With good information and plenty of examples that showed you what to shoot for, the process boils down to just brewing skill. Once I finished the easy styles, I moved on to the more difficult ones.

Bière de garde was one of the more difficult. Information on the style was seriously limited and often questionable. Even the style guide seemed a bit challenged to define this French style. Finding good examples was problematic as well. I remember buying every bottle of bière de garde I could find. I started with the "classic examples." Ugh, seriously cloudy, with chunks floating around, sour and stinking like a swamp on a hot day. Oxidation, heat staling, and more was present. Of course, these were the first examples I tasted. When you see something listed as the "best" example of a style, you question your own taste buds. "Oh, maybe it is supposed to be horrible," you think to yourself. "Maybe it should taste like I just drank a tablespoon of moldy pond water?"

This is one of my (admittedly many) pet peeves about listing beers as "great examples." Yes, a beer may be awesome at some singular point in time. Perhaps it has many of those points in time, but that does not guarantee that every bottle, every pint is also a flawless example of the style. When a person new to the style tries one of those flawed samples, they often force themselves to believe that what they taste is great. (We see this all the time today with "American" sour beers that taste full of vinegar and butter. No, that is not a great sour beer.) So, it took many more attempts to find great examples. I was very lucky in that I got to travel for work and I worked with people from around the world. It took time, but eventually

> "Bière de garde is one of those styles in the BJCP style guide with a wide range of color and character."

I began to understand what was a good example of bière de garde and what was just an overly corked, stale, sour shadow of its former self.

Bière de garde is one of those styles in the BJCP style guide with a wide range of color and character. Many experts believe that there are three distinct variations in bière de garde: Brune, blond, and ambrée. Yet there is only one category in the style guide for all three. By contrast, the German bock beer category has the four sub-styles of bocks. One might argue that the variations in bière de garde have just as much distinctiveness and uniqueness as the bock sub-styles. So why then clump all the bière de garde together and why separate out the German bock category? I would say that it has to do with popularity and interest of the styles when they first wrote the guidelines. When I started brewing, it was easier to find good examples of bock and people had a greater interest in them than bière de garde. It is not a fault of the style guides, but it does show how the style guides are driven by what we brew, consume, and chat about online. Now, more than a decade later, it could be argued that the tables have turned. Certainly, in some parts of the United States, there is a much greater interest in brewing and drinking bière de

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Bière de Garde by the numbers

OG:	1.060–1.080 (14.7–19.3 °P)
FG:	1.008–1.016 (2–4.1 °P)
SRM:	6–19
IBU:	18–28
ABV:	6–8.5%

Bière de Garde
(5 gallons/19 L, all-grain)
OG = 1.075 FG = 1.011
IBU = 24 SRM = 12
ABV = 8.5%

Ingredients
10 lbs. (4.5 kg) continental Pilsner malt (2 °L)
2.9 lbs. (1.3 kg) Munich malt (8 °L)
1.1 lbs. (0.5 kg) cane or beet sugar (0 °L)
10.6 oz. (0.3 kg) caramel Vienne malt (20 °L)
1.4 oz. (40 g) black malt (500 °L)
5.5 AAU Kent Goldings hops (60 min.) (1.1 oz./31 g at 5% alpha acids)
Irish moss (15 min.)
White Labs WLP072 (French Ale) or White Labs WLP011 (European Ale)
Priming sugar (if bottling)

Step by Step
I currently use Best Malz Pilsen and Munich, but feel free to substitute any high quality malt of the same type and color from a different supplier. The black malt and caramel Vienne I use is from Briess. I use the cheapest granular white sugar I can find at the store, sometimes it is cane sugar and sometimes it is beet sugar. My hops are in pellet form and come from Hop Union, Crosby Hop Farm, or Hopsteiner depending on the variety.

Mill the grains and then 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 147 °F (64 °C). Hold the mash at 147 °F (64 °C) until enzymatic conversion is complete. With the low mash temperature, you may need to lengthen the rest time to 90 minutes or more to get full conversion. 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 1.058.

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 hops with 60 minutes remaining in the boil. Add Irish moss or other kettle finings with 15 minutes left in the boil. Chill the wort to 66 °F (19 °C) and aerate thoroughly. The proper pitch rate is around 260 billion cells, which is approximately 2–3 packages of liquid yeast or one package of liquid yeast in a 0.9 gallon (3.4 L) starter.

Start fermentation around 66 °F (19 °C) and then raise the temperature a few degrees more (70 °F/21 °C) several days into active fermentation. Let the beer ferment until the yeast drops to the bottom and forms a layer. With healthy yeast, this should be complete in ten days or less, but there is no need to rush it. 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.

If you decide to add *Brettanomyces* or other critters, you might want to do it in a secondary fermenter and then package the beer after it has developed the character you desire. At that point, you can rack to a keg and force carbonate or you can add priming sugar and a fresh dose of yeast to carbonate in the bottle. Be careful if you bottle directly from the primary fermenter with *Brettanomyces*, there could still be significant sugars present and could result in bottle bombs.

Bière de Garde
(5 gallons/19 L, extract with grains)
OG = 1.075 FG = 1.011
IBU = 24 SRM = 15 ABV = 8.5%

Ingredients
8.8 lbs. (4 kg) Munich liquid malt extract (8 °L)
1.1 lbs. (0.5 kg) cane or beet sugar (0 °L)
10.6 oz. (0.3 kg) caramel Vienne malt (20 °L)
1.4 oz. (40 g) black malt (500 °L)
5.5 AAU Kent Goldings hops (60 min.) (1.1 oz./31 g at 5% alpha acids)
Irish moss (15 min.)
White Labs WLP072 (French Ale) or White Labs WLP011 (European Ale)
Priming sugar (if bottling)

Step by Step
There are many Munich extract blends out there, always choose the freshest extract. If you cannot get fresh liquid malt extract, see if you can find a dried Munich extract instead. Using fresh extract is very important to brewing great beer. The black malt and caramel Vienne I use is from Briess. I use the cheapest granular white sugar I can find at the store, sometimes it is cane sugar and sometimes it is beet sugar. My hops are in pellet form and come from Hop Union, Crosby Hop Farm, 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 1 gallon (~4 L) of water at roughly 170 °F (77 °C) for 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 L) and a gravity of 1.064. Stir thoroughly to dissolve the extract and bring to a boil.

Once the wort is boiling, add the hops. 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. Chill the wort to 66 °F (19 °C) and aerate thoroughly. Follow the fermentation and packaging instructions for the all-grain version.

garde than there is in bock.

Because of this catchall approach to bière de garde, the style guide describes the color as ranging from golden blonde to chestnut brown and the clarity from good to poor. While this is a style that is often unfiltered, I would argue that it is often clear, since it tends to have been cellared. With enough time, most haze will settle out.

The focus for this style is a complex malty sweetness with a moderate light toasty character. In the darker versions, there is often a toffee/caramel sweetness present, but no example of bière de garde should finish overly sweet. The beer should be well attenuated and contain enough hop bittering to present a dry finish. Hop character (flavor/aroma), if it is present at all, should be of the spicy, herbal or possibly floral variety. Esters are low to moderate as is any yeast phenolic character. This is a fairly clean fermentation when young, but aged examples will often have some funky character, which might be from local molds or wild yeasts. Unfortunately, these can be the same types of mold that cause cork taint in wine, resulting in a moldy, damp basement, wet dog, type of character. I have found that the cork-finished examples have a much higher incidence of cork taint. My understanding is that it is possible for cork taint to originate outside the cork and actually transfer through the cork to the beer. Regardless of the source, a strong, moldy character is never appropriate.

The base malt for a good bière de garde would consist of Pilsner, Vienna or Munich malts either singly or in varying proportions. The Vienna and Munich malts give more of a rich bready character, while the Pilsner malt is lighter and grainier.

Traditional brewers would lean more heavily on longer boils and more concentration to develop greater toffee/caramel flavors in the beer. My preference is to use mid-color caramel malts (20–70 °L) such as Caravienne and Caramunich®. They increase color and add some residual sweetness. You can also use other caramel malts, such as Special B, to add a raisin-like character to the beer. In general, your amount of these sweeter specialty malts should total 0–10% of the grist.

You can use other grains for some additional complexity and color. Wheat, biscuit, aromatic, and others can add varying levels of bready, toasty, and biscuit flavors. Small amounts of highly kilned malts, like black patent or chocolate malt can deepen the color and add a tiny bit of dryness to the finish. You need to be careful not to add too much highly kilned malt. This style should not have any roast notes to it. Keep the dark malts under 1% or so and other specialty malts to no more than 10% and you should be fine.

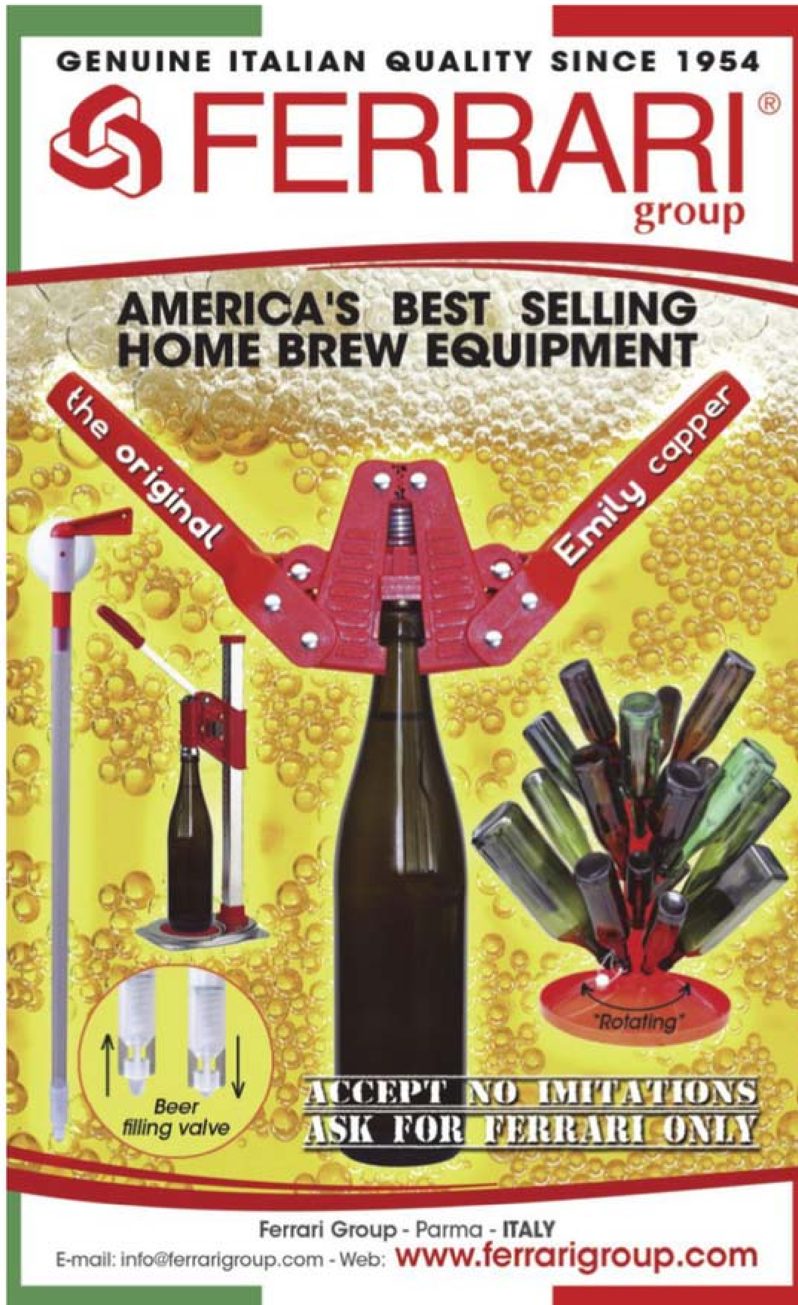
Finally, some simple sugar can help the beer attenuate more, resulting in a drier finish — 5–10% is about right. It can be any simple sugar, I like cheap table sugar for this style, but if you like the fancy kinds of sugar (turbinado, demerara, muscovado), those work too.

Extract brewers should use Munich malt extract as the base. 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. All-grain brewers should use a single infusion mash, in the range of 147–150 °F (64–66 °C). If you are brewing a bigger beer, use the lower end of the range. If making a smaller beer, choose the upper end of the range. When using lower mash temperatures, remember that it might take longer to get full conversion, so be patient.

Hop flavor aroma are minimal in this style. While the paler versions might exhibit slightly more hop character, it is always restrained. For hop bittering, you want just enough to provide a balance to any residual malt sweetness. The drier the finished beer, the less hop bittering required. As far as hop selection, low alpha hops with spicy, herbal, or floral characteristics are a good choice. I prefer Kent Goldings, but many other low alpha European hops work well. The bitterness-to-starting gravity ratio (IBU divided by the decimal portion of the specific gravity) generally ranges from 0.2 to 0.4. The hop additions should all be early in the boil, with maybe 60 minutes of boil time remaining. If you are going to cellar this beer for an extended period (a year or more), then you might want to err more on the high side for bittering because the hop bittering will drop over time.

I have tried fermenting bière de garde with a range of yeasts. I have tried lager yeast, Belgian ale yeast, and clean American ale yeast. These are all yeasts that people recommend as giving good results for this style. However, I find those yeasts either do not produce enough yeast character or produce too much. Perhaps I never found the exact combination of pitching rates, temperature, and nutrients to give a great result with those strains, but one of the better clean yeasts to use for this style is White Labs WLP011 European Ale. (Wyeast no longer makes 1338 European Ale.) The results are always very good, although it needs to be pushed to attenuate well enough. I like to start around the mid-60s Fahrenheit (~18–19 °C), but it is still important to have a strong ferment, so I raise the temperature toward the middle of fermentation. Vigorous fermentation drives off more of the volatile compounds, attenuates better, and results in a cleaner tasting final product. Pitch enough healthy yeast, and make sure to raise the temperature of the fermentation before it slows, which will help keep fermentation active. There are some other strains to try, such as the seasonal WLP072 French Ale from White Labs or some of the available saison strains from either White Labs or Wyeast.

As for the funky aspect, getting the same funky character as in your favorite example can be tricky. You might try growing up the dregs from a bottle or you can experiment with some strains of *Brettanomyces*. With either, I would add them after fermentation is complete and then see how they do over a long period of cellar time. If you do bottle this with *Brettanomyces* or other unknown yeasts or bacteria, make sure your residual gravity and any priming sugar you add will not form too much carbonation and result in bottle bombs. When adding the unknown yeast or *Brettanomyces*, always assume these critters will consume all of the remaining gravity points. BYO



Bière de Garde Commercial Examples

3 Monts Flanders Golden Ale
Brasserie De Saint-Sylvestre
Saint Sylvestre Cappel, France
www.brasserie-st-sylvestre.com

Abbaye De Saint Bon-Chien
Brasserie des Franches-Montagnes
Saignelégier, Switzerland
www.brasseriebfm.ch

Bière de Garde
Left Hand Brewing Company
Longmont, Colorado
www.lefthandbrewing.com

Castelain Blond Bière de Garde
Brasserie Castelain
Bénifontaine, France
www.chti.com

French Country Christmas Ale
Southampton Publick House
Southampton, New York
www.publick.com

Humphrey Bière de Garde
Parallel 49 Brewing Company
Vancouver, British Columbia
www.parallel49brewing.com

Lips of Faith Bière de Garde
New Belgium Brewing
Fort Collins, Colorado
www.newbelgium.com

Oro De Calabaza
Jolly Pumpkin Artisan Ales
Dexter, Michigan
www.jollypumpkin.com

Portsmouth Bière de Garde
Portsmouth Brewery
Portsmouth, New Hampshire
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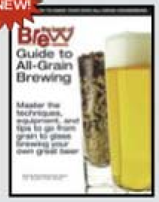

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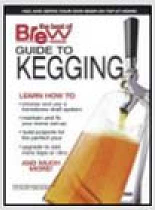

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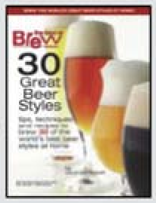

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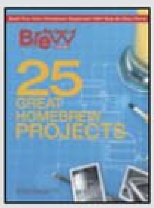

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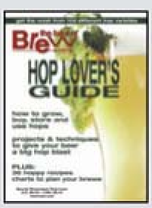

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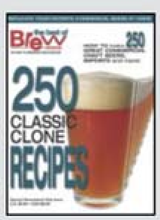

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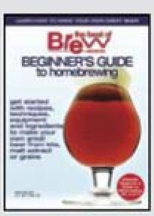

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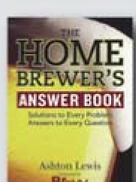

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MAXIMIZE YOUR MASH

story by **Walter Diaz**

Author	B-amylase temp	A-amylase range	Source
Kunze	140–150 °F (60–65 °C)	162–167 °F (72–75 °C)	Brewing and Malting Technology
Narziss	140–150 °F (60–65 °C)	158–167 °F (70–75 °C)	Die Bierbrauerei
Lewis	140–145 °F (60–63 °C)	154–158 °F (68–70 °C)	The Homebrewers Answer Book
Palmer	131–149 °F (55–65 °C)	153–172 °F (67–72 °C)	Howtobrew.com

Table 1. Ideal temperature range for beta and alpha amylase by different authors (Source: *Die Bierbrauerei* 2nd Volume)

Alpha Amylase	In Pure Starch Solution	In Mash
Ideal Temperature	140–150 °F (60–65 °C)	158–167 °F (70–75 °C)
Inactivation Temperature	158 °F (70 °C)	176 °F (80 °C)
Beta Amylase		
Ideal Temperature	104–113 °F (40–45 °C)	140–150 °F (60–65 °C)
Inactivation Temperature	140 °F (60 °C)	158 °F (70 °C)

Table 2. Ideal temperature range for beta and alpha amylase with pure starch substrate vs mash (Source: *Die Bierbrauerei* 2nd Volume)

There is an old saying that brewers make wort but yeast make beer. It is hard to argue against that fact, but the wort we feed the yeast will determine the final qualities in the beer. For example, the sugars available in the wort and its fermentability are critical parameters in determining how the beer will be perceived in the mouthfeel. Targeting the appropriate enzyme groups during mashing and providing the ideal conditions for its activity, the brewer can then have much of the final say in what the beer will be like.

A big factor in determining wort fermentability is the mash temperature(s) used and the length of time at that (those) temperature(s). In general, more fermentable worts are produced at lower temperatures where beta amylase is more active, and less fermentable worts are produced at higher temperatures where alpha amylase is more active. These enzymes are active in a wide range of temperatures but they do have an optimal narrower range. The optimal temperature for these enzymes is not a constant and absolute value and this is reflected in Table 1 (above), where different optimal temperatures are quoted from different sources. The optimal enzyme temperature varies according to how the enzymes are treated in the process, and that is the basic topic of the story.

Beta/Alpha Amylase Optimal Temperature and Colloidal Nature of the Mash

To better understand the conditions that favor the action for beta and alpha amylase, it helps to consider the ideal conditions for these enzymes when working on pure starch solutions, compared to ideal conditions when working in a mash. This comparative data is shown in Table 2 (above). As seen in this table, the ideal temperature range for alpha and beta amylase is much lower when enzymes are working on pure starch as substrate in comparison to mash. Also, deactivation temperatures are 18 °F (10 °C) higher in mash compared to pure starch solutions. This raises two questions: Why do these enzymes have a lower deactivation temperature in pure starch versus mash? And why are these enzymes more effective at lower temperatures in pure starch versus mash?

In relation to higher deactivation temperature of enzymes in mash versus pure starch, the answer can be rationalized in terms of mash thickness. It is well known that a thick mash provides better conditions for thermostable enzymes. For example, Figure 1 (top of page 32) shows that beta amylase loses about 90% of its activity at 149 °F (65 °C) after 10 minutes at 1:5 ratio (kilograms of malt to liters of water), which decreases more slowly in concentrated mashes. In a 1:2-mash after 40 minutes of around 30% the activity of beta-amylase activity is still detected. This is the result of colloidal protection of the mash to enzymes.

Enzymes are very large molecules with water soluble and water insoluble parts. Because these types of molecules are so long, they can fold into layers and adopt certain shapes. In the case of alpha and beta amylase

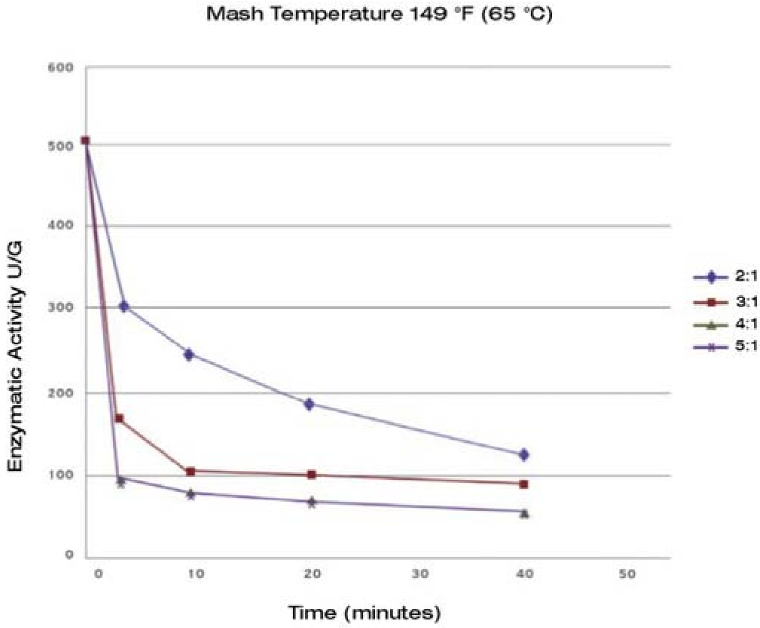


Figure 1. Mash concentration vs. enzyme activity over time

enzymes, they adopt a spherical shape (they are classified as globular proteins). These spherically shaped enzymes are folded in such a way that the hydrophobic parts of the enzyme (water insoluble) remain deeper inside the sphere, leaving the water soluble parts of the enzyme on the surface of the sphere. Since only the surface of the sphere is in contact with water,

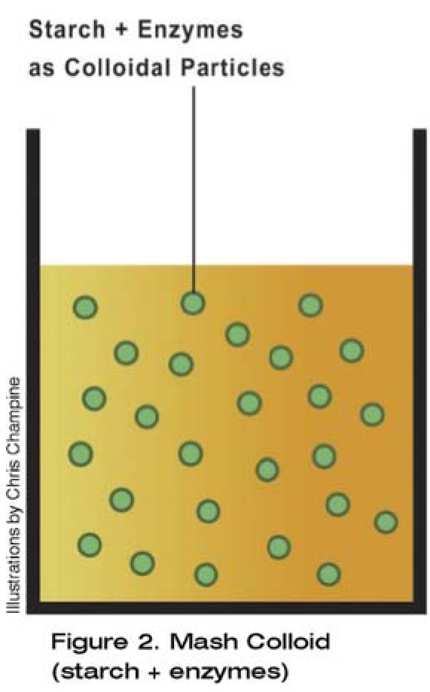


Figure 2. Mash Colloid (starch + enzymes)

enzymes remain water soluble/suspended even though they have a very large molecular weight. In the case of starch, these are even larger molecules. In both of these cases these can be visualized as very fine solid particles soluble (rather suspended) in water by chemical interaction. The resulting dispersion of fine solid particles is technically known as a colloid. See Figure 2 (below).

In brewing context, when malt is mixed with water, these fine particles disperse in water and remain in solution. Such solid matrix serves as a physical support system to stabilize the enzymes. In other words enzymes are most stable when bound to its substrate. Naturally, if more water is added into the mash, more dissolution and liquefaction of these particles occurs. It is more difficult for enzymes to retain a tridimensional shape in this kind of environment, and as a result enzyme activity is lost because its function depends on the integrity of its physical tridimensional shape.

The effect of colloidal protection seen in the mash is what allows enzymes to work at higher temperatures (preventing inactivation) but at the same time this colloidal protection can result in enzyme product inhibition (product accumulation in the enzyme surroundings), particularly when there is a lack of active diffusion mechanisms. Some of the reaction constants that describe the kinetics of enzymatic breakdown of starch by beta/alpha amylase were explained by Narziss (see Figure 3, next page).

The first step represented by KI is the binding of enzyme with suitable substrate. This step is diffusion limited and is dependent on factors such as temperature, mash viscosity, mixing intensity and mash thickness. Once the enzyme has bound and worked on the substrate, there are relatively large molecules that can serve as a substrate once again. If the constant Kr of catalysis in comparison to the dissociation constant of the K-I is very high, following the first degradation step further divisions may occur until the molecule is completely consumed. Only then connects the enzyme with a new substrate molecule. This mechanism is referred to as "chain attack." If, however, the rate constant K-I is much larger than Kr, the enzyme cleaves only one bond, separates from the degradation products and then connects with a new substrate molecule ("multichain attack") going back to the original KI binding step. In practical terms, KI and K-I constants are influenced by your process equipment (natural vs. forced convection during the mashing process) and this is explained in more detail below. The Kr constant is more dependent on mash pH because this has an effect on the ionizable groups of the enzymes. Having the correct mash pH will favor the repeated chain attack (Kr) mechanism vs the multi-chain attack (K-I).

Enzymes Behavior in Different Brewing Equipment Configurations

The three commonly used mashing systems — insulated single infusion, recirculated mash systems-heat exchange recirculated mash systems (RIMS-HERMs) and mash mixers — all treat the mash and its enzymes in a different way, mainly as a consequence of the mechanism used for temperature control. How each system affects the performance of enzymes and how

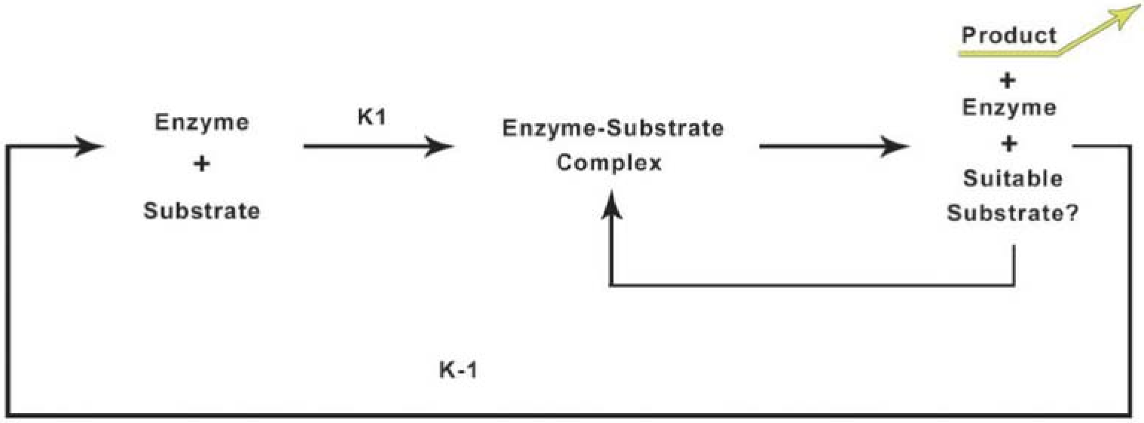


Figure 3. Enzyme kinetic constants K1, K-1, [Kr involved in starch breakdown by beta and alpha amylase. K1 = Enzyme + Substrate binding constant. K-1 is product/substrate dissociation constant. Kr is repeated attack constant]

each system compares to each other will be discussed.

Insulated Single Infusion

The insulated single infusion mash tun is the most commonly used system in microbrewing environments. This is also what most of us are using (or have used) to make beer at home because of its simplicity of operation. Water is heated up to the desired temperature and malt is mixed in it. Once the malt has been mixed with hot water, no more mixing or heating occurs (see Figure 4, an insulated ice chest used as mash tun, on page 34).

Because this type of mash is generally conducted thick (water to malt ratios lower than 3:1), there is a good deal of colloidal protection to the enzymes in the mash. This helps with the stability of enzymes to high temperatures. One drawback of the insulated single infusion mash is the lack of active diffusion mechanisms to promote the starch degradation process (forming new enzyme to substrate bonds, KI). Inducing the formation of enzyme-substrate complex is important, particularly in concentrated mashes because these have a natural tendency for product inhibition as a consequence of its high concentration (reference: *Brewing Science and Practice*, Chapter 4.3.7).

In comparison to well-mixed systems, such as mechanically mixed mash or RIMS, a slightly higher mash temperature may be used to promote better diffusion and interactions between enzyme and substrate. This is possible because of the high colloidal protection in the system, which allows the enzymes to function at higher temperatures for a longer time.

Re-Circulated Infusion Mash (RIMS/HERMS)

The recirculated infusion mash system is a very popular configuration in homebrewing. In this type of system, the mash and lautering process is done in the same container usually equipped with a false bottom. Wort is continuously removed from below the false bottom and pump-recirculated/heated in-line on its way back to the top of the mash tun (see Figure 5). One RIMS configuration that uses a water immersed coil as the heat source for heating up the wort is more commonly known as HERMS (heat exchanged recirculated mash system). The best RIMS systems spread the wort uniformly on top of the mash tun and little channeling occurs during the recirculation process (low flow rates for recirculation are necessary here). If this is done effectively, better results will be obtained in terms of mash efficiency in comparison to the single infusion process because there is a forced convection-process to promote new enzyme to substrate bindings (KI).

One disadvantage of recirculated infusion mash systems is that the continuously filtering action of recirculation through the grain bed removes much of the natural colloidal protection of the mash, making the enzymes more vulnerable to the effects of high temperature when passing through the heating element. To diminish this problem, a large heating surface area should be used with a low temperature differential between the mash temperature and the heat source. This temperature differential is critical when pumping the wort through a long heating loop because by the time the wort returns to the mash, the temperature of the wort will be equal to the temperature of the heat source. It is worth mentioning that enzymes do have a large range of working temperatures, and

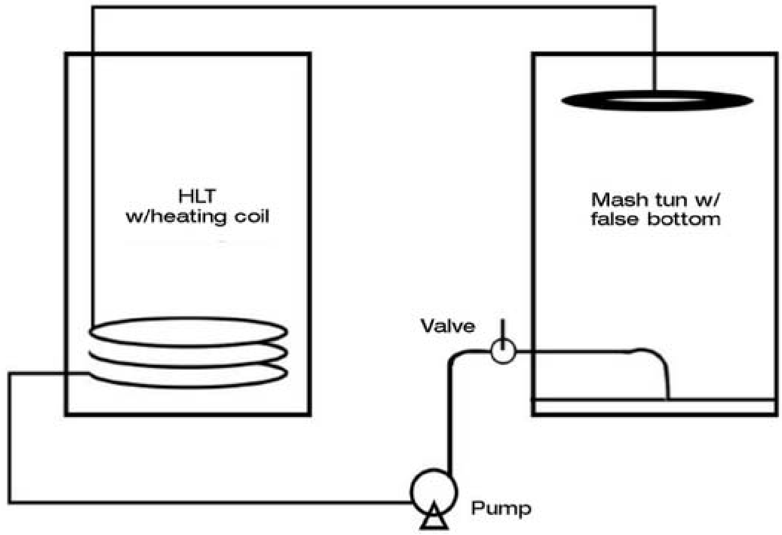


Figure 5. Schematic of a HERMS brewing system

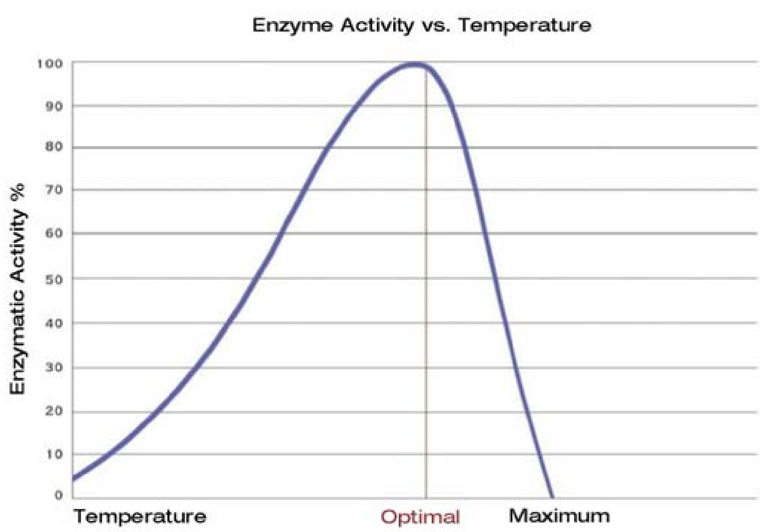


Figure 6. Enzyme activity vs. temperature (Source: Technology Brewing and Malting, 3rd Edition)

Photo by Jason Meyer

Figure 4. Insulated ice chest used as a mash tun

while enzymes are capable of working even at much lower temperatures than the optimal temperature, the case is very different once the temperature gets to be higher than optimal. As seen in Figure 6, after crossing the optimal temperature on the high side, irreversible inactivation is likely to happen very quickly.

In comparison to insulated single infusion systems, the mash temperature should be slightly lower temperature to compensate for mixing effects as more enzyme activity may be obtained at the same temperature due to improved diffusion.

Mechanically Stirred-Heated Mash (Mash Mixers)

Mash mixers are not as commonly used as single infusions or RIMS systems in homebrewing, but they are used. A mash mixer is a dedicated mashing vessel (lautering is done in a separate vessel) that consists of a mechanical mixer and heater. The mixer and heater work together as a system of temperature control. In large scale systems the heating is applied by means of steam jacket, but for homebrew-size mash mixers, the heating may be applied by direct fire, indirect heat with internal hot water coils or externally placed electric heaters (See Figure 7, right).

In mash mixing systems where the mash is continually agitated, a similar degree of colloidal protection of insulated single infusion systems is expected. This is because wort is never separated from the mash as in re-circulated systems for heating up in temperature ramps. A technical advantage of a mechanically mixed mash systems over non-agitated single infusions is that the product inhibition effect is diminished because of the active mixing action promoting enzyme to substrate binding (KI reaction). One aspect to point out is that mechanically mixed mashes are often conducted more diluted in water compared to single infusion insulated systems, often 3.5:1 to 4.5:1 water to malt ratios. While it is true that the thermal stability of enzymes diminishes at higher water/malt ratios, in mash mixed systems the starch breakdown is normally conducted in short steps targeting the optimal temperature of the desired enzyme. This allows the full conversion of starch by the given enzyme in a

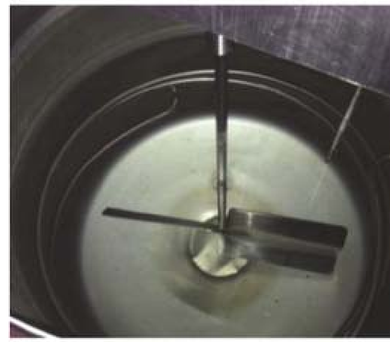


Photo by Walter Diaz

Figure 7. Homebrewing mash mixer with indirect internal heating coil

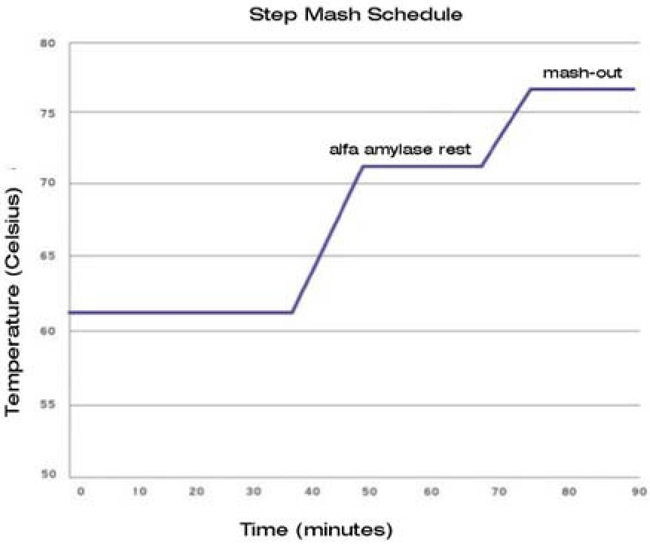


Figure 8. Step mash schedule (source: *Technology Brewing and Malting*, 3rd Ed.)

short amount of time before the enzyme can be inactivated. Figure 8 (page 36) shows a step mash schedule where a separate beta and alpha amylase are conducted.

In comparison to insulated single infusion and recirculated infusion systems, the temperature should be slightly lower in mash mixers to account for the effects of mixing. Well mixed systems are not diffusion limited and comparable effects may be achieved at lower temperatures. In comparison to recirculated infusions, the enzymes working in mash mixed systems have a better degree of colloidal protection.

In summary, the three brewing configurations discussed are perfectly suitable for making good beer. Each system works differently, therefore there will be differences in the optimal temperatures for the targeted group of enzymes. For example, within the broad range of most accepted temperatures for beta amylase, say 140 to 149 °F (60 to 65 °C), it is possible that in one brewing system beta amylase will peak in activity at 144 °F (62 °C) while in others the optimal can be slightly lower or higher. This is a matter of knowing how your particular system responds, and why brewing research will go on forever! BYO

BREW SAFE

Tips for avoiding injury in your homebrewery

I learned about safety in my homebrewery the hard way. I started out homebrewing about ten years ago wearing flip flops, and usually shorts, with not a care about the dangers all around me. My local homebrew shop told me that homebrewing was safe and that THE BEER couldn't hurt me. That's all I needed to hear at the time, but the lessons I have learned since then have been painful.

Homebrewing is Dangerous (Well... sort of)

I say that homebrewing is dangerous like I would say cooking soup is dangerous. If the pot was to fall off the stove and onto your feet leaving you with second-degree burns that would not be a pleasant thing. This outcome is not very likely unless you are being careless and inattentive, but nonetheless it is somewhat dangerous.

When you buy that first homebrew starter kit and brew either extract or partial mash batches on your stove indoors the dangers are minimal. Brewing an extract or partial batch indoors usually just requires that the homebrewer steep grains and boil wort. Being careful to not spill any hot wort during the boil and chill down is probably the extent of the danger here. Boilovers can cause a big mess on a gas or electric stovetop, but probably won't hurt anything.

That method is how I made beer the first few years and I had a few burns here and there, but nothing serious. After 20–30 batches of extract brewing I fell in love with all things beer. What came next? All-grain of course! When I made the switch I found that all-grain brewing required some new equipment — and that once you go all-grain or take brewing outside the safety level changes.

I got a few large plastic water coolers and modified them with some off-the-shelf kits to turn them into a HLT (hot liquor tank) and a MLT

story and photos by **Christian Lavender**

(mash lauter tun). I didn't have any pumps, so I constructed a gravity style sparge system that required hot water to be dumped into the HLT. I used a ladder. Not very smart.

I would heat water on the stove, climb the ladder (in flip flops) with a boiling kettle and dump it into the HLT cooler. (This method is NOT ADVISED.) I only share the silly way I used to make beer as an example of how to hurt yourself badly. At any moment I could have slipped off the ladder with the boiling kettle and ended up with horrible burns and other injuries. Once my wife saw how I was brewing she put an immediate stop to my ladder ascents.

My extract beers were always fermented in glass carboys because that is what the people at my local homebrew shop told me to do. Glass carboys are way more dangerous than plastic carboys. I've had my share of bad cuts from dropping and breaking carboys.

I luckily survived those early years of all-grain brewing and made the switch to a safer brewing method and system. Brewing with your local club and other homebrewers can really give you a new outlook on safety.

Here are the things you need to watch out for in your homebrewery and some essential safety gear you should have easily accessible.

Forgetting to Vent Propane

Propane burners release carbon monoxide and require ventilation. Brewing in garages with low or no ventilation can lead to

Top: An organized homebrewery is a safer brewery. Useful protective wear includes: long rubber heat and chemical-resistant gloves, goggles, thick apron or lab coat, hard hat, particulate respirator/mask. Also, equip your homebrewery with GFCI surge protector, fire extinguisher, first aid kit, carbon monoxide detector, anti-slip mats and beer bottle storage boxes.

Top middle: Boiling wort can be a hazard. Never turn the heat on and walk away; always watch your boil to avoid boilovers and spills. Always have a larger kettle than the boil volume.

Bottom middle: Always check your clamps before using. A pressurized pump can blow a hose off the pump sending hot water and wort flying.

Bottom: Plastic carboys are always safer than glass in terms of breakage. Also, carry all of your carboys with some sort of handle or even with a milk crate.

carbon monoxide poisoning. Usually the side effects are just a mild headache, but high levels of carbon monoxide can cause suffocation, capillary hemorrhaging, permanent damage of nerve tissues and brain cells, and, possibly, death.

Not Cleaning Up Spills Quickly

A small spill can cause a big slip and fall. I personally have slipped on water and wort spilled on the floor and not cleaned up. I fell onto my elbow once and it caused a burst bursa sac. My elbow swelled up like a balloon and then became infected with staph. Clean up those spills.

Unscheduled Brew Day

We're all guilty of this. Sometimes a spur of the moment brew day is the most fun, but put a few minutes into planning and you'll make the brew day much safer. Running around like a chicken with its head cut off in an unorganized brewery is dangerous. Tripping over cords and tubes can lead to spilled pots of hot wort resulting in burns, electrical shock and injury to elbows, knees, and head. Not being ready for next steps in the brewing process can cause frantic action resulting in lots of injuries. Download a free Brew Pad from my website at www.homebrewing.com/brewpad or get a software program like BeerSmith for planning.

Not Knowing to Bleed Pressure from Kegs Before Opening Lids

When you first start kegging you may not fully understand everything about CO_2 pressure. Kegs under pressure should be bled of built up gasses inside before attempting to open the lid. Failing to bleed off the pressure may cause the lid to fly off with great force directly into your face. People have died this way — take it seriously.

Not Testing Gravity of Beer Before Bottling

Bottles will explode if you cap the beer before it has been fully fermented. Exploding bottles can cause a huge mess and are considered similar to grenade shrapnel. Brewers call these "bottle bombs." Having experienced some bad blow ups, I put my bottles inside a cardboard box to soften the blow in case something goes wrong.

Climbing Ladders in Gravity Setups

I already went over this, so just don't do it. This is a quick way to fall, burn or scald yourself.

Homebrewing in Open-Toed Shoes

Like I said earlier, I used to brew in flip flops and I can't even remember all the things I spilled or dropped on my feet. After I dropped a carboy and the exploding glass cut open one of my toes, I switched over to boots. Burns and smashed toes are not supposed to be part of the brew day. Go into any commercial brewery and you will see that everyone is wearing some kind of boots with non-slip soles (often rubber boots) and often with steel toes.

Loose Hose Connection Clamps During Hot Liquid Transfers

It's easy to forget to check your hose clamps, but sometimes they become loose for whatever reason. Firing up a pressurized pump can blow a hose off the pump sending hot water and wort flying. Don't burn yourself, always check those clamps.

Carrying a Full Glass Carboy with a Carboy Handle

Glass carboy necks can snap off and shatter, resulting in lacerations. Never carry a full carboy by just a carboy handle. Products like the Brew Hauler or Bucket Sling can help move a full glass carboy. Heck, just put it in an old milk crate if you have one. New plastic carboys and stainless steel fermenters are better alternatives in my opinion.

Touching Boil Kettle Handles or Sides Without Protective Wear

This is where those heavy aprons, lab coats and gloves can save you from brushing up against a hot boil kettle and getting a burn.

Cleaning Brewing Equipment with Caustic or Acid-Based Cleaners Without Protective Gloves and Eyewear

Most homebrew grade cleaners and sanitizers are non-caustic and mild in strength, but over time can cause damage/dryness to your skin. I suggest wearing elbow length rubber gloves when washing and sanitizing in sinks and buckets. Goggles can prevent splashing acids and soaps into your eyes. I had some Star San hit my eye one time and it burned for hours.

Not Using GFCI Surge Protection on Brewery Pumps and Electric Brewery Systems

It's just good practice to have a Shock Buster or other GFCI outlet on all electrical equipment positioned near liquid. This will prevent shorting out the electrical device and electrocution of the brewer.

Not Wearing a Particulate-Grade Respirator Mask when Milling Grains

Always wear a particulate-grade respirator or mask when milling grain. Lung infections from bacteria like *Lactobacillus* naturally present on grain can occur. Other results may include "Farmer's Lung" or Hypersensitivity Pneumonitis (FHP) or "Organic Dust Toxic Syndrome" or ODTS.

Large Amount of Grain Being Milled with Powered Motor Causing Excess Grain Dust

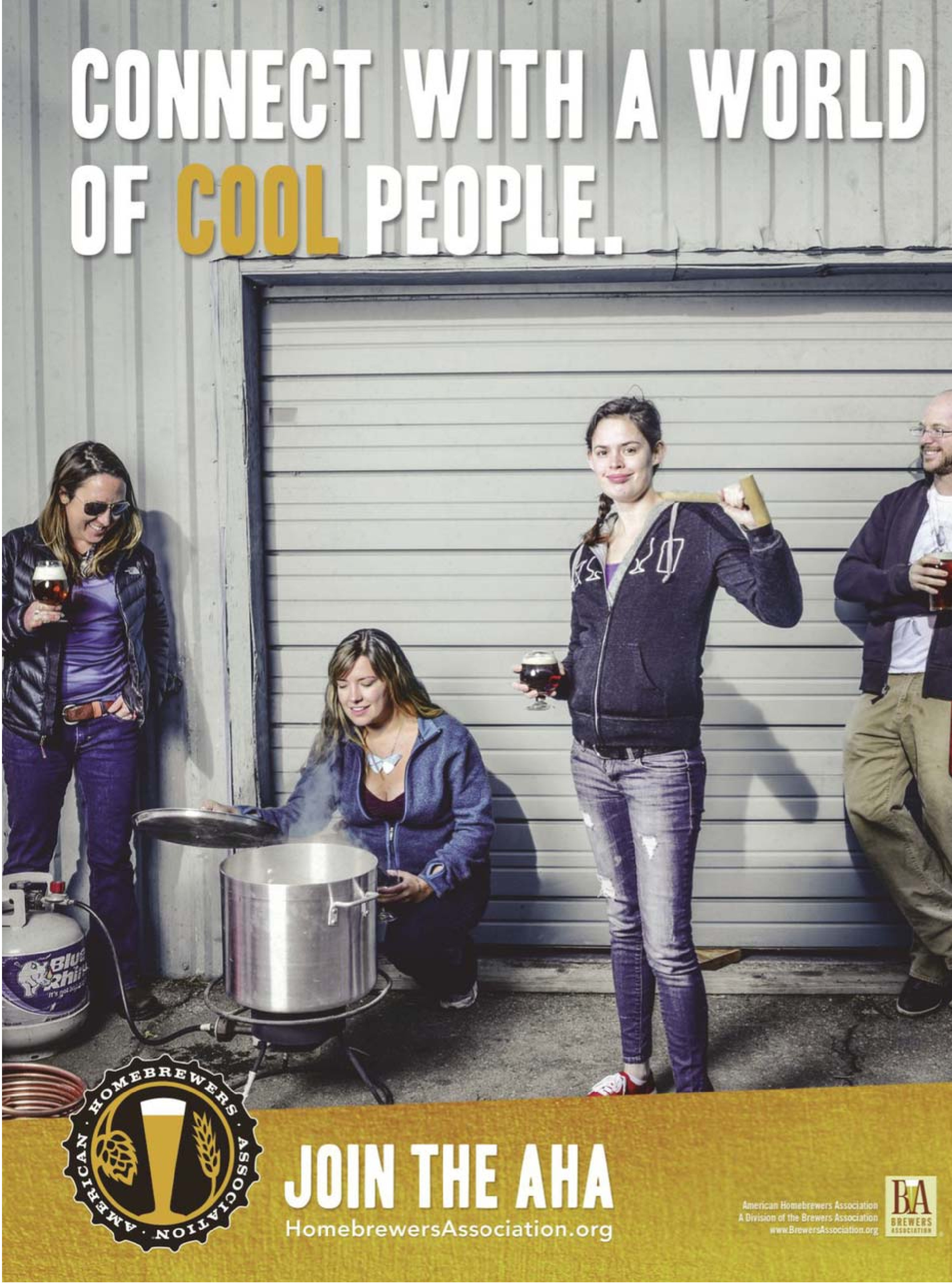
Most homebrewers use a drill to power their mill and this is perfectly safe. It's only when you are milling a large amount of grain at a fast rate that you need to worry about grain dust explosions and fires.

Boilovers

What homebrewer hasn't experienced this one? Beer tends to foam quickly when boiled and during hop additions, so just be attentive to the kettle and throttle back that heat if you see a boilover coming. Don't turn the heat on and walk away. I suggest always having a larger kettle than the boil volume. Failing to do this can cause burns and flare ups on open flame burners.

Stay Safe

The first question any workplace accident questionnaire will ask is, "Was this accident preventable?" Accidents do happen, and the risk shouldn't prevent you from enjoying the hobby of homebrewing. However, be smart, brew safe and use these tips to prevent hurting yourself. BYO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Home Grown, Grain to Glass

It seems as though there are a few things you learn early on as a homebrewer, including where your ingredients come from. Your hops come from the Yakima Valley, Germany or more recently New Zealand and Australia. Your barley was probably grown in the Pacific Northwest, Great Plains, Canada or Europe. But what if that didn't have to be the case? What if you could source your malt and hops locally? For our brewing forefathers, ingredients were often sourced close to home, and lately around the US a new group of farmers and maltsters are working to bring localization back to brewing.

by Nick Rodammer

Photos courtesy of Brewsquitos Homebrew Club

Top: The Brewsquitos Homebrewing Club members who were in attendance at the 2014 Siciliano's Market AHA Big Brew Day. In the background is the La Grand Vitesse, a sculpture by Alexander Calder that is one of the most notable landmarks in Grand Rapids.

Bottom: The main mash from the Brewsquitos MiIPA during the Big Brew Day.

Growing Locally

It might seem like an obvious point, but first and foremost, to brew a locally sourced beer, the local climate must be able to support growing those ingredients. For hops, this eliminates some parts of the US, as hops grow best between latitude 40 and 50, though there are areas of the country that have seen some success outside of this range. The Yakima Valley in Washington, with the highest concentration of hop acreage in the country, sits around latitude 46, while the Willamette Valley in Oregon is a bit further south, around the 45th parallel.

While over 97% of the hop acreage in the United States is located in Washington, Oregon and Idaho, growing hops outside of this region is not without precedent. From the mid-18th century until the early 19th century, Massachusetts was recognized as the leading region for hop production in the United States. By the mid-19th century, New York was the hop growing capital of the country, eventually reaching annual production of over

three million pounds. However, the industry fizzled, as a combination of competition from West Coast growers, major bouts with both downy mildew and aphids in the early 20th century, and finally Prohibition in 1918 put most local hop farmers in New York out of business for good. Other states such as Wisconsin and Michigan also had notable amounts of hop acreage prior to Prohibition, but like New York they did not last.

Despite the fact that commercial hop acreage has remained almost entirely contained to the Pacific Northwest for nearly 100 years, some of these old markets are finding life again. In Michigan, where I live, which now boasts more than 120 breweries, over 300 acres of hops are expected to be harvested in 2014, with that number anticipated to grow to as many as 500 acres for 2015. New York projects that 150 acres of hops will be harvested this year, with 75 more expected for 2015. In addition to Michigan and New York, 12 other states reported commercial acreage between 10 to 120 acres for the 2014 harvest, showing that interest in locally sourced hops isn't isolated to just a few pockets of the country.

Barley, unlike hops, is currently grown in most regions of the US; the USDA reports that 22 different states planted at least 10,000 acres in 2013, ranging from southwestern states like Arizona to northeastern states such as Maine. It should be noted that not all of this is malting barley acreage, as much is used for feed, but it does show the potential for expansion or conversion of current acreage used for feed to growing for malting purposes.

Malt houses were also a highly localized type of business at one point early in our nation's history, but like hops, consolidation led to most malt being produced by large companies with worldwide reach. Small, local malt houses, or as they identify themselves today, craft maltsters, are a small group but are growing rapidly, with around 20 actively malting for brewers in the US and Canada presently, and another 15 currently in the construction and planning stages. Craft maltsters are operating in nearly every region of the United States and Canada, with annual capacity ranging from 10 to 800 tons of malt per year. What makes a maltster a craft maltster? The North American Craft Maltsters Guild, a collection of small maltsters which organized in 2013, defines a craft maltster as one who sources the majority of their grains regionally, produces between 5 and 10,000 metric tons per year, and has ownership that does not exceed 24% by a larger, non-craft maltster. (Read more on the Web about The North American Craft Maltsters Guild at www.craftmalting.com.)

Why Local?

With so many choices of where to source ingredients already, the big question becomes, why choose to source anything locally? The answer lies in two main themes: That localization matters to both drinkers and brewers, and that the effect of local "terroir," or the unique attributes of a location's climate, soil and other environmental factors that can lead to flavors in local ingredients, can only be found regionally.

Maris Otter, American 2-row and continental Pilsner are all types of base malts, but each come from a different part of the world, and brewers use them based on their unique characteristics and flavor. Likewise, English and Noble style hops grown in Europe have notable differences from their American-grown counterparts. However, the differences in brewing ingredients can be much more regional. Michigan, for instance, has a few hop varieties that brewers have noted as standing out compared to their Northwest or European-grown counterparts. For example, Michigan Chinook is reported to have less pine and more citrus, even tropical fruit aroma, while Summit™, grown exclusively in Michigan by New Mission Organics, is heavy on dank and citrus flavors, but lower on the onion/garlic that many associate it with. Also, Saaz hops grown by Hop Head Farms, the only grower in the state offering this variety, can offer double to triple the alpha

MiIPA Recipe

MiIPA
(5.5 gallons/21 L, all-grain)

OG = 1.063 FG = 1.013
IBU = 59 SRM = 6 ABV = 6.6%

The recipe is formulated to achieve 6.5 gallons (25 L) in the kettle and 5.5 gallons (21 L) in the fermenter to compensate for the loss of wort due to trub after the boil and then dry hopping. The choice of hops is up to the individual homebrewer.

Ingredients

15 lbs. (6.8 kg) Pilot Malt House 2-row pale malt
1 lb. (0.45 kg) Pilot Malt House white wheat malt
1 lb. (0.45 g) Michigan Malt Co. crystal malt (15 °L)
15 AAU Michigan grown Nugget hops (FWH) (1.25 oz./35 g at 12% alpha acids)
8 AAU Michigan grown Centennial hops (10 min.) (1 oz./28 g at 8% alpha acids)
7.5 AAU Michigan grown Cascade hops (10 min.) (1 oz./28 g at 7.5% alpha acids)
3 oz. (85 g) Michigan grown Chinook hops (0 min.)
1 oz. (28 g) Michigan grown Cascade hops (0 min.)
1 oz. (28 g) Michigan grown Summit™ hops (0 min.)
1.5 oz. (43 g) Michigan grown Chinook (dry hop-6 days)
1 oz. (28 g) Michigan grown Summit™ (dry hop-6 days)
1.5 oz. (43 g) Michigan grown Chinook (dry hop-3 days)
1 oz. (28 g) Michigan grown Summit™ (dry hop-3 days)
0.5 tsp. yeast nutrients (10 min.)
½ Whirlfloc tablet (2 min.)
1 tsp. gelatin (secondary)
Fermentis Safale US-05 or White Labs WLP001 (California Ale) or Wyeast 1056 (American Ale)
Priming sugar (if bottling)

Step by Step

My malts and hops were all locally sourced. Feel free to substitute your own locally sourced malt and hops, or if unavailable, any high quality malts and hops. Mash in with 1.5 qts. (1.4 L) strike water per pound (0.45 kg) of grist to achieve a mash temperature of 149 °F (65 °C) and hold for 60 minutes. Sparge with 168 °F (76 °C) water and collect about 7.75 gallons (29.3 L). During the sparge, add your first wort hop addition. Boil for 75 minutes, adding hops and yeast nutrients with 10 minutes left in the boil. With 2 minutes left in the boil add the Whirlfloc tablet and the final addition of hops at flameout. Chill the wort to 68 °F (20 °C) and aerate thoroughly. Hold at 68 °F (20 °C) for seven days or until primary fermentation dies down, then increase temperature to 72 °F (22 °C) and hold for three days. Transfer beer to secondary at 68 °F (20 °C) and add first round of dry hops. After three days, add second round of dry hops. After three more days, drop the temperature to 30 °F (-1 °C), and add gelatin. Hold at 30 °F (-1 °C) for three days, or until dry hops and yeast have fallen out. Rack to keg and carbonate or rack to bottling bucket, add priming sugar and bottle. Carbonate to 2.2 volumes CO_2.

MiIPA
(5.5 gallons/21 L, extract with grains)

OG = 1.063 FG = 1.013
IBU = 59 SRM = 6 ABV = 6.6%

The recipe is formulated to achieve 5.5 gallons (21 L) in the fermenter to compensate for the loss of wort due to dry hopping.

Ingredients

6.6 lbs. (3 kg) extra light liquid malt extract
2 lbs. (0.91 kg) wheat dried malt extract
1 lb. (0.45 g) Michigan Malt Co. crystal malt (15 °L)
12 AAU Michigan grown Nugget hops (FWH) (1 oz./28 g at 12% alpha acids)
8 AAU Michigan grown Centennial hops (10 min.) (1 oz./28 g at 8% alpha acids)
7.5 AAU Michigan grown Cascade hops (10 min.) (1 oz./28 g at 7.5% alpha acids)
3 oz. (85 g) Michigan grown Chinook hops (0 min.)
1 oz. (28 g) Michigan grown Cascade hops (0 min.)
1 oz. (28 g) Michigan grown Summit™ hops (0 min.)
1.5 oz. (43 g) Michigan grown Chinook (dry hop-6 days)
1 oz. (28 g) Michigan grown Summit™ (dry hop-6 days)
1.5 oz. (43 g) Michigan grown Chinook (dry hop-3 days)
1 oz. (28 g) Michigan grown Summit™ (dry hop-3 days)
0.5 tsp. yeast nutrients (10 min.)
½ Whirlfloc tablet (2 min.)
1 tsp. gelatin (secondary)
Fermentis Safale US-05 or White Labs WLP001 (California Ale) or Wyeast 1056 (American Ale)
Priming sugar (if bottling)

Step by Step

The hops and malts were all locally sourced. Feel free to substitute your own locally sourced malt and hops, or if unavailable, any high quality malts and hops. Place crushed grains in a muslin bag and soak for 20 minutes in 1 gallon (3.8 L) water at 160 °F (71 °C). Wash the grain bag with 2 qts. (1.9 L) hot water. Top off to 5 gallons and bring to a boil. Off heat, stir in the liquid and dried malt extract as well as the first wort hops. Boil for 60 minutes, adding hops and yeast nutrients with 10 minutes left in the boil. With 2 minutes left in the boil add the whirlfloc tablet and the final addition of hops at flameout. Top off the kettle to 5.5 gallons (21 L). Chill the wort to 68 °F (20 °C) and aerate thoroughly. Hold at 68 °F (20 °C) for seven days or until primary fermentation dies down, then increase temperature to 72 °F (22 °C) and hold for three days. Transfer beer to secondary at 68 °F (20 °C) and add first round of dry hops. After three days, add second round of dry hops. After three more days, drop temperature to 30 °F (-1 °C), and add gelatin. Hold at 30 °F (-1 °C) for three days, or until dry hops and yeast have fallen out. Rack to keg and carbonate or rack to bottling bucket, add priming sugar and bottle. Carbonate to 2.2 volumes CO_2.

acids of their Czech and Pacific Northwest grown counterparts.

Malt is no different, and can be noticeably different depending on where it is sourced. When it comes to malt, region and climate often dictate the type of crop that can be suitably grown for malting purposes. Varieties that grow well in the cool, dry climates of the Dakotas and Montana may not translate well to the wetter, more humid weather in the Atlantic region of the US. To illustrate this point, five different craft maltsters held a workshop at the 2014 Craft Brewers Conference (CBC) in Denver, Colorado. Each provided a base grain grown and malted from their region, which was then brewed into a light, malt-forward beer made on the pilot brewing system at New Belgium Brewing Company in Fort Collins, Colorado.

The results were telling; each grain showed notable differences when it underwent malt analysis, but more importantly, each exhibited flavors that were distinct from the others. The effect of variety was on display in this workshop as well. Riverbend Malt House in Asheville, North Carolina was the only maltster to bring a 6-row barley, which is often frowned upon by both craft brewers and homebrewers alike. However, they chose this variety of barley specifically for its ability to make great malt while being grown in North Carolina's climate. The spicy and lightly grassy character it exhibits gives it a unique flavor, and due to some smart farming practices, its protein content of less than 10% is equal to or lower than most commercially grown 2-row malt. Riverbend also offers an heirloom malted rye, which has been grown regionally since the mid-19th century, and was featured in New Belgium's RyePA released in early 2014. Matty Gilliland, a brewer with New Belgium, who has used Riverbend's malts several times, stated that early feedback on their malt has been positive.

"We seem to get more character out of them. Riverbend is big on the terroir that comes with using local heirloom grain varieties and malting them by hand, and I really think there's something to that," said Gilliland.

Valley Malt, located in Hadley, Massachusetts, says that depending on where the barley is sourced, their malt can exhibit a faint strawberry note, something that was noticeable in their version of the beer brewed for CBC. What this workshop displayed first hand was that flavors truly can be local as well, and when a brewer chooses to source a local product, they may give their beer a characteristic that they wouldn't have found otherwise.

In addition to unique flavors that can be found in both malt and hops depending on locale, some markets are even trialing hop varieties that can't be found anywhere else. Here in Michigan, Lynn Kemme, the head grower at Great Lakes Hops in Zeeland, is working with growers to evaluate varieties found growing wild throughout the state.

Great Lakes Hops is a hop propagation and breeding facility that provides plants to many of the new hopyards starting up across the United States, and is the largest of its kind in the country outside of the Pacific Northwest. To date, over a dozen varieties found growing wild in Michigan have been brought to Great Lakes Hops where they were evaluated for origin, characteristics and suitability for brewing. Kemme said that most of the hops found growing wild in Michigan that he has seen are close relatives of hops that have grown in Europe for generations. While the true origin of these wild varieties may never be known, it seems likely they were transplanted by European immigrants during the 19th century, and when the hop growing industry in Michigan disappeared a century ago they were left to grow in the wild until they were found decades later.

Most of the wild hops brought to Great Lakes Hops are still undergoing evaluation, but one of them, a variety called Michigan Copper, was released to growers on a limited basis in 2014 after placing first in a sensory analysis of a number of trial varieties completed by a group of different commercial brewers. Some of the descriptors brewers used after evaluation, which include "pineapple," make this an exciting new variety to look out for over the next few years.

Local Investment

Ultimately, for local providers to be able to grow and thrive, the brewers themselves must be willing to invest in purchasing their malt and hops locally. While the movement to return to local sourcing has really only gained re-acceptance on a wide scale in the last five to ten years, brewers have shown a strong willingness to not only try locally sourced malt and hops, but to increase usage in the future. In a survey of 82 commercial brewers in 28 states, which was completed in spring of 2014, 72% stated intent to use more locally sourced ingredients in the future. When brewers were asked where they wanted to see improvement in the ingredients they use, they most often noted wanting increased consistency, lower prices, and processing that would ensure quality and freshness. However, many brewers noted that this is largely due to the relative youth of local producers, which don't have the experience of large hop farms and malting facilities that have been operating for several generations. Alec Mull, the Director of Brewing Operations for Founders Brewing Company in Grand Rapids, Michigan, which uses Michigan-grown hops in its annual Harvest Ale, a wet-hopped IPA, echoed this sentiment.

"Michigan growers have provided us high quality fresh hops that we enjoy every year, and we have seen them improve annually as well. It is important to recognize however that the hops that are grown and processed in the Pacific Northwest have generational experience and investment that provides them a current advantage," said Mull.

Hometown Yeast

If local malt or hops aren't available where you live, or if you just want to create a truly local Reinheitsgebot with your ingredients, you can also consider culturing a local yeast strain from the wild. David Thornton, one of the founders of SouthYeast Labs in Clemson, South Carolina is an expert in isolating wild yeast for brewing, and SouthYeast is built upon that principle. Since starting in 2013, SouthYeast has isolated more than 100 different wild yeast strains, which then go through their "Yeast Boot Camp" where they are tested for tolerance to alcohol, impacts on pH, flocculation characteristics, apparent attenuation, ester profiles and more. Roughly ⅓ of the strains isolated have passed these tests and made it to further trials, where suitability for brewing is determined. Presently, SouthYeast offers eight different wild yeast strains and a few native yeast blends for sale to both craft and homebrewers, which typically produce farmhouse style ales with a varying array of phenolic and ester profiles. Several local breweries have used their yeast with great success, and homebrewer Jamie Hawthorne even advanced a saison to the National Homebrew Competition's second round this year using SouthYeast's B3 strain, isolated from a blueberry.

When looking for ways to isolate local yeast, Thornton suggests looking for damaged fruit, flowers with insect activity, tree sap or bee hives, as all are notorious for harboring yeast. Open-air traps are also an option, but typically have a lower success rate. After deciding on a source, it can be added to a wort solution, with 1.032 as a suggested gravity, combined with yeast nutrients. After a few hours exposure to the air and some agitation, an airlock can be added to allow the wild yeast to begin fermentation. Once complete, this "starter" can be streaked and individual organisms isolated, or stepped up for further propagation. Yeast harvesting and isolation is a topic that is bigger than can be discussed in this article, however you can read more at http://byo.com/story1662.

Erik May from Pilot Malt House in Jenison and the kiln that is used in the malting process. Pilot is one of only two maltsters located in Michigan, and they began malting grains for the first time in 2013. The Brewsquitos used malt from Pilot to brew their MiIPA.

Brewing Michigan Style

In advance of the 2014 National Homebrewers Conference in my hometown of Grand Rapids, Michigan, my local club, The Brewsquitos (http://brewsquitos.com/), bounced around some ideas for what we could do to commemorate the year's biggest homebrewing party being in our backyard. To create a showcase for the movement of using local brewing ingredients, we settled on creating a series of beers to be served at Club Night made with all Michigan malt, hops and water, which we called the MiIPA Series. This was a perfect opportunity to showcase a burgeoning industry in our state and to give homebrewers a chance to see what an all-Michigan beer would taste like (and if they'd notice any differences from what they expected).

To make this project successful, our club needed buy in from a local hop grower and malt house, which we quickly found in Erik May at Pilot Malt House in Jenison, Michigan, and Brian Tennis, of the Michigan Hop Alliance (MHA). Pilot is one of only two maltsters located in Michigan, and began malting for the first time in 2013, providing malt to more than a dozen local breweries. MHA is a collective of more than a dozen hop growers in northern Michigan, is one of the pioneers in reviving the commercial hop growing industry in Michigan, and is a leading producer of organically grown hops in the state.

In designing the recipes for our project, we took into consideration the ingredients we had at our disposal. As a newer company, Pilot spent its first year refining its base malt offerings, which include 2-row and 6-row barley, along with white and red wheat, all which is Michigan grown. With Michigan growing in reputation as a hop growing state, we decided to use the India Pale Ale style to feature the ingredients we were using, shooting for a clean malt character with a big dose of flavor and aroma from the Michigan grown Summit™, Chinook, Cascade, Centennial, Columbus, Crystal and Nugget hops provided by MHA. (See the base recipe for our beers on page 48.)

To ensure consistency, our club set up two group brew days, the first of which was a club-only event where two double IPAs were produced using two distinctly different blends of hops. For the second brew day, where five different single-hopped IPAs were brewed, we chose Siciliano's Market Big Brew Day in downtown Grand Rapids as our venue, the largest homebrewing event in West Michigan, and just one block away from where the National Homebrewers Conference would be held just six weeks later. Each brew day employed a single mash split into different kettles for consistency, and despite pesky spring winds and even a bit of rain, we were able to achieve consistent starting gravities leading into fermentation.

We were fortunate to find that once we put our IPAs on tap at Club Night, the results were overwhelmingly positive, with each displaying a solid balance with a wealth of hop flavor and aroma. The effect of Northern Michigan's terroir was also on display, as many attendees noted the difference in hop character in our Michigan grown hops compared to their Pacific Northwest counterparts. As brewers had been reporting, our all-Chinook IPA was light on the piney notes that are often associated with this variety, and instead displayed big citrus and tropical fruit char-

acter. Our Summit™ IPA had a very citrus-forward character with lots of dank notes.

Our project ultimately showed that not only can you homebrew a beer using all locally sourced ingredients, but you can make truly standout beer that has touches of local flavor that can't be found elsewhere.

Go Local

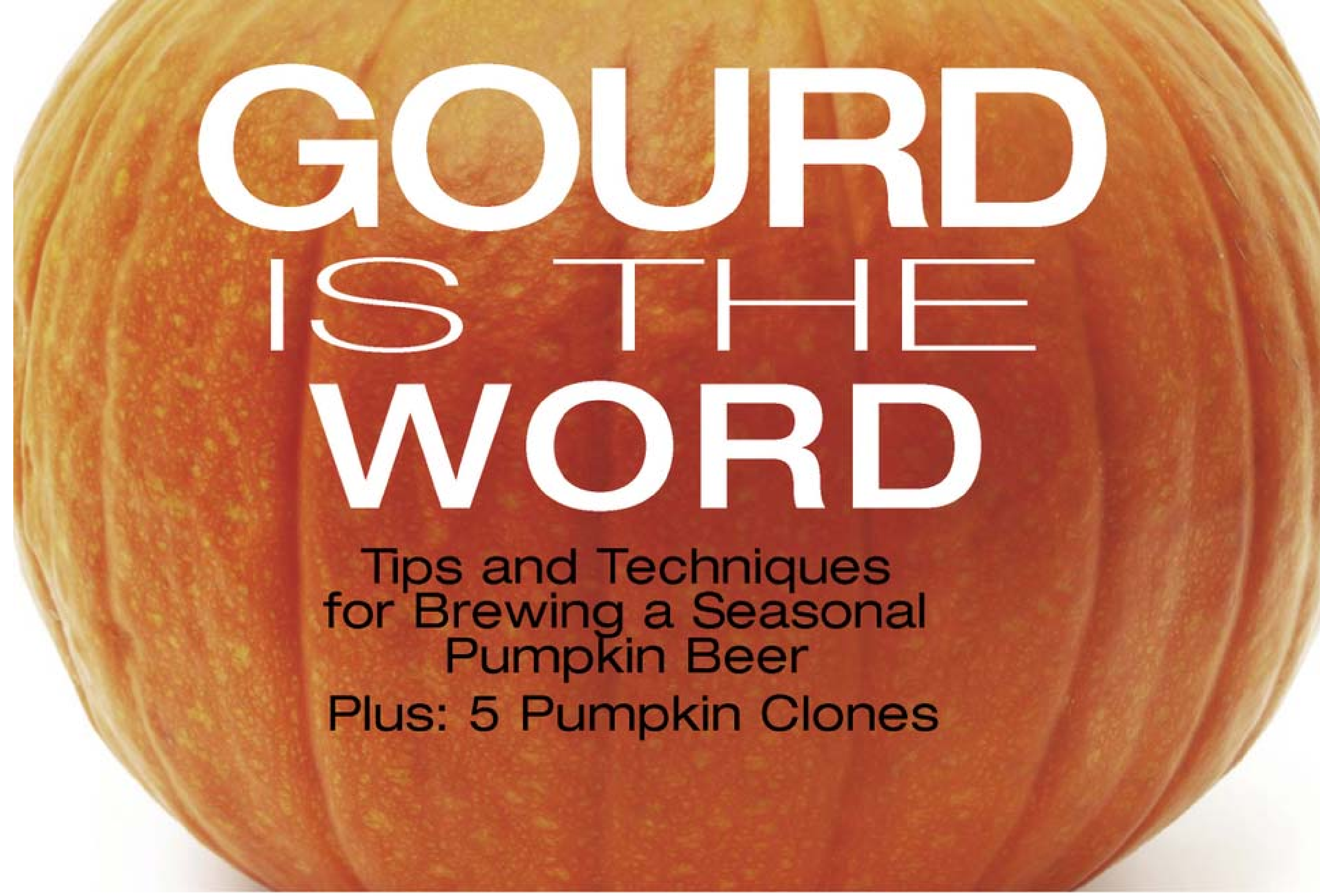
With the rise of local maltsters and hop growers over the past few years, and as quality improves, locally sourced beers are likely to become easier to find, and the accessibility of these ingredients will continue to grow for both homebrewers and craft brewers alike. In addition to supporting local companies from your area, as a homebrewer you have the opportunity to create a beer that has a true sense of place, both in flavor and story. So perhaps the next time someone is sampling your homebrew, in addition to talking to them about how it was made you can tell them where they can visit the farm where your hops were grown, or that the farmer and maltster who provided your barley are only a short drive away. Doing so might just put a little greater sense of home into your homebrewing. BYO

Related Links:

• Listen to Nick Rodammer and the rest of the Brewsquitos talk about their local homebrewing project and about hops and malt grown and produced in Michigan on *Basic Brewing Radio*: http://traffic.libsyn.com/basicbrewing/bbr07-17-14michbeer.mp3

• Put even more home into your homebrew by growing your own hops. Follow our instructions for planting, cultivating, and picking hops, as well as easy techniques for drying: http://byo.com/story723

• Check out the *BYO* beginner's guide to raising a bit of barley in your own backyard. PLUS: Simple step-by-step malting instructions: http://byo.com/story722



GOURD IS THE WORD

Tips and Techniques for Brewing a Seasonal Pumpkin Beer

Plus: 5 Pumpkin Clones

by **Dave Green**

Photos by Joel Tietge

"DRIP…DRIP…DRIP." The year is 2005 and I only had 2 ounces (57 g) of rice hulls in my grain bag while brewing a pumpkin beer. In hindsight, I should have ditched the plan, but at 10 p.m., and with pumpkins already baked, I was mentally ready to go through with the brew. But with the sparge going at less than a snail's pace, I realized I was in for a long night.

I was about a half gallon (2 L) into the sparge phase of my fall brew and things were going smoothly. It was my second attempt at brewing a pumpkin beer. The first attempt had gone well on brew day (with 8 ounces/227 g of rice hulls), but a lack of judgment (and experience) when it came to spice additions resulted in a nutmeg bomb.

I first tried underletting (feeding water into the bottom of the mash tun) to unstick the sparge. It worked for a little while, and I was able to get another half gallon (2 L) before the "drip, drip" resumed. In order to clean the false bottom, I dumped the mash from my Igloo cooler into my old Zapap lauter tun and back again and restarted the vorlauf — yet it wasn't long until I was back to


Photo by Charles A. Parker/Images Plus

Photos by Joel Tietge

"drip, drip." Underletting the mash tun again, I got another gallon (4 L) out. Slowly but surely the sparge became unstuck as the sticky glucans drained.

When I was attempting this brew, Randy Mosher had recently published the book *Radical Brewing*, and I had latched onto his words with a passion. My first attempt at a pumpkin beer in 2004 had been a blind attempt to clone the very first pumpkin beer I had ever tasted: Brooklyn Brewery Post Road Pumpkin Ale. With no guidance in the spicing department I created the aforementioned nutmeg disaster. A year later, thanks to Mr. Mosher's book, I had a better sense of what to do with pumpkin beers. By 4:30 a.m. I finally pitched the yeast and had the first taste. Despite several hours of frustration and complete exhaustion, the base beer tasted solid.

Pumpkin Beer History

While to me, pumpkin beers started the day I tried Post Road Pumpkin in 1997, pumpkin — or pompion — beers actually have quite a storied history dating back to the colonial American period. Pumpkins are indigenous to North America. Seeds for pumpkins (*Cucurbita maxima*) have been carbon-dated to about 6000 BC in Mexico. Native Americans cut the pulp of pumpkins into strips to dry. Dried strips had a variety of uses including pulverizing them into flour; the strips could be eaten as food during long winters or strands were used for making baskets.

When the early English colonists landed in the New World keeping a steady supply of beer was considered a high priority in order to make them feel at home. It may not be in most schoolhouse history books, but the story goes that the Pilgrims made landfall at Plymouth Rock because their ale supply was running low.

In 17th century colonial North America, malt was extremely hard to come by on the western shores of the Atlantic Ocean. As a result colonists turned to a broad range of fruits, vegetables and sugars to ferment, in order to get a hard beverage. Hard cider from apples would have been quite popular due to the vigor with which apple trees adapted to the climate of the New World. Corn, ginger, and the sugars (like molasses and brown sugar) available to them were also utilized in abundance. Assorted squash including pumpkins were also quite popular as well. In what some claim to be the first American folk song "New England's Annoyances," from the early 1600s there is a satirical stanza about using pumpkin in beer and for food.

"Instead of pottage and puddings and custards and pies, Our pumpkins and parsnips are common supplies; We have pumpkin at morning and pumpkin at noon; If it was not for pumpkins we should be undone . . . Hey down, down, hey down derry down . . . If barley be wanting to make into malt We must be contented and think it no fault
For we can make liquor, to sweeten our lips, Of pumpkins and parsnips and walnut-tree chips."

Note that they make reference to parsnips and wood chips, but no mention of spices. Colonial Americans were in fact using spices to make several alcoholic concoctions such as metheglin (spiced mead) and spiced hard cider, as well as in their pumpkin custards, but I couldn't find any reference to spices being used in pumpkin beers in those times. Several sources have uncovered the cocktail known as flip, which colonists mixed spiced rum with pumpkin beer and brown sugar. In *The Oxford Companion to Beer*, there is a reference to how colonists would produce the wort for a Pompion Ale (pumpkin beer):

"Let the pompion be beaten in a trough as apples. The expressed juice is to be boiled in a copper a considerable Time and carefully skimmed that there may be no remains of the fibrous part of the pulp. After that Intention is answered let the liquor be hopped cooled fermented as malt beer."

The quote was first published in the *American Philosophical Society* in 1771. By the 1800s, grain production was offsetting the need to brew beers with pumpkin, and before long the use of pumpkins as an ingredient in beer died off.

Fast-forward almost 200 years to the American craft beer revolution. Bill Owens, founder of Buffalo Bill's Brewery in Hayward, California, released the first of the modern renditions of pumpkin ale in 1985 after reading that George Washington used pumpkin to brew his pumpkin porter. Flavored with cinnamon, cloves, ginger and nutmeg, Buffalo Bill's Pumpkin Ale was meant to be an amber ale with a hint of pumpkin pie character. Today, almost 30 years later, pumpkin beers have continued to evolve and now come in many forms. From light lagers to stouts, some with a subtle spice that is barely detectable until warmed, ranging up to the pumpkin pie in a glass, the age of pumpkin beers has returned.

Into the Brewhouse

So, how do you craft a pumpkin beer to your liking? Well, as with many broad-based questions the answer isn't so simple. There are really at least three broad levels of complexity when crafting a pumpkin beer: The base beer, the pumpkin and the spicing. As a brewer, you must learn to dial in each to achieve a symbiosis between the three. I talked with several professional brewers whose pumpkin beers span the range from subtle pumpkin beer to dessert pumpkin pie bliss in order to learn what they think it takes to get a masterful pumpkin beer.

Base Beer

Starting with the malts, hops, yeast and water, homebrewers need to figure out a foundation for their beer. For a broad range of options in this category, look no further than the Seattle, Washington based Elysian Brewing Co. lineup of beers. Dick Cantwell and his team are pioneers in this department and have put together more than 20 different pumpkin beers ranging from pale lagers to stouts to pumpkin sour blends to pumpkin hefeweizens. "As in the case of using a Bavarian hefeweizen yeast, the yeast itself can provide the spice," Cantwell said. Step away from Elysian Brewing Co., and you'll find that most pumpkin beers use a base beer more in line with an amber ale or Oktoberfest. Mild on the hops, moderate caramelly toasted flavors dominate the pumpkin beer world. There is a reason for this since this profile lends itself well to the concept of pumpkin pie and its associated spices. Wayne Wambles at Cigar City Brewing Co. in Tampa, Florida says they, "utilize neutral base malts, then layer in specialty and Munich malts to impart flavor, body, color, and sweetness. These malts are also a nice interlude into the toasted malts that are going to develop your pie crust flavors and aromas."

After talking with several brewers I found that there is no right choice for yeast. Each brewer had his or her own opinion on where to go on this topic. Garrett Oliver from Brooklyn Brewery likes to use a more expressive English yeast to coax out some esters that play

Continued on page 63

Elysian Brewing Company Dark o' the Moon clone

(5 gallons/19 L, all-grain)

OG = 1.072 FG = 1.022
IBU = 25 SRM = 56 ABV = 6.5%

Ingredients

11 lbs. (5 kg) Great Western 2-row pale malt (or similar)
1.25 lbs. (0.57 kg) Weyermann Munich malt (9 °L)
1 lb. (0.45 kg) Crisp roasted barley (550 °L)
1 lb. (0.45 kg) Crisp chocolate malt (450 °L)
8 oz. (0.23 kg) Crisp crystal malt (77 °L)
8 oz. (0.23 kg) Castle Château Cara Ruby™ (20 °L)
5 oz. (0.14 kg) Special B malt (114 °L)
8 oz. (0.23 kg) pumpkin puree (mash addition)
8 oz. (0.23 kg) pumpkin puree (kettle addition) (90 min.)
5.3 AAU Magnum hops (60 min.) (0.4 oz./11 g at 13.5% alpha acids)
4 AAU Saaz hops (2 min.) (1 oz./28 g at 4% alpha acids)
0.25 oz. (7 g) Vietnamese ground cinnamon (5 min.)
0.125 oz. (3.5 g) Vietnamese ground cinnamon (0 min.)
0.125 oz. (3.5 g) Vietnamese ground cinnamon (secondary)
5.3 oz. (0.15 kg) pumpkin puree (fermenter addition)
Wyeast 1056 (American Ale) or White Labs WLP001 (California Ale) or Lallemand BRY-97 (American West Coast Beer) or Fermentis US-05 yeast
Priming sugar (if bottling)

Step by Step

Elysian uses three additions of pumpkin puree: 40% added to the mash, 40% added to the kettle, and 20% to the fermenter. The last two additions must be thinned with wort as pumpkin can lower starting gravities. To do this, draw some wort off into the pumpkin puree and mix until suspended.

Heat 5 gallons (19 L) of strike water to achieve a stable mash temperature of 154 °F (68 °C). Hold at this temperature until starch conversion is complete. Collect at least 6.5 gallons (25 L) wort in the kettle along with the kettle addition of thinned pumpkin puree and boil for 90 minutes adding hops, pumpkin puree, and cinnamon at the times indicated.

After boil, stir the wort for at least a minute and let it settle for 15 minutes total. Chill the wort to 70 °F (21 °C) and maintain this temperature during active fermentation. Add the final addition of thinned pumpkin puree to the fermenter once the primary fermentation begins to slow down. After allowing time for suspended material to settle, rack to a secondary vessel and add the final addition of cinnamon. Let the beer sit for a week then bottle or keg.

Elysian Brewing Company Dark o' the Moon clone

(5 gallons/19 L, extract with grains)

OG = 1.072 FG = 1.022
IBU = 25 SRM = 56 ABV = 6.5%

Ingredients

4 lbs. (1.8 kg) extra light dried malt extract
3.3 lbs. (1.5 kg) liquid Munich malt extract
1 lb. (0.45 kg) Crisp roasted barley (550 °L)
1 lb. (0.45 kg) Crisp chocolate malt (450 °L)
8 oz. (0.23 kg) Crisp crystal malt (77 °L)
8 oz. (0.23 kg) Castle Château Cara Ruby™ (20 °L)
5 oz. (0.14 kg) Special B malt (114 °L)
8 oz. (0.23 kg) pumpkin puree (mash addition)
8 oz. (0.23 kg) pumpkin puree (kettle addition) (60 min.)
5.3 AAU Magnum hops (60 min.) (0.4 oz./11 g at 13.5% alpha acids)
4 AAU Saaz hops (2 min.) (1 oz./28 g at 4% alpha acids)
0.25 oz. (7 g) Vietnamese ground cinnamon (5 min.)
0.125 oz. (3.5 g) Vietnamese ground cinnamon (0 min.)
0.125 oz. (3.5 g) Vietnamese ground cinnamon (secondary)
5.3 oz. (0.15 kg) pumpkin puree (fermenter addition)
Wyeast 1056 (American Ale) or White Labs WLP001 (California Ale) or Lallemand BRY-97 (American West Coast Beer) or Fermentis US-05 yeast
Priming sugar (if bottling)

Step by Step

The easiest way to brew this is with liquid Munich malt extract, but a partial mash is a good option and would allow the starch in the pumpkin puree to convert to simple sugars. If using a partial mash, allow conversion to occur before adding the bulk of the darker roasted grains as you may negatively affect the mash pH, hurting the enzymes' ability to convert the starch of the mash.

Heat 2 gallons (7.8 L) water to 170 °F (77 °C) and place crushed grains and pumpkin puree in a brewing bag. Soak the grains for 20 minutes at 160 °F (71 °C), then rinse the grains with 1 gallon (3.8 L) of hot water. Collect 6 gallons (23 L) of wort and pumpkin puree in the kettle and add the liquid and dried malt extract off the heat. Stir until all the extract has dissolved. Bring the wort to a boil for 60 minutes adding hops, pumpkin puree and cinnamon at the times indicated in the recipe. Now follow the remainder of the all-grain recipe.

CLONE RECIPES

Weyerbacher Brewing Co. Imperial Pumpkin Ale clone
(5 gallons/19 L, all-grain)
OG = 1.080 FG = 1.019
IBU = 21 SRM = 13 ABV = 8%

Ingredients
7.6 lbs. (3.5 kg) Muntons pale ale malt (2.5 °L)
5.25 lbs. (2.4 kg) Weyermann Vienna malt (3.5 °L)
1.8 lbs. (0.8 kg) Weyermann Munich I malt (6 °L)
1.8 lbs. (0.8 kg) Weyermann CaraMunich® II (45 °L)
0.9 lbs. (0.4 kg) Weyermann CaraFoam® (2 °L)
6.3 AAU Apollo hop pellets (60 min.) (0.35 oz./10 g at 18% alpha acids)
1.6 lbs. (0.7 kg) pumpkin puree (10 min.)
0.38 oz. (10.6 g) Vietnamese ground cinnamon (2 min.)
0.2 oz. (5.7 g) ground nutmeg (2 min.)
1 pinch ground cardamom (2 min.)
1 pinch ground clove (2 min.)
Wyeast 1272 (American Ale II) or White Labs WLP051 (California Ale V) or Lallemand Nottingham ale yeast
Priming sugar (if bottling)

Step by Step
Heat 5.5 gallons (20.5 L) of strike water to achieve a stable mash temperature of 144 °F (62 °C). Hold at this temperature until starch conversion is complete, which is at least 60 minutes. Check for complete conversion using an iodine test before beginning the sparge phase.

Collect 6 gallons (23 L) of wort in the kettle and boil for 60 minutes adding hops at the beginning of the boil. Weyerbacher uses a high alpha acid hop variety to keep vegetal matter to a minimum considering the amount of pumpkin to follow. They do not use any aroma additions and therefore just let the spices define the aroma. Add the spices with 2 minutes left in the boil. The pumpkin puree is added directly into the kettle to avoid the stuck mash issue. This means that the yield will be affected downstream as more beer will be lost at each transfer point. Weyerbacher reports that they lose a significant amount of wort in the fermenter. Be careful not to add too much of either the cardamom or the clove as they can easily overwhelm the beer.

After the boil, give the wort a stir for at least a minute and let the hot wort settle for 15 minutes total. Chill the wort to 68 °F (20 °C) and maintain this temperature during active fermentation. If you can, ramp the temperature up to 72 °F (22 °C) at the end of active fermentation to assure completion. Rack the beer to a keg and force carbonate, or rack to a bottling bucket, add priming sugar, and bottle.

Weyerbacher Brewing Co. Imperial Pumpkin Ale clone
(5 gallons/19 L, extract with grains)
OG = 1.080 FG = 1.019
IBU = 21 SRM = 13 ABV = 8%

Ingredients
9.5 lbs. (4.3 kg) Munich liquid malt extract
1.8 lbs. (0.8 kg) Weyermann CaraMunich® II (45 °L)
0.9 lbs. (0.4 kg) Weyermann CaraFoam® (2 °L)
6.3 AAU Apollo hop pellets (60 min.) (0.35 oz./10 g at 18% alpha acids)
1.6 lbs. (0.7 kg) pumpkin puree (10 min.)
0.38 oz. (10.6 g) Vietnamese ground cinnamon (2 min.)
0.2 oz. (5.7 g) ground nutmeg (2 min.)
1 pinch ground cardamom (2 min.)
1 pinch ground clove (2 min.)
Wyeast 1272 (American Ale II) or White Labs WLP051 (California Ale V) or Lallemand Nottingham ale yeast
Priming sugar (if bottling)

Step by Step
Heat 1 gallon (3.8 L) of water to 170 °F (77 °C) and place the crushed grains in a brewing bag. Soak the grains for 20 minutes at 160 °F (71 °C), then rinse the grains with 1 gallon (3.8 L) of hot water. Do not squeeze the bag — let it drip into the kettle.

Collect 6 gallons (23 L) of wort in the kettle and add the liquid malt extract off the heat. Stir until all the extract has dissolved. Bring the wort to a boil for 60 minutes adding the hops at the beginning of the boil. Weyerbacher uses a high alpha acid hop variety to keep vegetal matter to a minimum considering the amount of pumpkin to follow. We do not use any aroma additions and therefore just let the spices define the aroma. Add the spices with 2 minutes left in the boil. The pumpkin puree is added directly into the kettle to avoid the stuck mash issue. This means that the yield will be affected downstream as more beer will be lost at each transfer point. Weyerbacher reports that they lose a significant amount of wort in the fermenter. Be careful not to add too much of either the cardamom or the clove as they can easily overwhelm the beer.

After the boil, give the wort a stir for at least a minute and let the hot wort settle for 15 minutes total. Chill the wort to 68 °F (20 °C) and maintain this temperature during active fermentation. If you can, ramp the temperature up to 72 °F (22 °C) at the end of active fermentation to assure completion. Rack the beer to a keg and force carbonate, or rack to a bottling bucket, add priming sugar, and bottle.

Smuttynose Brewing Co. Pumpkin Ale clone
(5 gallons/19 L, all-grain)

OG = 1.057 FG = 1.012
IBU = 35 SRM = 8 ABV = 6.1%

"This beer was designed to have some nice sweetness created by a mix of caramel malts and we wanted a decent hop presence as well. Over the years we've reduced the amount of cloves we've added as that one spice always seems to be the one to throw things out of balance. If I was brewing this at home I'd go easy on the clove and add more in later batches if needed."

~ David Yarrington
Brewmaster

Ingredients

10.75 lbs. (4.9 kg) 2-row pale malt
0.9 lbs. (0.41 kg) Hugh Bairds light Carastan malt (15 °L)
4 oz. (0.11 kg) crystal malt (60 °L)
4 oz. (0.11 kg) pumpkin puree
5.5 AAU Cascade hops (75 min.) (1 oz./28 g at 5.5% alpha acids)
4.1 AAU Cascade hops (10 min.) (0.75 oz./21 g at 5.5% alpha acids)
3.4 AAU Liberty hops (0 min.) (0.75 oz./21 g at 4.5% alpha acids)
0.14 oz. (4 g) ground cinnamon (0 min.)
0.14 oz. (4 g) ground nutmeg (0 min.)
1 pinch ground clove (0 min.)
Wyeast 1056 (American Ale) or White Labs WLP001 (California Ale) or Lallemand BRY-97 (American West Coast Beer) or Fermentis US-05 yeast
Priming sugar (if bottling)

Step by Step

Heat 4 gallons (15 L) of strike water to achieve a stable mash temperature of 155 °F (68 °C). Add the crushed grains and the pumpkin puree in the mash and hold at 155 °F (68 °C) until starch conversion is complete. Be sure to check for complete conversion using an iodine test before beginning the sparge phase.

Collect 6.25 gallons (24 L) of wort in the kettle and boil for 75 minutes, adding hops at the beginning of the boil and again with 10 minutes left in the boil. At flameout, add the final addition of hops and spices. Give the wort a stir for at least a minute and let the hot wort settle for 15 minutes total. Chill the wort rapidly to 68 °F (20 °C) and pitch the yeast. Maintain this temperature during active fermentation.

Rack the finished beer to a keg and force carbonate, or rack to a bottling bucket, add priming sugar, and bottle.

Smuttynose Brewing Co. Pumpkin Ale clone
(5 gallons/19 L, extract with grains)

OG = 1.057 FG = 1.012
IBU = 35 SRM = 8 ABV = 6.1%

Ingredients

5.75 lbs. (2.6 kg) extra light dried malt extract
0.9 lbs. (0.41 kg) Hugh Bairds light Carastan malt (15 °L)
4 oz. (0.11 kg) crystal malt (60 °L)
4 oz. (0.11 kg) pumpkin puree
5.5 AAU Cascade hops (75 min.) (1 oz./28 g at 5.5% alpha acids)
4.1 AAU Cascade hops (10 min.) (0.75 oz./21 g at 5.5% alpha acids)
3.4 AAU Liberty hops (0 min.) (0.75 oz./21 g at 4.5% alpha acids)
0.14 oz. (4 g) ground cinnamon (0 min.)
0.14 oz. (4 g) ground nutmeg (0 min.)
1 pinch ground clove (0 min.)
Wyeast 1056 (American Ale) or White Labs WLP001 (California Ale) or Lallemand BRY-97 (American West Coast Beer) or Fermentis US-05 yeast
Priming sugar (if bottling)

Step by Step

Heat 1 gallon (3.8 L) of water to 170 °F (77 °C) and place the crushed grains and the pumpkin puree in a brewing bag. Soak the grains and puree for 20 minutes at 160 °F (71 °C), then rinse the bag with 1 gallon (3.8 L) of hot water. Do not squeeze the brewing bag — allow it to drip back into the kettle.

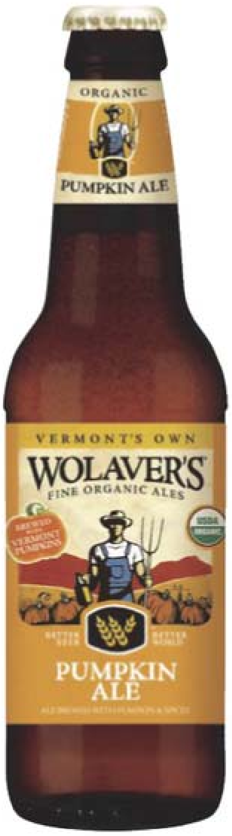
Top off the kettle to make 6.25 gallons (24 L) wort and boil for 75 minutes. Add the hops at the beginning of the boil and again with 10 minutes left in the boil. At flameout, add the final addition of hops and spices. Give the wort a stir for at least a minute and let the hot wort settle for 15 minutes total. Chill the wort rapidly to 68 °F (20 °C) and pitch the yeast. Maintain this temperature during active fermentation.

Rack the finished beer to a keg and force carbonate, or rack to a bottling bucket, add priming sugar, and bottle.

Tips for Success:

In the all-grain recipe, use 0.5 lb. to 1 lb. (0.23 to 0.45 kg) of rice hulls per 5-gallons (19-L) to prevent a slow or stuck sparge. You can also add a beta glucan rest at 122 °F (50 °C) for 15 minutes at the beginning of the mash.

CLONE RECIPES



Wolaver's Organic Brewing Pumpkin Ale clone

(5 gallons/19 L, all-grain)
OG = 1.057 FG = 1.016
IBU = 20 SRM = 9 ABV = 5.4%

"We source our pumpkins from a pumpkin grower just a few miles down the road. We are looking for a balance between malts, hops and a mild spice character."
~ Ryan McKeon
Brewery Production Manager

Ingredients

9 lbs. (4.1 kg) organic 2-row pale malt
2.5 lbs. (1.13 kg) organic Munich malt (10 °L)
10 oz. (0.27 kg) organic crystal malt (60 °L)
4 oz. (0.11 kg) organic pumpkin puree
2.2 AAU organic Perle hops (60 min.) (0.25 oz./78 g at 8.6% alpha acids)
3.4 AAU organic Perle hops (15 min.) (0.4 oz./11 g at 8.6% alpha acids)
3.4 AAU organic Perle hops (0 min.) (0.4 oz./11 g at 8.6% alpha acids)
0.14 oz. (4 g) ground cinnamon (0 min.)
0.14 oz. (4 g) ground ginger (0 min.)
0.05 oz. (1.4 g) ground nutmeg (0 min.)
0.05 oz. (1.4 g) ground cloves (0 min.)
Wyeast 1056 (American Ale) or White Labs WLP001 (California Ale) or Lallemand BRY-97 (American West Coast Beer) or Fermentis US-05 yeast
Priming sugar (if bottling)

Step by Step

Heat 3.75 gallons (14 L) of strike water to achieve a stable mash temperature of 154 °F (68 °C). Add the crushed grains and pumpkin puree in the mash and hold at 154 °F (68 °C) for 60 minutes, then ramp mash temperature up to 170 °F (77 °C) for mash out and hold for 5 minutes.

Collect 6 gallons (23 L) of wort in the kettle and boil for 60 minutes, adding hops at the beginning of the boil and again with 15 minutes left in the boil. At flameout, add the final addition of hops and spices. Give the wort a stir for at least a minute and let the hot wort settle for 15 minutes total.

Chill the wort rapidly to 68 °F (20 °C) and pitch the yeast. Maintain this temperature during active fermentation. Rack to a keg and force carbonate or rack to a bottling bucket, add priming sugar, and bottle.

Wolaver's Organic Brewing Pumpkin Ale clone

(5 gallons/19 L, extract with grains)
OG = 1.057 FG = 1.016
IBU = 20 SRM = 9 ABV = 5.4%

Ingredients

6.25 lbs. (2.8 kg) organic light liquid malt extract
2.5 lbs. (1.13 kg) organic Munich malt (10 °L)
10 oz. (0.27 kg) organic crystal malt (60 °L)
4 oz. (0.11 kg) organic pumpkin puree
2.2 AAU organic Perle hops (60 min.) (0.25 oz./78 g at 8.6% alpha acids)
3.4 AAU organic Perle hops (15 min.) (0.4 oz./11 g at 8.6% alpha acids)
3.4 AAU organic Perle hops (0 min.) (0.4 oz./11 g at 8.6% alpha acids)
0.14 oz. (4 g) ground cinnamon (0 min.)
0.14 oz. (4 g) ground ginger (0 min.)
0.05 oz. (1.4 g) ground nutmeg (0 min.)
0.05 oz. (1.4 g) ground cloves (0 min.)
pinch ground clove (0 min.)
Wyeast 1056 (American Ale) or White Labs WLP001 (California Ale) or Lallemand BRY-97 (American West Coast Beer) or Fermentis US-05 yeast
Priming sugar (if bottling)

Step by Step

Heat 1.5 gallons (5.7 L) water to 165 °F (74 °C) and place the crushed grains and pumpkin puree in a brewing bag. Soak the grains and puree for 40 minutes at 155 °F (68 °C), then rinse the bag with 1 gallon (3.8 L) of hot water. Do not squeeze the bag — allow it to drip back into the kettle.

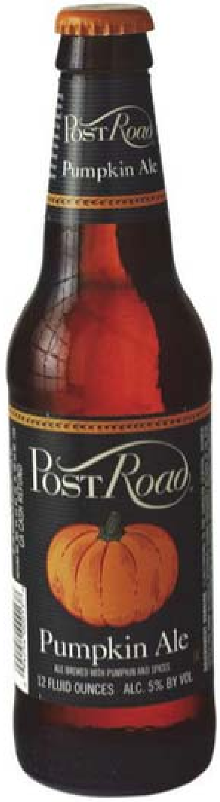
Top off kettle to 6 gallons (23 L) wort and boil for 60 minutes, adding hops at the beginning of the boil and again with 15 minutes left in the boil. At flameout, add the final addition of hops and spices. Give the wort a stir for at least a minute and let the hot wort settle for 15 minutes total.

Chill the wort rapidly to 68 °F (20 °C) and pitch the yeast. Maintain this temperature during active fermentation. Rack to a keg and force carbonate or rack to a bottling bucket, add priming sugar, and bottle.

Tips for Success:

In the all-grain recipe, use 0.5 lb. to 1 lb. (0.23 to 0.45 kg) of rice hulls per 5-gallons (19-L) to prevent a slow or stuck sparge. You can also add a beta glucan rest at 122 °F (50 °C) for 15 minutes at the beginning of the mash.

PUMPKIN BEER CLONE RECIPES



Brooklyn Brewery Post Road Pumpkin Ale clone

(5 gallons/19 L, all-grain)

OG = 1.055 FG = 1.013
IBU = 24 SRM = 10 ABV = 5.6%

Ingredients

9.75 lbs. (4.4 kg) North American 2-row pale malt
1 lb. (0.45 kg) British crystal malt (55 °L)
6 oz. (0.17 kg) Belgian biscuit malt (20 °L)
6 oz. (0.17 kg) Belgian aromatic malt (25 °L)
1.2 lbs. (0.54 kg) Dickinson pumpkins pureed
5 AAU US Fuggles hops (60 min.) (1 oz./28 g at 5% alpha acids)
1.3 AAU US Fuggles hops (15 min.) (0.25 oz./7 g at 5% alpha acids)
1.3 AAU Willamette hops (15 min.) (0.25 oz./7 g at 5.2% alpha acids)
0.2 oz. (6 g) ground cinnamon (0 min.)
0.2 oz. (6 g) ground ginger (0 min.)
0.1 oz. (3 g) ground nutmeg (0 min.)
Wyeast 1028 (London Ale) or White Labs WLP013 (London Ale) or Lallemand Nottingham yeast
Priming sugar (if bottling)

Step by Step

Heat 3.75 gallons (14 L) strike water to achieve a stable mash temperature of 158 °F (70 °C). Add crushed grains and pumpkin puree in the mash and hold at 158 °F (70 °C) for 60 minutes, then ramp mash temperature up to 170 °F (77 °C) for mash out and hold for 5 minutes.

Collect 6 gallons (23 L) wort in the kettle and boil for 60 minutes adding hops at the beginning of the boil and again with 15 minutes left in the boil. At flameout add the spices then give the wort a stir for at least a minute and let the hot wort settle for 15 minutes total. Chill the wort to 68 °F (20 °C) and maintain this temperature during active fermentation. Rack to a keg and force carbonate or rack to a bottling bucket, add priming sugar, and bottle.

Brooklyn Brewery Post Road Pumpkin Ale clone

(5 gallons/19 L, extract with grains)

OG = 1.055 FG = 1.013
IBU = 24 SRM = 10 ABV = 5.6%

Ingredients

6 lbs. (2.7 kg) extra light liquid malt extract
1 lb. (0.45 kg) North American 2-row pale malt
1 lb. (0.45 kg) British crystal malt (55 °L)
6 oz. (0.17 kg) Belgian biscuit malt (20 °L)
6 oz. (0.17 kg) Belgian aromatic malt (25 °L)
1.2 lbs. (0.54 kg) Dickinson pumpkins pureed
5 AAU US Fuggles hops (60 min.) (1 oz./28 g at 5% alpha acids)
1.3 AAU US Fuggles hops (15 min.) (0.25 oz./7 g at 5% alpha acids)
1.3 AAU Willamette hops (15 min.) (0.25 oz./7 g at 5.2% alpha acids)
0.2 oz. (6 g) ground cinnamon (0 min.)
0.2 oz. (6 g) ground ginger (0 min.)
0.1 oz. (3 g) ground nutmeg (0 min.)
Wyeast 1028 (London Ale) or White Labs WLP013 (London Ale) or Lallemand Nottingham yeast
Priming sugar (if bottling)

Step by Step

Heat 1.5 gallons (5.7 L) water to 170 °F (77 °C) and place crushed grains and pumpkin puree in a bag. Soak the grains and puree for 60 minutes at 158 °F (70 °C), then rinse the bag with 1 gallon (3.8 L) of hot water.

Top off kettle to 6 gallons (23 L) wort in the kettle and boil for 60 minutes adding hops at the beginning of the boil and again with 15 minutes left in the boil. At flameout, add the the spices then give the wort a stir for at least a minute and let the hot wort settle for 15 minutes total. Chill the wort to 68 °F (20 °C) and maintain this temperature during active fermentation. Rack to a keg and force carbonate or rack to a bottling bucket, add priming sugar, and bottle.

Tips for Success:

In the all-grain recipe, use 0.5 lb. to 1 lb. (0.23 to 0.45 kg) of rice hulls per 5-gallons (19-L) to prevent a slow or stuck sparge. You can also add a beta glucan rest at 122 °F (50 °C) for 15 minutes at the beginning of the mash.

nicely with the caramel notes and spice found in this beer. Wayne Wambles likes a clean, neutral yeast that is at least moderately malty in order to let the malts be the centerpiece of their base beer. Cantwell uses everything from *Brettanomyces*, to hefeweizen strains, to blends soured with *Lactobacillus*.

As for hops, keep them subtle and low key. "You are basically just looking to offset the malt sweetness" said Chris Wilson, from Easton, Pennsylvania based Weyerbacher Brewing Co. "You don't want the beer to be bitter or for the hop aromas to overpower the spice aromas, so we add all our hops at the beginning of the boil." Keeping the IBUs below 25 is the consensus among the brewers I polled. The one exception was Hampton, New Hampshire's Smuttynose Brewing Co. Brewmaster David Yarrington finds that, ". . . a bit of hop balance lets the drinker be aware they are still drinking a beer and not a dessert."

Pumpkins

Pumpkins can be the biggest headache involved in brewing a pompion beer as I discussed in my opening. They're high in sticky glucans and high in proteins and while they are not necessarily low in carbohydrates, it's a challenge to get any fermentable extract from pumpkin flesh because of a high water content. These traits are great for a healthy diet, but for brewers they pose a challenge since it necessitates a large addition of pumpkin pulp in order to get much sugar contribution. In fact, if you add one pound (0.45 kg) of pumpkin pulp, you'll get a modest boost of only about 0.005 to your starting gravity in a 5 gallon (19 L) batch.

For homebrewers, we have the option of roasting or boiling our own pumpkins to add into the beer. "If I was homebrewing, I'd roast up some real pumpkin meat with brown sugar" said David Yarrington of Smuttynose Brewing Co. Roasting the pumpkin can caramelize the sugars available and provide some character. Roast a pumpkin for one hour at 350 °F (177 °C) or until some browning appears and the entire pulp is soft, but not mushy. The timing of the roast will depend largely on the size of the pumpkins and will require you to monitor them to test for the right level.

So what pumpkins should you use? Again there is not much consensus here, but brewers that are using whole pumpkins instead of puree look for high-fiber varietals. I've always used pie pumpkins with the idea that they are more flavorful and contain more sugar than the larger pumpkins, but they also contain less fiber and will be more difficult to deal with in the mash.

A looming question though is when and how do we add the pumpkin to the beer? Mash, boil or fermenter? Since there is starch that can be converted to sugars, traditionally brewers have added the pumpkin to the mash to get conversion. But when the result is at best 0.005 additional points per pound, is adding all those gums to the mash really worth it? I found that while all the brewers I talked to added pumpkin in some form or other, there is no standard of when to add it. Some added it to the mash, some to the kettle, some to the fermenter; and in the case of Elysian Brewing Co., all three. Many brewers were just looking to get the classic carotene color from the pumpkins since pumpkins can add a slightly sour, astringent note. Most brewers normally shy away from adding an ingredient like this, but these are obviously not your ordinary brews.

There are plenty of ways to offset the gummy character the pumpkin provides if you plan to add the pumpkin to the mash. First is adding rice hulls, which helps break up the mash and create more pores in the sludge. Half a pound to a pound (0.23 to 0.45 kg) of rice hulls per 5-gallon (19-L) batch can be worth its weight in gold. Adding in a beta glucan rest at 122 °F (50 °C) for 15 minutes to help break those gums down is another helpful trick. Another tip is if you're fly sparging, constantly rake the top of the mash as the gums rise to the top of the mash.

One thing the pros agreed upon is that the pumpkin addition doesn't always seem to make or break the end product. The brewers I talked to were using between 0.5 lbs. (0.23 kg) pumpkin puree per barrel of wort and ranging up to 10 lbs. (4.5 kg) per barrel. Smuttynose adds on the lower end of the range while Weyerbacher Brewing adds on the higher end. Cigar City adds caramelized pumpkin puree to the fermenter while Brooklyn Brewery adds pumpkins to the mash. When I asked Garrett Oliver from Brooklyn Brewery how often they get a stuck sparge, he said, "never." A protein rest plus proper mash out has worked for them despite the fact that their mash grist for Post Road Pumpkin Ale is about 10% pumpkin puree.

Spices

Finally we get to what may be the most controversial aspect of pumpkin beers: Spices. While some of you may want the golden ticket answer in this category, the fact is there is no one right answer as everyone has their own opinions on the subject. (See "Tips from the Pros" on pg. 13 for more brewer opinions). The best I can offer are suggestions of how to find the right mix to suit your own tastes. Traditional pumpkin pie spices rule the roost in the modern pumpkin beer world. Cinnamon, nutmeg, ginger, cloves, as well as allspice and vanilla, tend to dominate pumpkin beers. Many spice makers produce a pumpkin pie spice blend that can be a good starting point for homebrewers as well. Adjuncts such as brown sugar, molasses, maple syrup, and honey will also add some flavor into the mix. "Balancing the beer without overwhelming any singular aspect is our main goal. You should be able to pick up spice, the pumpkin, and the beer when you taste our pumpkin ale," said Ryan McKeon, Brewery Production Manager at Otter Creek Brewing Co. in Middlebury, Vermont (which brews the Wolaver's line of beers).

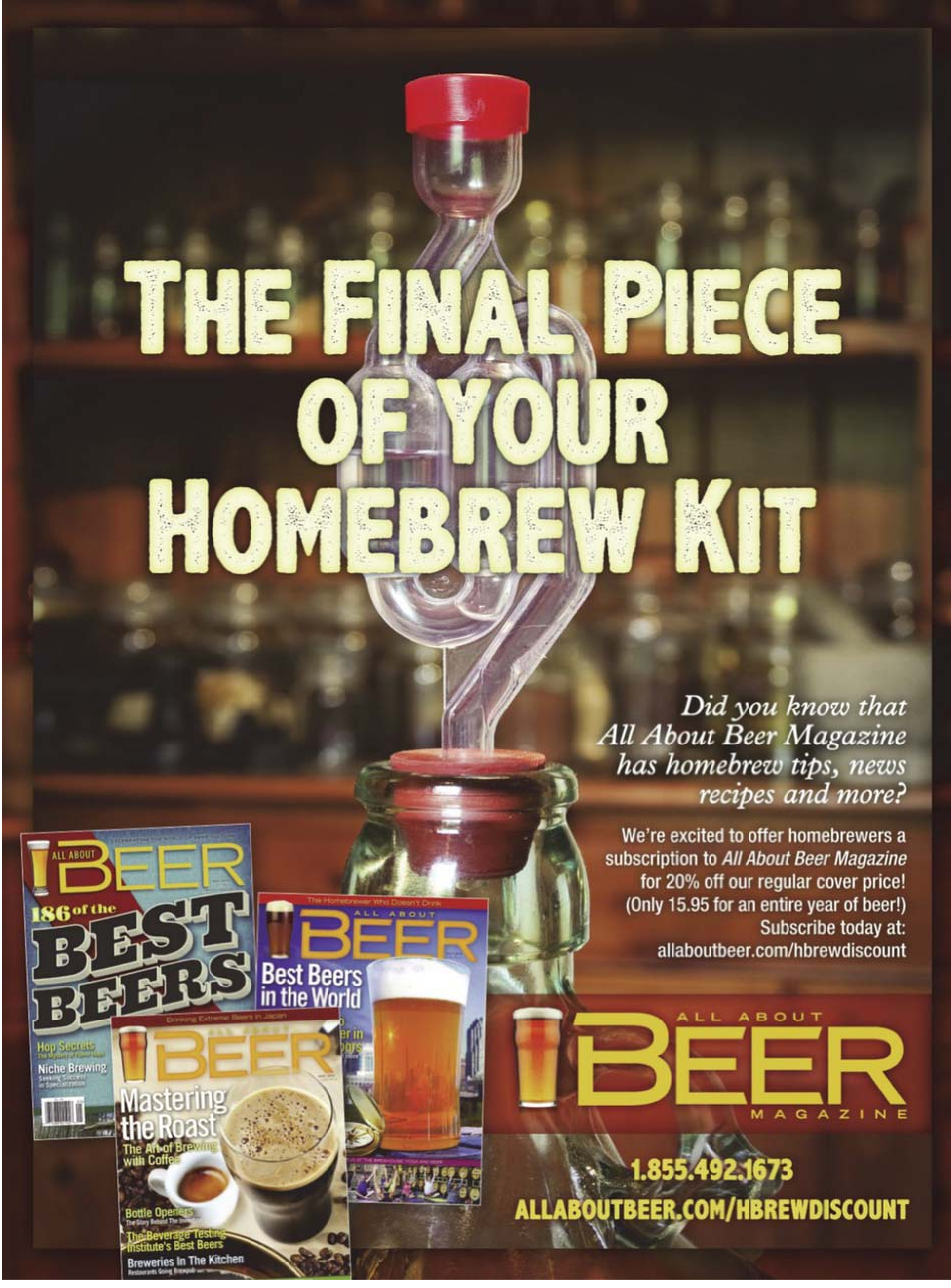
Everyone seems to have his or her own preference for what level of spicing is proper for a pumpkin ale. But if you're going for a higher spice level in order to obtain a pumpkin pie in a glass experience, you'll want to boost not only the final gravity of your base beer to increase the sweetness, but also boost the ABV so the ethanol can help balance the flavors. Ryan McKeon's advice is to, "Make sure the base beer does not get lost. If you boost the spices, be sure to ramp up the base beer to keep a balance."

Timing of the spice additions is very similar to timing of aroma hops additions. Many brewers try to keep the spice additions to very late in the boil or directly into the whirlpool on brew day. Something to consider is that if you can smell the aromas of the spices, the volatile oils are being driven off. Chris Wilson from Weyerbacher adds the spices with 2 minutes left in the boil in order to sanitize the spices, but not drive off much flavor and aroma. "We do get some of the spice into the fermenter which we find does not impact the final product," he said.

Other brewers put the spices into the fermenter, much like dry hopping, with the idea that this will keep the most volatile oils in the beer. What I've done for years now is make tinctures from the spice additions. I originally learned of making tinctures from Randy Mosher in *Radical Brewing*. I make tinctures by soaking my spices in cheap vodka for about a week. The technique is fully outlined in Randy Mosher's book, but the basics are that by using an eyedropper in a one ounce pour of the beer, you can scale the tincture up to your full batch size and add the correct level of the tincture just before bottling or kegging. If you feel like tinctures are too much of a hassle, you can start off trying one of the clone recipes in this story, starting on page 58, to get your feet wet. If your beer has too little or too much of a certain spice, make the necessary adjustments for the next batch. If you do decide to experiment with spices, be sure to err on the side of caution. You can always add more, but you can't take the spice out.

Pour your Pumpkin Beers

Pumpkin beers have come a long way since the days of Colonial America. My second pumpkin beer turned out to be a huge success despite the hair pulling on brew day. I'll always remember that batch since it was my first "extreme" beer that had gone right. Best of luck in crafting a pompion beer of your own! BYO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Story and photos by **Ryan Thomas**

OPERATION **STRAIN:**

A Colorado Homebrew Club Experiments with Yeast

I have been a member of the Keg Ran Out Club (KROC) in Broomfield, Colorado for about eight years, and during that time I've seen my batch size increase five-fold, to 25 gallons (95 L) post boil. One day while homebrewing it occurred to me that I could work with my homebrew club at that volume to try some parallel experiments. I decided that supplying 10 people with 2 gallons (7.6 L) each of wort would be a nice group size to work with. Being a post-boil split, a yeast experiment was a prime candidate: At that volume a single vial of yeast would supply about the perfect pitch rate without requiring a yeast starter, and variations in experimental parameters could be fairly easily controlled or eliminated. I'd been focusing on brewing German Pilsner at the time, and was experimenting with a few different yeast strains. I thought that a group experiment like this would be great for sharing the work to be done in finding the perfect strain.

We did our yeast project shortly after our Great American Beer Challenge homebrew competition, hosted annually at Arvada Beer Company by owners and award-winning brewers Cary and Kelly Floyd, who are also long-standing KROC members and huge supporters of the club. They volunteered to let us brew in their brewhouse with their pilot system kettle, a 55-gallon (208-L) Boilermaker, which would allow us to double the participant slots available.

We recruited 12 homebrewers from the club willing to do 16 different batches. Each requested or was assigned a strain within their temperature control ability. White Labs provided vials of the requested strains, all freshly packaged about a week earlier.

Methodology

On brew day we did two parallel mashes using my two 27-gallon (102-L) stainless kettles. We targeted and achieved a low mash temperature of 150 °F (66 °C), which was intended to enhance fermentability and accentuate the differences in attenuation among strains. Our grain bill was entirely Pils malt, and I treated the liquor with gypsum and calcium chloride to promote the hop bitterness and to provide sufficient calcium for healthy fermentation. After a mash-out infusion and some recirculation we proceeded to sparge and lauter, collecting 41 gallons (155 L) of hot sweet liquor. We began the 90-minute boil with a 40-IBU charge of Magnum hops for bitterness and in the last few minutes we added two pounds of Noble hops: A mix of Hallertau Hersbrucker and Spalt. After a quick gravity check (1.046 S.G.) we whirlpooled for 20 minutes, then counterflow chilled the wort to 55 °F (13 °C), infused with inline oxygen, and drained into 16 carboys. Each brewer then headed home to stash the wort under temperature control until it reached the assigned fermentation temperature (see the recipe on page 70).

Each brewer was assigned an optimum fermentation temperature for his or her strain, generally 52 °F (11 °C) for lager yeasts and 68 °F (20 °C) for ale. They were instructed to chill the wort to their respective temperature and then shake the carboy vigorously for two minutes. After aeration they were to sanitize the yeast vial, agitate and pitch, then leave the carboy alone until fermentation signs subsided. Once activity slowed, each brewer brought their batch(es) up to a diacetyl rest for two days at several degrees above fermentation temperature, then chilled slowly back to fermentation temperature until they were ready to bottle. Each batch of wort came with a measured dose of bottling sugar for the 2-gallon (7.6-L) batch. All brews were bottled within a few day span, bottle conditioned for at least a week, then chilled. Total time from brew day until the meeting was 28 days, quick for the lagers, but aided by the relatively high pitch rate and initial oxygen levels.

At the club meeting, I randomly assigned members into three sampling groups. Each judge received a form with spots for 16 beers, on which to rate each on a 0–10 scale based on eight different attributes: Malt intensity, hop intensity, bitterness, body, sweetness, esters, phenols, sulfur, diacetyl and acetaldehyde. The samples were presented with a blind judging number, and the presentation order varied among the sample groups. The first two samples for each group were the "classic" German Lager and Southern German Lager strains, which were intended to establish a baseline. Each group completed quick evaluations of all 16 beers in approximately 20–25 minutes, which I collected for some number crunching and analysis.

I had my work cut out for me. I wanted to produce spider plots based on the average ratings, but found that my data was widely varied. Some people rated every attribute between 0 and 3, while others had attributes such as diacetyl or phenols in the 4–8 range across each beer — apparently my samplers had done some "sampling" of their own at the meeting prior to the experimental tasting. I decided to leave the personal ranges unmodified, which seemed justified based on the graphs produced, and applied a few techniques to crunch the data, mainly weighting each group based on sample order (being a bitter and hoppy beer it affected taste thresholds considerably over the course of several samples).

I then enlisted the aid of Greg Toothaker and John Allison, BJCP National Judges; Don Blake and David Lytton, Masters; and also sat in myself (BJCP Grand Master). We gathered about a month after the tasting at the club meeting and utilized a "best of show" type setup where each of the samples was presented side by side. Strain names were provided. The beers had had a bit more time to

The members of the Keg Ran Out Club (KROC) brewed 16 small batches of German Pils using the same wort but pitched with 16 different strains of White Labs brewer's yeast.

mature and cold-age, and some flavor changes were noted. Having frequently worked together before, we quickly determined a consensus opinion for each beer, noting the high and low points and how well it fit the German Pils style. After discussion we started eliminating beers until we had a few standouts, then rank-ordered the remaining beers until we had our "best of show (BOS.)"

In the data that follows, I've gatherd the distilled notes provided by the experienced judging panel. The assigned fermentation temperature, measured terminal gravity, and the rank in the "German Pils BOS" are also shown. One strain (San Francisco Lager) was assigned at both 58 and 65 °F (14 and 18 °C). The Cry Havoc strain was also done at 65 °F (18 °C) by the same brewer as the high-temperature SF Lager; unfortunately both of these batches suffered a strong lightstrike flavor and aroma defect and were not included in the final results. I also created a spider plot graph for each strain from the quantitative sampling at the club meeting, which you can see at http://byo.com/story3123.

Mexican Lager - WLP940

Temp: 52 °F (11 °C) F.G.: 1.006
BOS Rank: 1

The Mexican Lager strain was the favorite of the judges. It presented as very clean, with a strong but pleasant bitter character and a crisp finish. The hop flavor also came through best with this strain when compared side-by-side with others.

German Lager - WLP830

Temp: 52 °F (11 °C) F.G.: 1.010
BOS Rank: 2

This was the first beer presented at the quantitative evaluation session. The judges found it to be very true to style, but less crisp and with a sharper bitterness than other samples. Hop character came through well, but carried some astringency not found in the other samples.

Southern German Lager - WLP838

Temp: 52 °F (11 °C) F.G.: 1.008

BOS Rank: 3

The judges found this to be more malt forward than WLP830, providing a better balance with the hops. The bitterness was not harsh or astringent, and the finish was crisper. Some esters were noted, along with a light "yeasty" character. This was the favorite when re-tasted with the brewers at Arvada Beer Company.

American Lager - WLP840

Temp: 52 °F (11 °C) F.G.: 1.003
BOS Rank: 4

A definite alcohol note was detected by the judges in this sample, and acetaldehyde/green apple was also present, though it wasn't noted at the earlier tasting. The malt presented as more toasty than in other samples, and the bitterness lingered longer.

San Francisco Lager - WLP810

Temp: 58 °F (14 °C) F.G.: 1.010
BOS Rank: 5

The judges found this to be reasonably close to the classic German strains. Very light diacetyl and acetaldehyde were detected, as well as a slightly higher level of esters than the classics. The malt presented as very mild, and the finish was not as crisp.

German Bock Lager - WLP833

Temp: 52 °F (11 °C) F.G.: 1.010
BOS Rank: 6

The Bock strain seemed to greatly mute the hop intensity and bitterness, and therefore was judged to be very malt forward. There was also a bit of diacetyl reminiscent of butterscotch or caramel, and the finish was noted as sweeter and less crisp than the more traditional Pilsner strains.

Pilsner Lager - WLP800

Temp: 52 °F (11 °C) F.G.: 1.010
BOS Rank: 7

Our second Czech strain produced an overall mild beer that exhibited a lower level of malt and bitterness than the classic German strains. The malt presented a grainy, bready character. There was a low level of corn-like, almost vegetal, DMS. The beer was

KROC Yeast Experiment Recipe

KROC German Pils

(5 gallons/19 L, all-grain)

OG = 1.046 FG = 1.003-1.015
(strain dependent)
IBU = 50 SRM = 3 ABV = 4.1-5.7%
(strain dependent)

Ingredients

9.5 lbs. (4.3 kg) continental Pilsner malt (2 °L)
9.6 AAU Magnum pellet hops (90 min.) (1 oz./28 g at 9.6% alpha acids)
6.8 AAU Hersbrucker pellet hops (5–0 min.) (2.25 oz./64 g at 3% alpha acids)
10.8 AAU Spalt pellet hops (5-0 min.) (2.25 oz./64 g at 4.8% alpha acids)
Yeast strain of choice
Priming sugar (if bottling)

Step by Step

We pre-treated our strike water with 0.9 grams/gallon gypsum and 0.6 grams/gallon calcium chloride to promote a healthy fermentation and hop bitterness. Heat 3.5 gallons (13 L) to achieve a stable mash temperature at 150 °F (66 °C). Hold at this temperature until starch conversion is complete. Sparge 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 90 minutes adding the Magnum hops at the very beginning of the boil. Mix all the Spalt and Hersbrucker hops together and start to add slowly with 5 minutes remaining in the boil. Space the addition out over the final 5 minutes.

Whirlpool the wort for 20 minutes then chill the wort to desired fermentation temperature and aerate thoroughly. Pitch the yeast of your choice and ferment at recommended temperature, about 52 °F (11 °C) for bottom fermenting yeast and 68 °F (20 °C) for top fermenting yeast. If using a bottom fermenting yeast, once active fermentation is complete, bring the beer up to diacetyl rest for two days, then slowly chill back to lagering temperature. After proper lagering time (about one month), 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.

KROC German Pils

(5 gallons/19 L, extract only)

OG = 1.046 FG = 1.003-1.015
(strain dependent)
IBU = 50 SRM = 4 ABV = 4.1-5.7%
(strain dependent)

Ingredients

5.1 lbs. (2.3 kg) Pilsen dried malt extract (2 °L)
10.6 AAU Magnum pellet hops (60 min.) (1.1 oz./31 g at 9.6% alpha acids)
6.8 AAU Hersbrucker pellet hops (5–0 min.) (2.25 oz./64 g at 3% alpha acids)
10.8 AAU Spalt pellet hops (5–0 min.) (2.25 oz./64 g at 4.8% alpha acids)
Yeast strain of choice
Priming sugar (if bottling)

Step by Step

We pre-treat our strike water with 0.9 grams/gallon gypsum and 0.6 grams/gallon calcium chloride to promote a healthy fermentation and hop bitterness. Bring 6 gallons (23 L) of water up to a boil. Remove from heat and add dried malt extract. Bring back to a boil. The total wort boil time is 60 minutes adding the Magnum hops at the very beginning of the boil. Mix all the Spalt and Hersbrucker hops together and start to add slowly with 5 minutes remaining in the boil. Space the addition out over the final 5 minutes.

Whirlpool the wort for 20 minutes then quickly chill the wort to desired fermentation temperature and aerate thoroughly. Pitch the yeast of your choice and ferment at recommended temperature, about 52 °F (11 °C) for bottom fermenting yeast and 68 °F (20 °C) for top fermenting yeast. If using a bottom fermenting yeast, once active fermentation is complete, bring the beer up to diacetyl rest for two days, then slowly chill back to lagering temperature. Now follow the remainder of the all-grain recipe (to the left).

noted as particularly clear in appearance compared to the others.

Czech Budejovice Lager - WLP802

Temp: 52 °F (11 °C) F.G.: 1.005
BOS Rank: 8

The judges found fairly strong diacetyl as the main detraction for this strain, and also some acetaldehyde as the samples warmed. The diacetyl was not as noticeable in the earlier tasting. The bitterness was lower and smoother than the classic German strains, the color was also noted as darker, and the perceived finish sweeter.

German Ale/Kölsch - WLP029

Temp: 68 °F (20 °C) F.G.: 1.006
BOS Rank: 9

The judges found this beer to lack the traditional light ester profile of a Kölsch, which kept it in line with the German Pils style. Malt was soft and subdued, with a yeasty/bready character. Light acetaldehyde was noted, as well as low sulfur and some acidity. The hop flavor was light, and bitterness lingered well into the aftertaste.

San Diego Super Yeast - WLP090

Temp: 68 °F (20 °C) F.G.: 1.009
BOS Rank: 10

A light butterscotch-like aroma was noted, as well as some sulfur. The bitterness seemed to be intensified almost to the point of harshness, while the hop flavor and aroma were subdued in comparison to other strains.

Cream Ale Blend - WLP080

Temp: 68 °F (20 °C) F.G.: 1.004
BOS Rank: 11

The judges found this to be quite clean, with only very low esters. Judges noted it as smooth and creamy, but lacking any character from the Pils malt. The finish was perceived as somewhat sweet despite the low final gravity. Hop flavor, aroma, and bitterness were quite subdued.

California Ale - WLP001

Temp: 68 °F (20 °C) F.G.: 1.009
BOS Rank: 12

This strain presented with some clove-like phenols and moderate esters. The bitterness was long lasting and somewhat harsh. The body was relatively thick, and lacked the crispness associated with the style. Not a good substitute for a clean lager yeast.

Zurich Lager - WLP885
Temp: 52 °F (11 °C) F.G.: 1.005
BOS Rank: 13

This strain produced a beer that was definitely not in style for a German Pils. A moderate spicy phenol was present in both aroma and flavor, though it fell short of more Belgian style qualities due to a lack of esters. The malt character was noted as particularly toasty.

Trappist Ale - WLP500
Temp: 68 °F (20 °C) F.G.: 1.006
BOS Rank: 14

This yeast exhibited a more traditional Belgian profile with clove and vanilla phenols, and esters of banana and bubblegum. Hops and malt were both low, and the bitterness did not linger into the finish. There was a perception of alcohol in the aroma and flavor. The beer was quite tasty, but certainly not a German Pils.

Conclusions

The experiment definitely demonstrated the huge impact that yeast strain has on the finished beer. Everything from intensity, character, and balance of the malt and hops, to the color of the beer is subtly or strongly influenced by the yeast.

Of particular note:

The Bock strain's ability to make malty bock-like beer even from hoppy wort. The Trappist and Cream Ale strains showed similar effects for their respective styles.

The Czech strain's diacetyl production, which tracks with the acceptability of low levels in the Bohemian style Pilsner.

The Mexican and American strains' overall profiles point to potential German origin, consistent with the influx of German brewers into Mexico and the United States during the late 1800s.

The San Diego Super Yeast's ability to emphasize bitterness but reduce hop flavor and aroma.

Final gravity readings varied from 1.003 to 1.015 S.G.

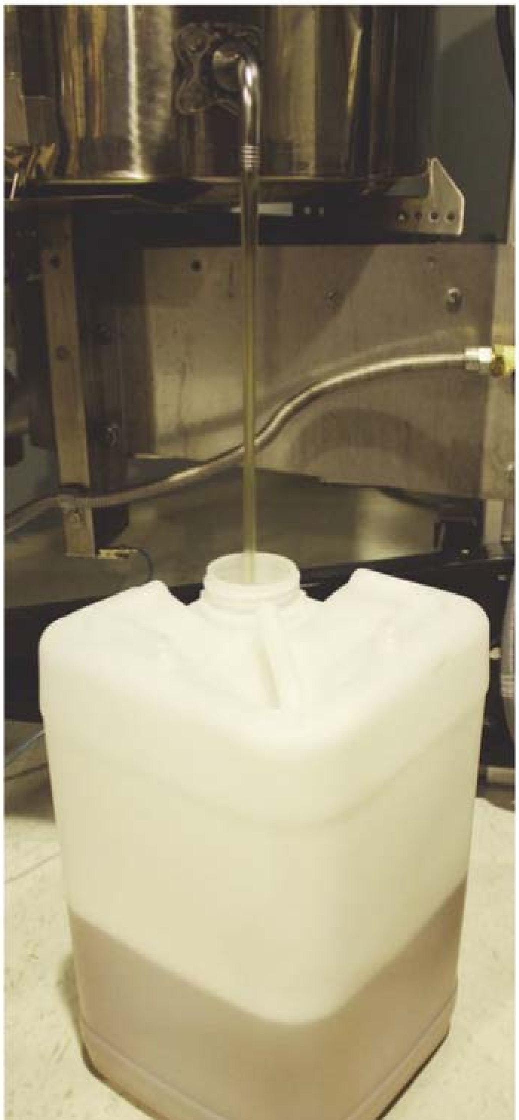
None of the ale strains were able to produce a convincing lager.

A month of lagering in the bottle between judging sessions served to change the profile to varying degrees. Some beers that were high in diacetyl or acetaldehyde were much more pleasant after aging, though some were found to have changed for the worse.

I'd like to thank the brewers of the Keg Ran Out Club for participating, as well as John Carroll and White Labs, my all-star BJCP judge team, and Cary and Kelly Floyd of Arvada Beer Company for supporting this enlightening experiment.

NO-chill brewing

save time and water on brew day



As the name suggests, no-chill brewing is the simple process of skipping the chilling step of homebrewing.

by **Dave Louw**

THE LAST YEAR has had its ups and downs for me on California's Central Coast. On the positive side a healthy new son joined our family, our first child. On the negative side rainfall has been scarce and we're racking up yet another year of exceptional drought. The combination of the two means that I've been looking for ways to save both time and water on brew days.

As readers of my earlier article "Speeding Up Your All-Grain Day" in the March/April 2012 issue of *Brew Your Own* will remember, shortening your brew day is primarily an exercise in shortening or eliminating as many steps as possible from your critical path. One of the longest such tasks on brew day is chilling your wort from boiling down to yeast pitching temperature.

Depending on your chilling equipment, technique, batch size, and ground water temperature, chilling can take anywhere from 15–45 minutes. If you're running tap water through the chiller this can then waste as much as five times as much water as a typical shower. Industrious homebrewers may either capture this runoff in large storage containers or divert it to landscaping uses once it's cool enough to avoid scalding plants. I've tried both methods and found they provide more hassle than I want to add to my brew day. Furthermore, neither method addressed the time savings I was looking to achieve.

It was then that I started considering a technique I'd heard about that ran counter to much of the common homebrewing wisdom but nonetheless met my needs: No-chill brewing. Like so many aspects of brewing history, be it homebrew or commercial, it's difficult to determine the definitive origin of the practice. What is clear is that no-chill brewing came to prominence in the Australian homebrewing scene where water is scarce and conventions are often flouted. This may have been have been further encouraged by the practice of Australian

> "Once the wort is at or near room temperature (usually about 8–12 hours later) transfer to your fermenter, aerate, and pitch as usual. If you are fermenting in a temperature-controlled space you can of course use that to get the wort right to your pitching temperature after the transfer."

brewers selling "cubes" of unfermented wort for customers to ferment at home.

No-Chill Brewing

Much like no-sparge brewing, no-chill brewing is defined by what is left out rather than what it includes. As the name suggests, the step of actively chilling the wort is skipped. At the end of the boil you simply turn off the flame, let the wort cool to just off boiling, drain it into a cleaned and sanitized heat-safe container, seal it up, and let it cool with the ambient air temperature over time.

Once the wort is at or near room temperature (usually about 8-12 hours later) transfer to your fermentor, aerate, and pitch as usual. If you are fermenting in a temperature-controlled space you can of course use that to get the wort right to your pitching temperature after the transfer.

That's all there is to it. As I said, it's more about what you don't do than any special procedure.

From my experience and research into others' practices there are a few tips that can help:

- If possible squeeze all the excess air out of your containers. Air expands and contracts much more dramatically with temperature and so could result in some excess bulging or shrinking that deforms the container. Also, minimizing oxygen contact in this unpitched wort will decrease the potential for oxidation issues down the line.
- Make sure you place the filled container on a surface that can handle the high wort temperatures.
- Be extremely careful when transferring the hot wort as it can easily burn your skin.
- If using a hose to transfer the near boiling wort, make sure it's made of a material that can handle the high temperatures. Regular PVC hose will leech chemicals and melt. Silicone is an excellent choice. The same is true of the wort container (read on). One note about silicone hose is that this material is normally not rated for much pressure when used with hot liquids. This is important for brewers who use pumps or gas pressure to help move hot wort. Teflon hose is another good choice.

Another variation of this approach is to simply leave the boiled wort in the brew kettle and seal it from outside contamination with something like a layer of aluminum foil while it cools.

Benefits

In addition to the obvious savings of reduced water usage, I realized several other benefits to my brewing when using the no-chill method.

First, I no longer needed to set up a pump and whirlpool immersion chiller in preparation for flame-out. That also meant I didn't have to clean either of these items. I didn't have to set up and eventually coil up my garden hoses either.

One of the most important rules for practicing no-chill brewing is to use a container that is food-safe for near-boiling liquid.

Second, I could remove a 20+ minute step from the critical path of my brew day. While the beer was chilling I was always twiddling my thumbs because all the vessels from earlier in the brew day were already cleaned and put away during the boil. Transferring sooner meant I could get to cleaning the brew kettle sooner.

Third, since the wort was all sealed up and sanitized I had a lot more flexibility on exactly when I'd pitch my yeast and so could more easily work around family obligations. I'll get into timing a bit later in the article but there really shouldn't be any concerns with waiting a day or two before pitching.

For a beginning brewer no-chill could simplify the brew day and significantly decrease the cost of moving to full wort boils. A properly sized copper immersion or counterflow chiller is one of the most expensive pieces of brew day equipment.

Thinking beyond the common brew day, no-chill would also work really well for large club brews or camping where water sources are a bit more limited.

Containers

Let me say right away that not all containers are suitable for receiving hot wort. On the top of that list are glass carboys as they aren't made from a type of glass (such as borosilicate) that can handle large temperature changes. You will crack your glass carboy if you try to fill it with near-boiling wort.

Next on the list of problematic materials is PET, such as the material used in BetterBottles®. PET is only food safe up to about 120 °F (49 °C) and will shrink up and release chemicals at higher temperatures.

Beyond those two you should check with the manufacturer on any plastic container you want to use to ensure it's food safe and resilient up to boiling temperatures.

Good choices for containers include anything stainless such as kegs or conicals, as well as plastic containers designed to receive high temperature foods. Two examples of the latter are the Winpack® tight head pails and HDPE carboys that are FDA approved.

These can be found at the following links from US Plastics, a supplier to the food industry:

- 5-gallon (19-L) Blue Winpak® Tight Head Pail: http://www.usplastic.com/catalog/item.aspx?sku=75033
- 2.5-gallon (9.5-L) Square Poly Carboy: http://www.usplastic.com/catalog/item.aspx?sku=74093

I particularly like the 2.5-gallon (9.5-L) square poly carboys because they are easy to stack and maneuver around when full since they weigh much less than a full 5-gallon (19-L) batch. You may be able to source similar containers locally to avoid shipping costs. Just make sure that they are designed to safely store food at near-boiling temperatures.

Possible Issues

When people first hear of this technique they have several concerns because of the justification they've heard for quickly chilling and pitching beer. I'll cover these in decreasing order of importance.

Botulism

Let's hit this right up front. The process of no-chill brewing is similar to hot-packing for canning to preserve foods. To safely store foods that have a pH above 4.6, such as wort, the US Department of Agriculture recommends using a pressure cooker to process your containers at 240 °F to 250 °F (116 to 121 °C) for a number of minutes depending on the food type and container size. This is required to ensure that all spores of *Clostridium botulinum* are killed.

Literature on the actual risk of botulism poisoning from stored wort is sparse, and while the risk is low, botulism can be fatal so it is important to explore the risk. The history of botulism falls into two primary groups. The first is with foods that contain bot spores that are then processed in a way that leads to vegetative cell growth, followed by sporulation. This is when bot toxin is released. Canned vegetables and pickled olives are two examples of this. The second major grouping is

"One reason to pitch your yeast quickly is so that undesirable contaminating yeast and bacteria don't have a chance to get a foothold in your wort and affect the flavor."

when foods that do not have bot spores are processed and then contaminated post processing. There was a famous incident with canned salmon where the source of the bot spores was the cooling water used to cool the cans after processing. Leaky can seams caused water to be sucked into the cans after processing and the anaerobic environment lead to cell growth.

The key thing to know about *C. botulinum* is that is an anaerobic organism and that bot toxin is not produced when the cells are in an aerobic environment. Boiled wort is not an anaerobic environment, even before wort aeration. Chris Colby has an excellent discussion of this topic in depth on his blog at http://beerandwinejournal.com/botulism/.

Recommendation: Pitch your yeast promptly rather than store the wort for extended periods of time.

Contamination

One reason to pitch your yeast quickly is so that undesirable contaminating yeast and bacteria don't have a chance to get a foothold in your wort and affect the flavor. It is not feasible to produce completely sterile wort and transfer it to a sterile fermenter without picking up at least some minuscule amount of yeast and bacteria.

Recommendation: Ensure your cooling containers are clean and sanitized. That in combination with pasteurization from the extended contact with hot wort means the risk is actually quite low.

Bitterness

An area of significant recent discussion in the homebrewing world is the effects of late hop additions on the bitterness of a beer. For example, a flame out addition to wort that is then chilled very quickly contributes little bitterness. On the other hand hops added to a wort that is going to spend 30 minutes in a hot whirlpool can contribute significant bitterness. At play here is the fact that alpha acid from hops continues to isomerize even when the wort isn't boiling.

I have not been able to track down any reliable calculations for the impact of late additions with respect to no-chill brewing. As it's unlikely commercial brewers will adopt this practice any time soon, the homebrewing community is going to have to come up with ways of quantifying this as this becomes more popular. Until that time it will largely be trial and error.

Recommendation: Consider dialing back quantities of late hop additions if they normally would have had little time to isomerize and contribute to bitterness. Alternatively, consider lower alpha hops for late additions to minimize the impact.

Dimethyl Sulfide (DMS)

The presence of DMS can cause an off flavor or aroma reminiscent of cooked

Top: PET carboys, such as BetterBottle®, are only food safe up to about 120 °F (49 °C). When practicing no-chill, choose a container such as a stainless steel keg or container, or plastic containers that are food safe under high heat, such as Winpack® tight head pails and HDPE carboys that are FDA approved. When your wort has cooled, you can transfer it to your PET carboy (pictured) and ferment as usual.

Bottom: Pitch your yeast quickly so that you can avoid contaminating your wort with bacteria or yeast. No matter how well you sanitize your container (as pictured), it is not possible to be completely sterile.

corn or vegetables in a beer. One common source is the conversion of the precursor substance S-Methyl Methionine (SMM) at high temperatures. DMS is driven out of the wort by a vigorous boil but once the boil stops there is a period of time when SMM can continue to convert to DMS in the hot wort and carry over to the finished beer.

While this is an often-theorized shortcoming of no-chill brewing, in my experience and research I haven't found it to be a common problem. This is likely because at a homebrew scale the conversion of SMM to DMS and the off gassing during a vigorous boil means that there is little precursor left to cause problems during the extended cooling.

Recommendation: Use 60-minute boils for most grain bills and 90-minute boils for very lightly kilned base malts that have high levels of the SMM precursor.

Clarity

A commonly stated reason for quickly chilling wort is to get a strong "cold break" where proteins flocculate and precipitate out of the wort. What is unclear is whether a similar process is at work with a slower chill over a longer period of time. Those who hear about this technique often cite this reasoning as a concern, but I've been unable to track down cases where this panned out to be a real issue. That's quite possibly because with no-chill brewing the wort has a longer time to settle before transfer and so even though the cold break flocs are smaller they still fall to the bottom and are left behind.

Recommendation: This doesn't appear to be an actual issue in practice.

Try No-Chill

While I know that some homebrewers have the luxury of freely available water and time, there are many like me that need options to manage these scarce resources. No-chill brewing seems to offer one solution with minimal downsides in terms of beer quality at the homebrew scale. I look forward to lower water bills and more flexibility in squeezing in brew sessions so I can pursue the hobby I love without having to give up valuable family time.

I encourage all of you to try this at home too. It's a perfect opportunity to split a batch and compare the results as you can simply run off half your wort into a no-chill container and then chill the rest as you usually would. Ferment side by side and then share the results with your homebrew club to get as much feedback as possible. We'd love to hear your experiences with this convention-busting technique! BYO

Related Links:

• Do you know how much water to use for mashing and sparging the grain and boiling the wort?: http://byo.com/story410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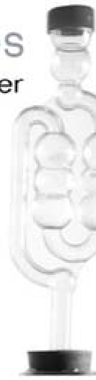
Hop Pairing & Substitution

techniques
by Terry Foster

Consider a hop variety's characteristics



When the esteemed editorial staff of *BYO* suggested the topic of pairing hops and hop substitution, I thought it would be an interesting one to write about. Then I sat down to write it and realized it was actually something of a minefield instead. That is because it involves talking about things like flavors and aromas, and perceptions of these are very personal — so my suggestions might not be acceptable to other brewers, experienced or not. For example, Cascade was the predominant hop used by home and craft brewers in pale ales and IPAs in the 1980s and 1990s. This variety was used in some very good beers, yet one acquaintance of mine would not touch Cascades because he just didn't like the flavor at all. And my very good friend, Jeff Browning (brewer at BrüRm@BAR) wouldn't touch this hop, simply because when he started brewing commercially everybody else was using it and he wanted to be different.

Given these comments, I considered it would be best to lay out some guidelines as to how to pair or substitute hop varieties, rather than to give a long list of specific suggestions, although there will of course be some examples. Under pairing, I am only going to deal with hops added for flavor and aroma, not those used for bittering. For the latter, many brewers simply take the option of using the highest alpha acid variety they have in order to reduce the amount of trub at the end of the boil. This approach assumes that hops boiled for 60-90 minutes have no effect on flavor or aroma so that pairing of bittering hops is an unnecessary procedure. Note that there are arguments against this statement, such as that some hop varieties yield a cleaner, sharper bitterness than others, and that first wort hopping affects hop flavor in the beer — but I shall not deal with these effects here.

Hop pairing

My first comment here is one that I have admonished brewers to do before, and that is to ask yourself exactly what sort of beer you are brewing. Quite obviously, it has to be a style in which hop flavor and aroma are important, so we are not talking about beers like porters and dry stouts, saisons, or any of those various Belgian-derived beers where yeast flavors are the most important taste characteristics. Mostly that leaves pale ales and the various forms of IPA to be considered as most suitable for this approach, although it would also work for a Czech-type Pilsner. I am not suggesting that you cannot add hops for flavor and aroma to any brew you fancy; indeed it is your beer and you can do what you want, and you may well want to experiment with unusual combinations and develop your own take on any given style. If you do try something on these lines, such as aiming to brew a brown ale with a lot of hop aroma; however, I would suggest that your first approach to such an experiment should be with only a single hop variety. If the result is pleasing to you, then you can consider using two or more varieties in subsequent brews.

Once you have sorted out what kind of beer you aim to brew, you must then ask yourself why you want to use a combination of hop varieties. Is there a variety with a character you like, but can be a little too intense when used alone? As I indicated earlier, some people do not find Cascades entirely to their taste and may want to

"Once you have sorted out what kind of beer you aim to brew, you must then ask yourself why you want to use a combination of hop varieties."

Photo by Charles A. Parker/Images Plus

mute its effect by pairing it with a milder hop, such as Fuggles, Saaz, Liberty or Mt. Hood. Note that if you do this you need to replace some of the Cascades (50% seems like a good number) with your chosen alternative, rather than keeping the original amount of Cascade and adding the same amount of the second hop. In the latter case the Cascade may continue to dominate the flavor and aroma and you will have wasted your time adding a second variety.

The second option for pairing is where you want to get a spectrum of hop character, say where you have found two or three varieties work well individually with a particular beer and you want to see how they work in combination with each other. I would suggest three rules to follow in this case, the first being that you do not want to use too many varieties, or you can actually get a "muddy" effect on the palate and in the nose — a sort of olfactory overload! Two to three varieties is good but 15 is certainly over the top! Rule two, concomitant with the first, as indicated before, do not overdo the amount of hops added. If, say, your original recipe calls for 1 oz. (28 g) of finishing hops, and you want to replace that with three varieties instead of one, use ⅓ – ½ oz. (9–14 g) of each, not 1 oz. (28 g) of each. Note that this implies that you must have a scale capable of accurately weighing amounts of less than an ounce; in fact I would recommend that you have such a scale whether you are pairing hops or not! The third is that the chosen hops should have similar characteristics — they should complement each other. If the effects of one hop variety dominate the beer then you have lost the point of the exercise. That means that you should choose varieties with similar types of aroma/flavor characters. An obvious bad example would be to use a combination of a hop yielding mild, gentle aromas (such as Magnum) with one with more powerful and definitive character (such as Citra®).

To amplify the third rule, let's say you are brewing a beer where hop flavor and aroma are background aspects of the beer's palate. Then you might get optimum results with a mildly spicy hop such as Hallertauer paired with a Hallertauer derivative such as Liberty or Mt. Hood, or with the mild English varieties such as Goldings, Fuggles, First Gold, or Target. If you want your beer to have a little more intensity of hop character, then you could consider, say, a mixture of Nugget and Northern Brewer or Willamette. If you are looking at achieving even more intensity in this respect then you would probably want to go with combinations of the various types that give strong citrus flavors and aromas. These obviously include Cascade, Centennial, Citra®, Simcoe®, and Amarillo®, but you could also include "piney" types, such as Chinook. In this case, you do not have to do the mixing yourself, for you can buy blends of such hops, specially designed to complement one another under the trademark name of Falconer's Flight® from Hop Union. Note that in this paragraph I have not offered any recommendations as to which beer styles these hop combinations should go with — remember that I said earlier you must decide exactly what you want to achieve with your beer before deciding upon which hop combination will work for it.

Hop substitution

Here we are looking at something completely different than hop pairing, either because you cannot obtain or do not have a variety called for in a recipe, or because you want to try out a different variety to see how you like it. In other words, you are looking to use a different variety to give an identical or at least closely similar result. Again I am not going to give a list of appropriate substitutions but will rather try to explain the philosophy behind the procedure. If you want a comprehensive list, then check out the hop chart at http://byo.com/resources/hops.

In the case of bittering hops, your approach should be quite simple — use another hop with pretty much the same alpha acid content as the "original." That way you won't noticeably change the IBU level of the beer. If you use a hop with different alpha acid content you will need to adjust the amount in order to maintain the same IBU level. You do not need to do a fancy calculation, just pro-rate it:

Weight of new hop = weight of original hop x (alpha of original hop/alpha of new hop).

So, if the original was 1.5 oz. (42.5g) at 7.2% alpha, and the new one is only 4.5% alpha; then:

Wt. of new hop = 1.5 x (7.2/4.5) = 2.4 oz. (68 g)

That means you can make your substitution without knowing the IBU level of the beer, (but if you don't know it then shame on you, because you should know it!). As far as flavor goes, you should generally substitute the original with a variety known (preferably from your own experience) to give a clean bitterness.

Substitution is a little trickier when it comes to flavor and aroma. Your first approach should be to check out the characteristics of the original and try to match them with the new variety. If you know the composition of the oils in the hops in question just look for a match, especially in levels of co-humulone. But you probably will not have access to that information, so a second approach would be to look carefully at the descriptors given by your supplier and see if you have a reasonable match. If both hops are described as giving mildly spicy aromas that's a fine substitute. Similarly if both are said to give citrus aromas, although be careful as not all citrus is equal! The hop chart on byo.com is useful for this as it not only gives descriptors for a wide range of varieties, but it also offers suggested substitutes.

One way of looking at that is to say that you should replace one English variety with another English variety, or to substitute one citrus Northwest hop with another. Or, at the other extreme, substituting an intense citrus hop like Amarillo® for the much milder Styrian Goldings is going to give your beer a very different palate. But this is a very simple approach, because, for example UK Fuggle can be nicely substituted by US Willamette (itself a Fuggle derivative).

Another very simple approach is to actually smell the hops you are using. Take the time-honored approach of breaking up a pellet of each by rubbing it vigorously on the palm of your hand and then comparing the two by smell. It is a bit of a hit or miss method depending upon the accuracy of your nose, but it does have the advantage of dealing directly with the actual samples you have, and thus accounting for when and where they were collected and how they have been stored.

You may even already have the answer from your own brewing records. Check back and see if you have made beers similar to the one you wish to brew now, and what hops you used in them and what flavors they conferred upon the beers. With any luck you will find enough clues in your notes to tell you which are the best substitutes for the original hop in the recipe. You do keep detailed notes don't you? If you don't, then this is a good reason to do so in the future.

It should also be obvious that when substituting flavor and aroma hops you should make additions at the same time in the boil and/or post boil as in the original, and should use the same quantities as before. Also, I have not said anything about dry-hopping in the fermenter or keg. In fact, that's because most of the comments above also apply to dry-hopping, even though the flavors and aromas obtained in this way may be very different from those obtained by the various forms of late hopping.

Finale

Hop pairing and substitution are complex issues and depend very much upon personal taste. But if you think about it carefully, follow the guidelines above, and match them with your experience, you should be able to safely navigate this minefield. If you make a change, in either pairing or substitution, and the beer does not quite turn out the way you expected it to, don't be disappointed — always judge it by whether it is a good beer or not. Also, keep in mind that to the scientist there is no such thing as a failed experiment; they all teach us something! BYO

Beer Spoilage

The organisms that ruin beer

advanced brewing
by Chris Bible

Microorganisms can cause undesirable effects on beer in several ways, including undesirable changes in beer flavor and aroma. Growth of microorganisms on raw materials or in wort can produce changes that alter the normal fermentation pathways. Additionally, the growth of contaminants on raw materials or in wort can generate many different microbial metabolites that may be retained throughout the brewing process and affect the flavor and aroma of the finished beer.

Spoilage organism categories

The primary categories of organisms that can cause beer to spoil are bacteria and wild yeasts. Here is a look at these categories:

Bacteria

Beer is a hostile environment for most microorganisms. The ethanol concentration and relatively low pH in beer creates an environment that is not favorable for bacterial growth. The dissolved carbon dioxide concentration and very low dissolved oxygen concentration makes beer an almost exclusively anaerobic medium. Beer also contains dissolved hop compounds that are toxic to many bacteria. Only a few kinds of bacteria are able to grow under such inhospitable conditions and are able to spoil beer. Some types of bacteria can, however, grow rapidly in wort. Active yeast must be pitched into fresh wort as soon as possible to inhibit and "outcompete" undesired bacterial growth.

Bacteria may have many different shapes, but beer-spoiling bacteria generally are either round (*cocci*) or rod (*bacilli*) shaped. Bacteria can further be characterized by a staining procedure known as "Gram stain." Bacteria is considered to be either "Gram positive" or "Gram negative" depending on how they react to this stain. The way bacteria interact with the stain is related to the specific structure of the bacteria cell walls.

Gram-negative bacteria

Important kinds of Gram-negative bacteria are acetic acid bacteria, *Zymomonas spp.*, *Pectinatus spp.*, and various *Enterobacteriaceae*. Several members of this group not only interfere with the fermentation process or produce undesired by-products, but also have been reported to survive the fermentation process and to transfer into the finished product.

Acetic acid bacteria

These are Gram-negative, rod-shaped bacteria that produce acetic acid from ethanol. *Acetobacter* and *Gluconobacter* are two important kinds of acetic acid bacteria that are traditionally associated with brewing. *Acetobacter* can oxidize ethanol to CO_2 and water via the hexose monophosphate pathway and TCA cycle. For *Gluconobacter*, the hexose monophosphate shunt is the most important route for sugar metabolism. The entire glycolytic and TCA cycles are not functional in *Gluconobacter*. These organisms cannot thrive in the highly anaerobic conditions of finished beer. Contamination with *Acetobacter* and *Gluconobacter* can only manifest in beers that contain some amount of oxygen as a result of defects in the manufacturing process.

> "Beer is a hostile environment for most microorganisms."

Zymomonas

These are Gram-negative rods that occur as single cells, in pairs, chains, or filaments. The most distinctive characteristic of *Zymomonas* is the ability to convert glucose or fructose to ethanol and CO_2 via the Entner-Doudoroff pathway. Ethanol only

Photo by Mike Tonsmeire

begins to inhibit the growth of *Zymomonas* at a concentration of around 8%. *Zymomonas mobilis* can be responsible for production of unacceptable levels of acetaldehyde and hydrogen sulfide in lager beer.

Enterobacteriaceae

One homebrewery contaminant in the bacteria family *Enterobacteriaceae* is *Obesumbacterium proteus*. It is a Gram-negative, rod shaped bacteria that is often found as a contaminant in the pitching yeast. It grows well in unhopped wort and is able to tolerate pH values ranging from 4.4 to 9.0. *Obesumbacterium proteus* is known to suppress the fermentation process and produces dimethyl sulfide, dimethyl disulfide, diacetyl and fusel oils. Beer contaminated with *Obesumbacterium proteus* may have a characteristic fruity or parsnip-like odor.

Gram-positive bacteria

Gram-positive bacteria are capable of a rapid growth rate, and they generally have a strong tolerance to high temperature and low pH conditions. Because of this, Gram-negative bacteria are generally considered to be the most threatening contaminants in the brewery. Gram-positive bacteria belonging to the genera *Lactobacillus* and *Pediococcus* are often called lactic acid bacteria because they produce lactic acid from simple sugars. Gram-positive bacteria are generally less able to resist the antiseptic effects of hop resins but this is not true for all varieties and there is significant variability.

Lactobacillus

There are several species of *lactobacilli* that have been isolated from beer, and these are major spoilage organisms within the beer industry. They are rod-shaped organisms and are resistant to hop bittering compounds. *Lactobacillus* can spoil beer by causing acidity, off-flavors and turbidity. Some of the *lactobacilli* produce diacetyl, which is responsible for a "buttery" flavor in beer. Although all *lactobacilli* produce lactic acid, the level of the acid accumulated in beer may not reach a concentration that is high enough to make a significant flavor impact on the final beer.

Pediococcus

Pediococcus damnosus is a very common spoilage organism found in breweries that produce lager beer. The organisms are usually found during the late fermentation or in the final beer. Spoilage by *pediococci* is similar to that caused by *lactobacilli*. *Pediococci* cause high acidity and buttery aroma due to the production of diacetyl. *Pediococci* also inhibit yeast growth, which results in decreased fermentation rates. *Pediococcus* can also produce thixotrophic polysaccharide slimes that cause "ropey" strands within beer.

Table 1: Gram-Negative Bacteria

Bacterial Type (Gram Negative)	Description	Effect on Brewing Process or Finished Beer
Acetic acid bacteria: ***Acetobacter*** *A. aceti* *A. liquefaciens* *A. pastorianus* *A. hansenii*	Straight or slightly curved rods up to 4 µm in length. Cells are pleomorphic and occur in pairs or chains. Capable of oxidizing ethanol.	Forms hazes or pellicles in beer containing oxygen. Products of metabolism include acetic acid acetanal, and acetate.
Acetic acid bacteria: ***Gluconobacter*** *G. oxydans*	Morphology is similar to Acetobacter. Obligate aerobes, catalase positive. Ethanol can be oxidized to acetic acid, but sometimes is not oxidized.	Same as Acetobacter. Forms hazes or pellicles in beer containing oxygen. Products of metabolism include acetic acid acetanal, and acetate.
Zymomonas *Z. mobilis*	Fat rods, which may occur singly, in pairs, chains or rosettes. Endospores are not formed. Some species are motile but others are not. They grow anaerobically but are catalase positive. Tolerant of aerobiosis. Glucose and are fermented to form ethanol. Maltose is not fermented. Optimum growth temperature range is 77–86 °F (25–30 °C).	Exclusive to ale breweries. Causes a "rotten apple" flavor due to the formation of hydrogen sulfide and acetaldehyde
Obesumbacterium (Hafnia) *O. proteus*	Short, fat, pleomorphic rods. Catalase positive. And ethanol tolerant. Growth in wort produces dimethyl sulfide (DMS), higher alcohols and diacetyl. Nitrate or nitrite are reduced to form carcinogenic nitrosamines.	Commonly a contaminant in pitching yeast. Grows with yeast during fermentation and causes slow attenuation rates and high pH beer. Produces fruity/parsnip off-flavors.
Citrobacter *C. freundii*	Slender, straight rods occurring singly or in pairs and usually motile. Cells are catalase positive and are facultative anaerobes. Citrate is metabolized by most species. Glucose is fermented to form mixtures of various organic acids (lactate, pyruvate, isocitrate and succinate). Relatively ethanol intolerant.	Rare contaminant in fermentations. Causes accelerated attenuation rate and produces increased organic acids and DMS. Killed in late fermentation by the presence of ethanol.
Enterobacter (Rahnella) *R. aquatilis* *E. agglomerans*	Short, squat rods, which may be motile. Glucose is fermented to produce acid and gas.	Usually a contaminant of pitching yeast. Acts similar to *Obesumbacterium*. Relatively intolerant to ethanol. Survives better in top cropping ale fermentations. Produces high diacetyl levels in contaminated worts.
Klebsiella *K. terrigena* *K. oxytoca*	Slender, straight capsulated, non-motile rods that occur singly or in short chains. Facultative anaerobes. Ferment glucose to produce acid and gas.	Ferulic acid in wort is decarboxylated to produce 4-vinylguaiacol. Creates phenolic off-flavor in beer. This reaction is also catalysed by the presence of some wild yeasts.
Pectinatus *P. cerevisiiphilus*	Very slender, curved rods occurring singly or in pairs. Older cells may be elongated. Motile and obligately anaerobic.	Contaminants of beer where oxygen levels are low. Produces hydrogen sulfide and other sulfur compounds.
Megasphaera *M. cerevisiae*	Slightly elongated cocci occurring singly or in short chains. Non-motile and non-spore forming. Obligately anaerobic. Relatively ethanol intolerant.	Spoilage happens only in low oxygen environments where the ethanol concentration does not exceed approximately 4% v/v. Putrid aromas and tastes occur due to the formation of hydrogen sulfide and other sulfur containing metabolites.

Table 2: Gram-Positive Bacteria

Bacterial Type (Gram Positive)	Description	Effect on Brewing Process or Finished Beer
Lactobacillus *L. brevis* *L. casei* *L. plantarum* *L. fermentum* *L. buchneri* *L. delbrueckii*	Slender, non-motile anaerobic rods that do not form endospores. Lack catalase but can tolerate oxygen and low pH. Some strains are resistant to hop resins. Usually have fastidious nutritional requirements. Fermentative growth produces mainly lactic acid or mixtures of lactic acid, acetic acid, ethanol and carbon dioxide.	Produce turbidity in infected beers. Some strains produce Extracellular, slimy polysaccharides, which appear as visible "ropes" in infected beer. Sour/acidic off-flavors are generated.
Pediococcus *P. damnosus* (or *P. cerevisiae*) *P. inopinatus*	Non-motile cocci occurring singly, in pairs or as tetrads/short chains. Catalase negative but can tolerate some oxygen and grow under microaerophilic conditions. Most strains are homofermentative and many are resistant to hop resins. Ethanol tolerant.	Spoilers of fermenting worts and beers. Produce hazes, acidity and high concentrations of diacetyl.
Bacillus *B. coagulans*	Large, motile rods that form endospores. Catalase positive and aerobic/facultatively anaerobic. Thermoduric and thermophilic but sensitive to hop resins and cannot grow in media with a pH lower than approximately 5.0.	Endospores allow them to survive wort boiling. They are able to grow in hot (131–158 °F/55–70 °C) sweet wort where they produce lactic acid. Inhibited by hop acids and low pH. Rarely spoil beer.
Micrococcus *M. kristinae*	Catalase positive and usually obligate aerobes (*M. kristinae* is a facultative anaerobe). Sensitive to acidic pH and hop resins.	Common contaminants in breweries but high sensitivity to hop resins and intolerance of acidic pH usually prevent beer spoilage.

Pediococcus is often considered one of the most difficult types of bacteria to remove from an infected brewery.

Wild yeasts

Wild yeast can be defined as any yeast that a brewer did not intentionally introduce into a beer. Wild yeasts can produce a wide variety of undesired flavors in finished beer. These flavors include hydrogen sulfide (rotten egg), estery (fruity), acidic (sour), fatty acid, and phenolic or medicinal. Turbidity can also be produced by wild yeast strains that do not flocculate well. Wild yeast infection can also cause higher alcohol content with lower final gravity in the finished beer (if the infecting yeast is highly attenuative). Wild yeast can either be *Saccharomyces* or non-*Saccharomyces*.

Saccharomyces wild yeasts

Saccharomyces wild yeasts are facultative anaerobes. Cross-contamination with another *Saccharomyces cerevisiae* strain can cause production of off-flavors and unusual fermentation performance. The strain *Saccharomyces diastaticus* has the ability to break down the dextrins which are not normally consumed by most brewing yeast strains. This results in overattenuated, thinner-bodied beers.

Non-*Saccharomyces* wild yeasts

There are many different genus and species of non-*Saccharomyces* yeast which can cause problems in beer. They tend to be aerobic organisms.

One common strain of these kinds of yeast are *Brettanomyces*. *Brettanomyces* produce acid, cidery, and clove/medicinal aromas and flavors. Other non-*Saccharomyces* wild yeast include *Pichia, Candida* and *Hansenula*. *Pichia* form films, haze and various unusual esters. *Candida* and *Hansenula* grow fast and form films. *Pichia* and *Candida* will also oxidize ethanol to acetic acid if aerobic conditions are present.

Non-*Saccharomyces* yeast are sometimes deliberately used by brewers to create a specific effect within beer. These yeasts can create different flavor/aromas to increase the unique character of a particular beer. For instance, *Brettanomyces bruxellensis* is often used to create the characteristic sour taste that is expected within Belgian lambic beers.

Conclusion

Microorganisms are everywhere, and they can find their way into the wort or beer at most any step in the brewing process. Although no pathogenic microorganisms can survive in beer, beer that is infected in a way not intended by the brewer will usually be quite unpleasant or even undrinkable. A good brewer must understand how to manage cleaning and sanitation practices in order to minimize the potential problems associated with unwanted microorganisms. BYO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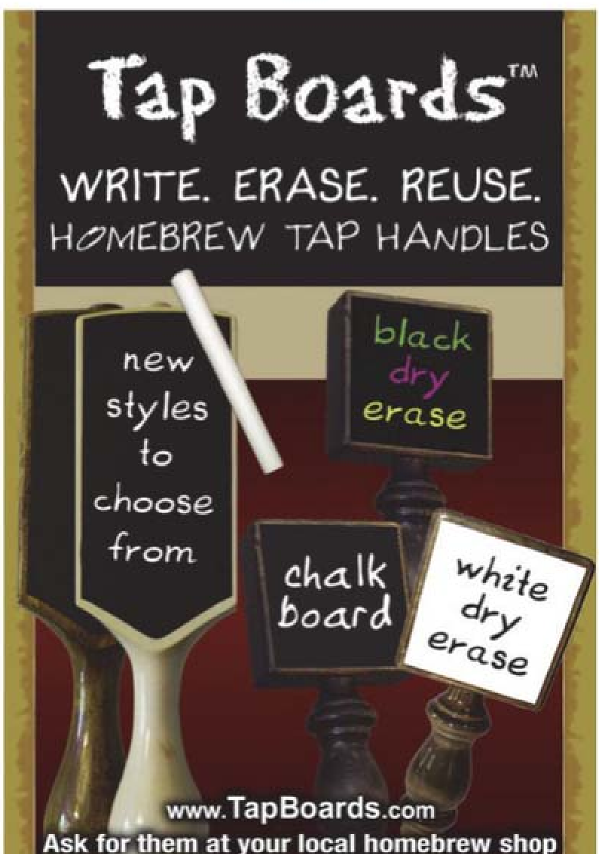
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Chalkboard Kegerator

by Stephen D. Turner

Bring life back to an old fridge

The first-time homebrewer usually finds the entire beer-making process new and enjoyable. The second time around, bottling is usually seen as tedious, yet still rewarding. Every time after that scraping labels and sanitizing all those bottles is seen as the chore it truly is. A few years ago a beat-up old refrigerator fell into my lap. Converting it into a kegerator was the only logical thing to do.

For the first iteration of my kegerator I just pulled all the shelves out of the spare fridge and put three kegs and a 5-lb. CO_2 tank in the fridge with picnic taps attached — you would open the fridge, find the tap line you wanted, pour your beverage of choice, then close the fridge.

After looking around at other projects on homebrewing forums and mailing lists, I realized that I could have a fully functional kegerator with only minimal equipment and a few hours work. Since I already had the draft system built, all I needed were the shanks (the metal piece that goes through the fridge door), the faucets, and a few yards of tubing. And while I was at it, I figured it was a good time to do some cosmetic work on the rusty old icebox.

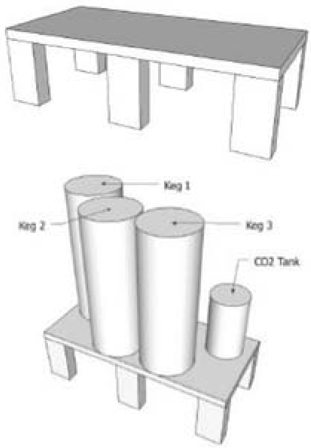
A few notes on the draft system itself: Everyone's fridge is a little different, as is everyone's draft system. My setup allowed me to fit three kegs and a gas tank with only slight modification to the fridge. I used ball-lock kegs, which are taller and skinnier than pin-lock kegs. The bottom backside of my fridge has space taken up by the refrigeration system that prevents kegs from sitting directly on the bottom. I'm by no means skilled at woodworking, but I was able to hack together a platform in about 30 minutes by nailing some plywood on 2x4s cut to length, then spray painting and applying a coat of polyurethane to keep it dry. This platform allowed me to fit three kegs and a gas tank, with room for a few 22 oz. (650 mL) bottles underneath. Each fridge is different. You'll have to measure yours to figure out how many kegs you can fit and what kind of platform (if any) you'll need. There's one gas tank in the fridge with a dual-gauge regulator. One gauge I keep at 10 PSI, and I split that with a tee to pressurize two kegs of beer. The second regulator is set to 12 PSI and is dedicated to a cider.

> "I realized that I could have a fully functional kegerator with only minimal equipment and a few hours work."

Assuming you already have a spare fridge and a functioning draft system, the entire project should set you back around $250. You can save money by getting cheaper chrome-plated components instead of stainless steel, but I wouldn't recommend it. You should set aside a weekend for the entire project. However, most of that time is spent watching paint dry (while sipping a homebrew, of course). If you're skipping the paint, the entire conversion should only take a couple of hours.

Materials & Tools:

- Spare refrigerator
- 30 feet (9 m) of 3/16-inch I.D. beverage tubing (plus more tubing for CO_2 distribution)
- Worm gear clamps
- 3 faucet/shank combo kits
- Painting supplies: Sandpaper, masking tape, paintbrushes, small paint roller and rolling pan, 1 quart plain latex primer, 1–2 quarts blackboard paint.
- Shelf-building materials (optional): plywood, 10 feet (3 m) of 2x4, nails, paint, polyurethane.
- Drill
- 15/16-inch hole saw bit
- Faucet wrench

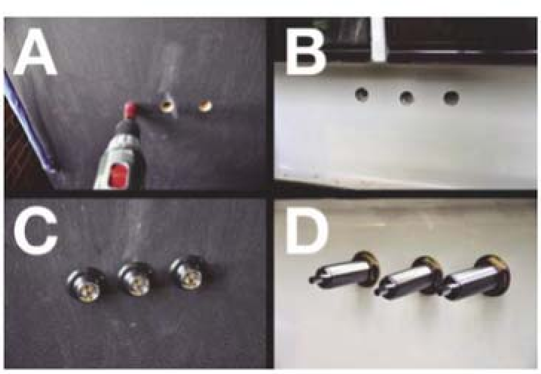


1. PLAN THE DRAFT SYSTEM ARRANGEMENTS

Every fridge is a little different inside. However, they all need space for the compressor and other components of the refrigeration system. This space is typically behind your crisper drawers on the bottom, and usually cuts into the front-to-back space available. If you want to fit three kegs and a gas tank you might need to construct a small platform to support them all. Maybe you'll need to cut away parts of the shelves on the inside of the fridge door. In any case, detailed planning is key. Take measurements of the internal dimensions of your fridge. Measure your kegs and gas tank. Don't forget you'll need space for the regulator to stick out from the tank as well as space for 30 feet (9 m) of tap line excess (see step #5). Make sure everything will fit and the door will close before you proceed. This diagram shows my layout, but yours may be different.

2. SAND, PRIME, AND PAINT FRIDGE

First, turn off and unplug your fridge, and open the doors. Allow any moisture to condense and dry off. Give the fridge a thorough cleaning inside and out, then sand every surface of the fridge that you plan to paint. Sanding is important to scuff the surface enough for the primer to stick, and is especially important if your spare fridge was rusty like mine. Use masking tape to protect any parts you don't want painted. Apply one coat of primer to every surface that will be painted. After letting this dry completely, apply a coat of blackboard paint. Allow to dry, then cover with a second coat of blackboard paint. One quart (1 L) can of paint was just enough for two full coats on the front, both sides, and the top (you may need two cans if you apply a third coat).



3. INSTALL SHANKS

Here comes the important part. Once you start drilling holes through your fridge you're committed, so make sure you put them where you want them. Use a $\frac{15}{16}$-inch hole saw bit to drill the holes (panel A). Make sure you put the holes low enough so you can open your freezer without hitting the tap handles that will eventually be on the faucets. Also, look at the inside of the door and make sure you're not drilling into a compartment or a shelf (panel B). Slide the shanks barb-end first through the holes with the black plastic flange facing out (panel C). Secure the flange in place using a brass lock nut (panel D).

4. INSTALL FAUCETS

It gets easier from here. Once you've secured the shank using the lock nut, attach the faucet to the shank using a faucet wrench. You can pick up a faucet wrench at most homebrewing stores. I recommend against improvising with pliers or other tools to make sure you get a tight seal and avoid scratching your faucets. Attach your tap handles; making sure you can still open the freezer without hitting them. We'll be connecting the kegs in the next step, so make sure your faucets are off (tap handle pushed back).

5. CONNECT BEER LINES TO FAUCETS

The length of the beer line running from the keg to the tap, the width of the tubing, and the elevation change from keg to faucet all affect the pressure balance at the tap, and an imbalance can cause your beer to be too foamy or too flat. Longer tap lines and a smaller internal tube diameter will increase resistance and decrease foam. For this setup, I used 10 feet (3 m) of 3⁄16-inch tubing to connect each keg to the tap. When pressurized at 10-12 PSI, I get fizzy beer with zero foam. Hook one end of the 10-foot (3 m) tube to your keg quick disconnect and secure the other end to the shank barb using a worm gear clamp. It will be tough to get the 3⁄16-inch tubing to slide onto the 1⁄4-inch barb, so dip the end of the tubing into boiling water for a few seconds to make this easier.

6. PUT IT ALL TOGETHER

Connect the gas lines to the "in" posts and the tap lines to the "out" posts. If you followed step #5, you'll have 30 feet of tubing to cram in there somewhere (my CO_2 tank and tap lines are sitting behind the two kegs on the right). Use chalk to label what's being served on each tap. If you have an artistically talented friend, offer some homebrew in exchange for drawing some cool artwork on the sides. Sample one (or two or three?) pints from each tap to make sure everything is functioning correctly, and revel in your glorious new creation. Finally, make sure to regularly clean your tap lines by running sanitizer through as soon as a keg is kicked — nothing spoils a great brew like poor sanitation and dirty tap lines. BYO

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Another National Homebrew Competition has come and gone, but before we get into the 2014 results I'd like to dig deeper into what beers were declared the best of their categories in 2013. History was made in 2013 as Annie Johnson became the first African-American to ever win the coveted Homebrewer of the Year award, and was the first female winner in many years.

She also deserves kudos for one more thing: Winning with a really simple recipe. In the midst of so many brewers, home and craft, making ever more extreme beers like double this, triple that, quadruple something else, imperial everything, 120-minute continuously hopped beers with 100s of IBUs, and so on (not to mention the exotic recreations of beer from scientific analysis of ancient residue found in long lost clay pots and unusual ingredients that no one has ever brewed with before), she showed the brewing world that you can be judged the best of the best with a recipe just one step away from being a SMaSH (Single Malt and Single Hop) beer. (For more on SMaSH brewing, I loved the article in the July/August 2014 issue, which got me thinking.)

Don't get me wrong, I am not against anyone getting as complicated as they want while formulating a recipe, but sometimes less is indeed more. I have some complex recipes in my files; my #6 Hopping Street IPA uses six different British hops and my Russian Imperial Stout uses seven different grains, but I find a lot of comfort in what I like to call the KISSOFF principle: Keep It Simple Sir Of Fermentation Fanaticism. KISSOFF keeps brew days simple and there's a reduced cost in a beer with only one or two specialty malts, which is pretty important to those of us still waiting for the recovery to tag us in.

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Photo courtesy of Steve Ruch

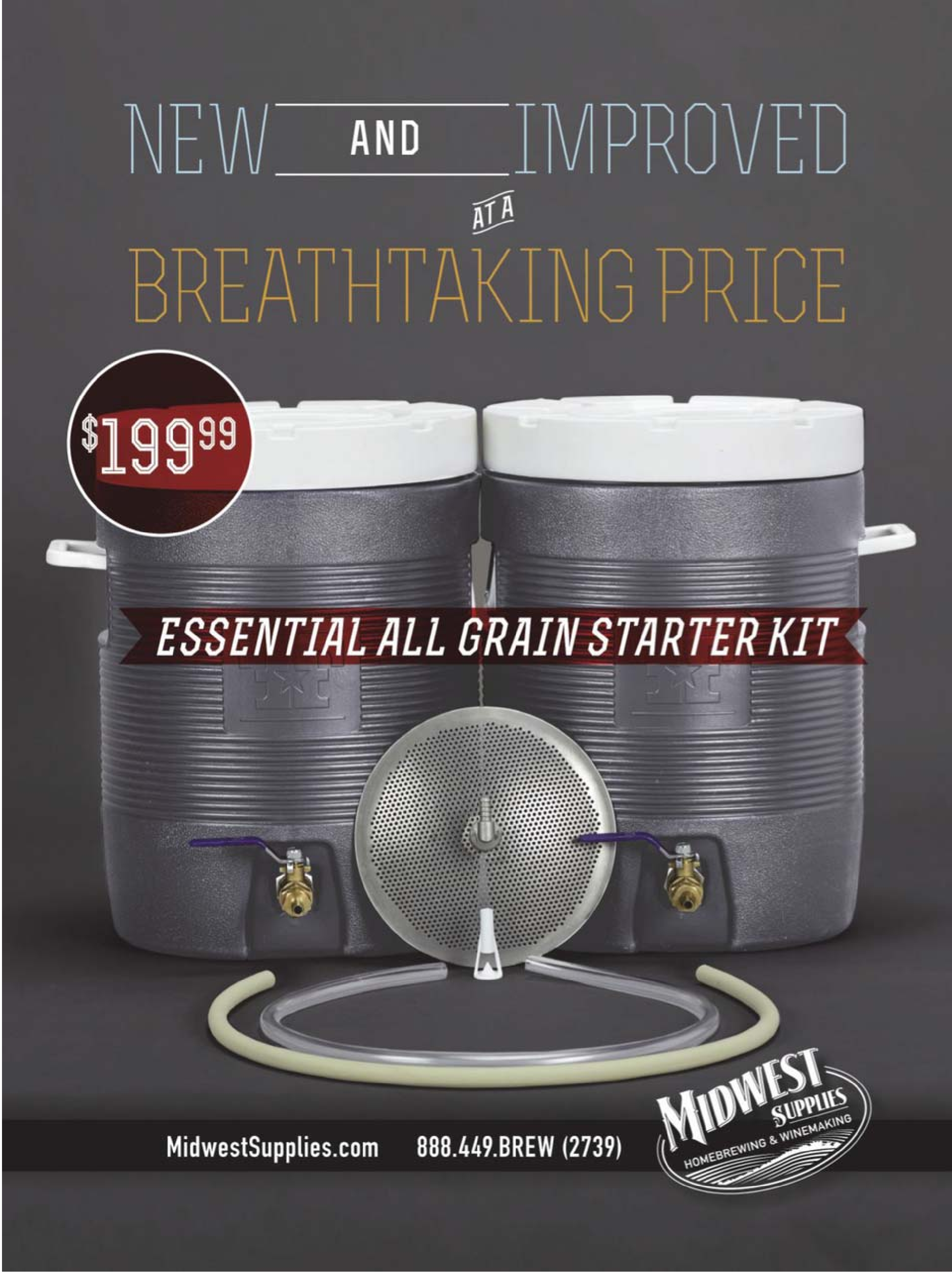
My search into the previous five years of the National Homebrew Competition results revealed that a fairly large number (35) of gold medal-winning recipes fell into the range of what I consider to be simple recipes: Three grains or less and two hops or less (there may be more than one hop addition, but all of them would be of the one or two different varieties).

The 2009 gold medal recipe for IPA had two grains plus three hops which is a tiny stretch for a KISSOFF beer, but still fairly simple for an IPA. The simplest recipe to win gold in the last five years was in 2011 in the "Cream Ale" category: 2-row malt and Willamette hops. You can't get much simpler than a SMaSH beer.

One step up from a SMaSH beer is a recipe with dual grains and one hop (DMaSH). In the past five years I counted 10 such recipes winning gold medals, 11 if you include the 2012 gold medal-winning recipe for Berliner weisse, which used two extracts and one hop, but also used two different yeasts: one ale and one *Lactobacillus*. I consider it a KISSOFF as the two yeasts are necessary for the style.

When I dug deeper, I found gold medal-winning simple recipes spread out over 17 categories and 29 subcategories. Category 1 had two American light lagers, one Dortmunder and one Munich helles. Category 2 featured two Bohemian Pilsners, one German Pilsner, and one classic American Pilsner. In category 6, I found two cream ales, including the SMaSH recipe mentioned earlier, one American rye, one Kölsch, and one American wheat. And in category 16, I found two Belgian specialty ales, one witbier, and one saison. Other styles that have also been represented include Munich dunkel, Märzen, ESB, Scottish ale, robust porter, rauchbier, German wheat, and Bock.

Be as extreme as you like with your recipes and more power to you, but I think this research shows that you shouldn't discount the pleasures of keeping things simple. BYO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