INDIA PALE LAGER TIPS | SMOKED BEERS FOR FALL | GLUTEN-FREE HOMEBREWS

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THE HOW-TO HOMEBREW BEER MAGAZINE

NOVEMBER 2013, VOL.19, NO.7

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CONTENTS

November 2013 Volume 19 Number 7

features

19

departments

where to find it

RECIPE INDEX

BYO RECIPE STANDARDIZATION

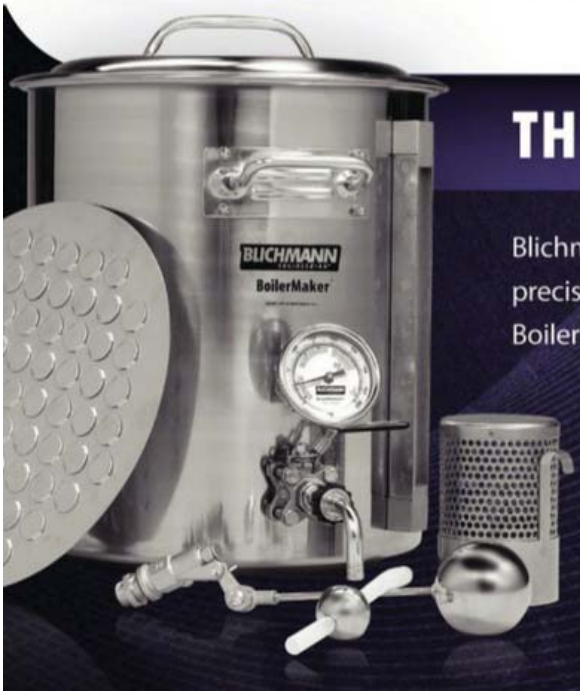
Extract efficiency: *65%*
(i.e. — 1 pound of 2-row malt, which has a potential extract value of 1.037 in one gallon of water, would yield a wort of 1.024.)

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.

FALSE BOTTOM.
TRUE INNOVATION.



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what's happening at BYO.COM

Rauchbier: Style Profile

In this issue, Jamil Zainasheff explores adding smoked malt to various styles of beer in "Style Profile" on page 19. But we can't forget the classic rauchbier, the style for which smoked malts are most well-known.
http://byo.com/story1296

Lager: Pale Pilsner to Malty Munich

Most homebrewers begin by brewing ale, and their entire exposure to lager is limited to mostly commercial American light lagers. But there is another world of lagers to explore.
http://byo.com/story972

Gluten-Free Brewing

Want even more tips and techniques for brewing gluten-free beer? Check out this story from the archives that offers another writer's take on brewing gluten-free beer, plus two more gluten-free recipes for you to try at home.
http://byo.com/story698

Brewing with Pumpkin: Tips from the Pros

Got pumpkins left over from Halloween? Why not use them in your next batch of homebrew? Here is some advice from three pros who can help talk you through it.
http://byo.com/story324

Cover Photo: Boston Beer Company

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
Special Subscription Offer
8 issues for $28.00

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

Brew Your Own (ISSN 1081-826X) is published monthly except February, April, June and August for $28.00 per year by Battenkill Communications, 5515 Main Street, Manchester Center, VT 05255; tel. (802) 362-3981; fax (802) 362-2377; e-mail BYO@byo.com. Periodicals postage rate paid at Manchester Center, VT and additional mailing offices. Canada Post: Return undeliverables to PO. Box 25542, London, ON N6C 6B2. POSTMASTER: Send address changes to ***Brew Your Own,*** P.O. Box 469121, Escondido, CA 92046-9121. Customer Service: For subscription orders call 1-800-900-7594. For subscription inquiries or address changes, write ***Brew Your Own,*** P.O. Box 469121, Escondido, CA 92046-9121. Tel: (800) 900-7594. Fax: (760) 738-4805. Foreign and Canadian orders must be payable in U.S. dollars plus postage. The print subscription rate to Canada and Mexico is $33, for all other countries the print subscription rate is $45.

Volume 19, Number 7: November 2013

contributors

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 *Brew Your Own*, including an article on brewing with nuts and seeds in the October 2012 issue. In addition, he has contributed several installments of our "Projects" column in the past couple of years.

In this issue, on page 78, Christian shares some tips for maintaining your kegging setup to get the best-tasting beer out of your taps (and yes, one of those tips is cleaning your lines, so it's time to get out the PBW, stat).

Forrest Whitesides has been homebrewing since 1995 and is the undisputed king of emergency decoction mashing. He is a member of the NJ Hopz brew club and a regular contributor to Final Gravity podcasts. His favorite styles to brew include IPAs, porters, and just about anything Belgian. When not brewing and sampling beers, he enjoys photography, building tube amplifiers and playing guitar. Forrest lives in Sussex County, New Jersey, with his wife Meaghan. You can follow him on Twitter: @2N3904. Beginning on page 42 of this issue, Forrest discusses methods for brewing gluten-free beer and shares a few recipes for brewing with sorghum and brown rice syrup.

Bob Hansen is the Technical Services/Quality Manager at Briess Malt & Ingredients Co. in Chilton, Wisconsin. Prior to joining Briess, Bob was a brewing consultant and brewer and consultant for Water Street Brewery, in Milwaukee, Wisconsin. At Briess, Bob commissioned a 500-bbl brewhouse in the new Briess Extract Plant, and established a new pilot brewery. In addition to extensive research and development, Bob also provides technical support and recipe formulation assistance to customers. He holds a Bachelor of Science degree from the University of Wisconsin-Milwaukee and attended Siebel Institute courses. In this issue, on page 34, he teams up with Terry Foster to explain the difference between crystal and caramel malt.

mail

Holey Moley, that sounds good!

My new *Brew Your Own* magazine has a clone recipe for an Imperial IPA from The Alchemist brewery called Holey Moley. Sounds really good . . . could this be my next brew??

Larry Peters
Osceola, Indiana

Brew Your Own *responds: Larry, we certainly hope you'll give our Holey Moley clone a try. The story author, an avid homebrewer and* BYO *Recipe Editor Dave Green, had a great time visiting the breweries for his "Vermont Cult Clones" story from the October 2013 issue, and he got a lot of good first-hand advice from John Kimmich, Brewmaster of The Alchemist, for that recipe. If you do brew Holey Moley, be sure to let Dave know how it went by emailing him at dave@byo.com.*

Cidermaking

I really enjoyed the cidermaking story in the October 2013 issue of *Brew Your Own* as well as the story about hopped ciders. I have a question, though. In the cidermaking story, the author mentions using pectic enzyme to get the cider to be clear. What is pectic enzyme, and if I wanted to use it, how much of it would I use for a 5-gallon (19-L) batch of cider?

Jack Jones
Huger, South Carolina

Brew Your Own *responds: Jack, pectic enzyme, or pectinase, is an enzyme that breaks down the bonds of the large pectin molecules present in your cider, which can stick together and cause a haze to linger. It is often used in fruit winemaking as fruits naturally have more pectin. Commercially available pectic enzymes are offered at most homebrewing and home winemaking suppliers in both powder and liquid form from a variety of manufacturers, each with individual recommendations for use — each variety will almost always provide the dosage instructions on the package.*

Yeast question

The articles about yeast in the September 2013 issue of *Brew Your Own* were great, and I recently started yeast washing so it came at a perfect time. One question I have that wasn't answered is how many yeast cells are there per mL of washed yeast slurry? I'm also wondering about pitching rates when using dry yeast. I mostly use Fermentis (Safale) ale yeasts, and everything I've read says to re-hydrate and pitch directly into a 5-gallon (19-L) batch. According to the manufacturer's literature there are 6 billion cells per gram, so 69 billion cells per 11.5-gram packet. That's far short of the recommended 113.5 billion recommended in the article. Should I be using a starter to up the cell count to 113.5 billion?

John Perrotta
via email

Brew Your Own *responds: John, glad you enjoyed the yeast issue! Determining the density of washed yeast is very difficult because washing dilutes the yeast and depending on how someone goes about decanting the water the washed yeast may or may not be different from the initial slurry. A general rule of thumb for thick yeast slurries harvested from the bottom of a fermenter is 750 million cells per mL.*

Your question about the number of cells in a package of dried yeast has a pretty simple answer, however: Use two packets of dried yeast — unless you are chomping at the bit to do a propagation — and you should be fine. Happy brewing!

Recipe creation question

The article by Terry Foster on recipe creation in the July-August 2013 issue of *BYO* reinforced the notion of downsizing hop bitterness for session IPAs. My experience with scaling down an IPA led to a beer that was too dry. His Small IPA recipe seems to be missing the Victory® malt described in the article about recipe creation and it also seems to be missing malts that would lead to an 18 SRM brew. Could you confirm or correct the recipe?

Dave Hardy
via email

Terry Foster *responds: "Dave, there is indeed supposed to be 2.25 lbs.(1.0 kg) of Victory® malt in that recipe. It was accidentally overlooked somewhere along the way during editing. I think you'll find that adding that will bring the OG up to 1.045, and should also account for the color number I provided."* BYO

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READER PROJECT: Sun-Dried Spent Grain

Meredith Yanchak • Temple, Texas

Generally speaking, I am not a crafty person. Sure, my husband, Matt, and I make our own beer, but that mostly developed out of a need for good beer in our lives after moving to Central Texas. It quickly spiraled into a bit of an obsessive hobby (we brewed over 200 bottles as wedding favors for our nuptials four years ago), and often we are brewing two or three types of beer at one time.

I typically give the spent grains to a co-worker who has a potbelly pig named Olivia. As our brew days increase, so does Olivia's size. When we have extra spent grains, we'll use them – happily and lazily – as mulch on our plant beds. (I can't wholeheartedly recommend this, however effective it may be, as the mulch smells like feet after a few days.)

One evening, after brewing a batch of Three Flower Saison, Matt and I were perusing a back issue of *Brew Your Own* (May-June 2013) and found an article about using spent grains in the kitchen. Ready for a change of pace, I decided to take on the task of making spent grain flour.

To make spent grain flour (which can be used in pretty much any recipe that calls for flour), most recipes tell you to leave your oven on 170-200 °F (77-93 °C) for six to eight hours to dry out the grains, and then grind those dry grains in a coffee grinder. Six to eight hours? That's a long, ridiculous time for August in Texas. A brainstorming session at the kitchen table ensued. We came up with the ingenious idea that I could stick a pan of wet spent grains on the dashboard of my black Volkswagen Beetle and it would dry in half the time.

To test the theory, I pulled my car out of the garage at 11 a.m. and into the direct sunlight on the driveway. The outside temperature was already 95 °F (35 °C). I let the car sit while I spread 3 cups of wet spent grains (2-row, crystal 20, and CaraPils from the saison) evenly on an ungreased baking sheet. Then I set two trivets on the ample dash of the VW and balanced the sheet and thermometer on them. The thermometer read 103 °F (39 °C) already. I closed the door, went back inside, and watched an episode of "30 Rock." After Liz Lemon delivered her last sardonic punch line, I went back to the car and turned the grains with a wooden spatula. I could already tell it was working as my utensil crunched through the top layer of dried grains. I let the grains sit for another 30 minutes. By this time when I went out to retrieve them with my oven mitt the thermometer screen had partially blacked out. But my hypothesis was proven: The car, acting as an oven, dried the grains in about an hour.

I ground the grains in my husband's coffee grinder until they were as fine as possible (about 30-45 seconds per ¼ cup of dried grains).

The debate then began about what to make with them. We discussed this one night while sampling beers at The Draughthouse in Austin, where one of the foods they serve is soft pretzels. Spent grain soft pretzels? Well, I don't mind if I do!

I consulted with a few foodie friends of mine and was directed towards the Brooklyn Brew Shop recipe for Spent Grain Pretzel Rolls. I modified it a bit as I wanted to use as much of the spent grain flour as possible so we could really get an idea of what it was like.

In the end, we ate the rolls with some spicy brown mustard. So delicious! Next up: VW Beetle Dried Granola?

reader recipe
Spent Grain Pretzel Rolls

Ingredients

- 1 cup warm water (110 °F/46°C)
- 1 packet dry active yeast
- 2 cups flour
- 1 cup spent grain flour
- 1 tablespoon sugar
- 2 teaspoon kosher salt, plus more for sprinkling
- 5 cups water
- (1) 12 oz. bottle of beer
- ¼ cup baking soda

For cooking instructions, visit http://brooklynbrewshop.com/the mash/recipe-spent-grain-pretzel-rolls/

byo.com brew polls

Have you ever brewed a gluten-free beer?

No, I'm not interested 53%

No, but I'd like to learn 37%

Yes, I have tried a time or two 7%

Yes, I brew gluten-free very often 3%

what's new?

The Brew Bucket

Ss Brewing Technologies has released a brewer's-grade stainless steel bucket fermenter. This is a feature-rich product that includes a convenient ball valve spigot, an integrated racking cane, a conical bottom, and a design that allows for stacking one Brew Bucket on top of another during fermentation, which is great for tight spaces or putting in coolers. The Brew Bucket is available now with a manufacturer's suggested retail price of $175. For more information visit www.ssbrewtech.com

FastRack Wine

This new model modifies the original FastRack design to fit 750-mL wine bottles, bomber beer bottles and 1-liter bottles. Use FastRack Wine instead of setting up and taking down your bottle tree and for storing empties for your next homebrew batch. Each FastRack Wine holds 12 larger-sized bottles and comes with a drainage tray. For more information visit www.thefastrack.ca.

Boutique Beer

The newest book from award-winning writer and drinks expert Ben McFarland, *Boutique Beer*, ventures off the well-trodden drinking path and takes the adventurous beer connoisseur deeper into the world of today's most compelling craft brewers. McFarland talks of the tales and tastes of more than 500 beers, reviews the ingredients and brewing process for each beer, assesses the appearance, aroma, flavor and finish of each brew, includes a listing of key breweries to visit around the world and much more. Available at major booksellers.

calendar

November 9
Knickerbocker Battle of the Brews
Albany, New York
The Saratoga Thoroughbrews Homebrew Club holds its annual homebrew competition at C. H. Evans Brewing Co. in Albany. This is a BJCP/AHA sanctioned competition with an entry deadline of October 27. Prizes will be awarded for the top brews.
Entry fee: $7
Web: http://thoroughbrews.com

November 16
FOAM Cup
Tulsa, Oklahoma
The Fellowship of Oklahoma Ale Makers is back with its annual AHA sanctioned homebrew competition with judging November 15-16 and a banquet at the 907 Café at the conclusion. The competition includes categories from the latest BJCP style guidelines and a specialty IPA category.
Entry fee: $7
Web: http://foamcup.us

November 23
Son of Brewzilla Homebrew Competition
Middleburg Heights, Ohio
Organized by the Society of Northeast Ohio Brewers, the Son of Brewzilla Homebrew Competition is open to 600 entries. Registration opened this summer, but entries will be accepted from November 1-15. The event is hosted by Fat Head's Brewery and Saloon.
Entry fee: First entry $7, other entries $5.
Web: http://beersnobs.org/cbwcomp

November 28
Half Pints Pro/Am Brew Challenge
Winnipeg, Manitoba
The Winnipeg Brew Bombers and Half Pints Brewing Co. present Manitoba's first BJCP/AHA sanctioned Annual Pro/Am beer competition. Along with amateur and professional winners in each category, the Best of Show winner will have the opportunity to brew 1,000 liters (264 gallons) of the winning batch at Half Pints Brewery.
Entry fee: $8 for amateurs, $15 for pros.
Web: http://winnipegbrewbombers.ca

homebrew drool systems

Homebrew Automation

Herman Verbeek • Overloon, Netherlands

I am an electronics designer and have also been a homebrewer since 2005. I think it is important to be able to replicate each brewing process, so I use automation to achieve this. More specifically, I use a temperature control to control all the mash step temperatures and timings. I also designed my own fermentation control board, called Tcontrol-IO, with personally programmed software. All of my brewing is done without a pump. I use a mash tun with a 24 VDC stirring motor on top and direct heater that is controlled by a proportional valve from a central gas heater.

A handmade printed circuit board (PCB) with some Inter-Integrated Circuit (I^2C) components is the interface to the parallel port of my brewing computer. On this computer I fill in the mash scheme for my beer using my homemade program BeerPID, which also controls the speed of the stirring motor. I have digital temperature sensors that measure the temperature of the beer.

After mashing, the mash tun is hoisted on the counter with an electric cable hoist. Heating the sparge water automatically begins after mashing and is regulated to 176 °F (80 °C) during the sparge. After filtering and sparging, the boiling starts. The software detects the start of the boil so the first hop can be added. A timer on the screen alerts me when the next addition should be added.

Tcontrol-IO allows me to control two different fermentations at the same time in refrigerators next to the computer. The system allows me to set slow temperature changes over time, measure carbon dioxide during fermentation, view my fermentation from all over the world, and it sends emails to my phone with updates. More information about my system is available online at Tcontrol.rr.nu

beginner's block

BOTTLING VS. KEGGING

by dawson raspuzzi

New homebrewers spend a lot of time considering the style of beers they want to brew, but another question to consider early in the process is what to do with your beer after it's done. With respect to Shakespeare, "To bottle or to keg, that is the question." Both have their advantages and drawbacks.

Financial investment

If saving money is the most important factor for you, bottling is the way to go. The initial investment in equipment for bottling (most of which is included in a homebrew starter kit) includes a racking cane, bottling bucket, tubing to transfer the beer from the bucket to the bottles, a bottle filler, and a capper. Continued expenses for each batch are bottle caps and priming sugar. Assuming you are buying commercial beer, there is no added expense for the bottles that can be reused.

To keg your beer, at the minimum, you'll need a 5-gallon (19-L) soda keg, a carbon dioxide tank with a regulator, gas and food-safe beer lines, disconnects, and a dispenser. The primary reoccurring expense is refilling the CO_2 tank. A 5-gallon (19-L) keg can be kept in a refrigerator, but most commonly it is kept cold in a kegerator, which can cost anywhere from a few hundred dollars to more than $1,000, but with an old dorm fridge or chest freezer you can make your own for less (check out the November 2008 *BYO* or the March-April 2011 issue for two different approaches).

Time and ease

Maybe convenience is more important to you? In that case, kegging may be the way to go. Often the most frustrating chore in homebrewing is cleaning and sanitizing bottles so any bacteria left in them does not contaminate your homebrew. The process is made easier if you clean each bottle immediately after it is emptied so yeast sediment does not harden at the bottom, but no matter how you cut it, cleaning 50 bottles or so is more work than cleaning one keg and its detachable parts. Of course, you can purchase new bottles for each batch, which increases your cost but eliminates the tedious chore of cleaning. After cleaning and sanitizing the bottles, it also takes more time and effort to fill and cap each bottle than it does to rack your beer into a keg. After the bottles are capped there is generally at least a two-week waiting period for your beer to carbonate in bottles. Kegs, on the other hand, can be force-carbonated in a day or two thanks to CO_2.

Space

Which option is better for space is a matter of opinion. Because of their size, kegs can often be burdensome without a kegerator, as much of your refrigerator is filled when you put a 5-gallon (19-L) keg in it. With bottles, you can keep a small amount in the fridge and replenish your supply as you drink. However, if you are brewing large batches, or multiple batches, bottles can take up a lot of space where you store them.

Transportation

If you want to bring some beer to a buddy's house, bottles are much easier. Dragging a keg and CO_2 tank obviously gets cumbersome when all you really need is a six-pack. Bottles are the only option when submitting your homebrew into a competition or giving homebrew away as a gift.

Other factors

Any homebrewer can recall the batch they bottled with excitement only to be let down weeks later when they opened a bottle and a fountain of foam erupted, or, almost as bad, when there was barely a trace of carbonation. With a keg, carbonation is something you can control and adjust.

Whether you bottle or keg, the choice must be made based on what's best for you and what you can afford in your homebrewery. Either way, if you brew beer you enjoy drinking and are proud to serve, you can't go wrong.

by marc martin

DEAR REPLICATOR, WORKING IN THE COMMERCIAL AIRCRAFT INDUSTRY, I GET TO TRAVEL A LOT. THEY SEND ME TO SEATTLE AT LEAST ONCE A YEAR, WHERE THE CRAFT BEER SCENE HAS REALLY EXPLODED. THERE ARE A BUNCH OF GOOD BREWERIES AND BREWPUBS TO CHOOSE FROM, BUT MY FAVORITE IS BIG AL BREWING. IT IS A LAID BACK, OUT OF THE WAY LITTLE TASTING ROOM BUT THEY CRANK OUT SOME DELICIOUS BEERS. I THINK THEIR SMOKED PORTER HAS THE MOST CHARACTER AND I WOULD LIKE TO TRY TO COPY THIS ONE. CAN YOU HELP GIVE ME SOME IDEAS FOR A RECIPE?

COLIN WALLACE
TORRANCE, CALIFORNIA

It seems that you and Big Al Brewing owner, Alejandro Brown, followed similar paths to find great craft beer. He is also from southern California and moved to Seattle.

In 2001 Al discovered Larry's Brewing Supply and found that you can brew excellent beers at home. Members of the local homebrewing club, the Impaling Alers, helped him hone his skills and recipes. Brewing became an obsession and in 2008 he left his corporate job with Nissan Motor Co. to pursue his dream of commercial brewing. While developing a business plan, the closing of Seattle's Pacific Rim Brewery was announced. Things fell into place and in August 2008 he became the proud owner of their brewing facility.

There were challenges to overcome like scaling up homebrew recipes to 15-barrel batches. Soon, Al discovered that brewing and owning a brewery was more than a full-time job. Employing the help of some of his friends from his homebrewing days, Al built a team that now cranks out some of the best beers in the Seattle metro area.

Even with annual growth of over 10% (up to 2,400 barrels this year), Al still takes time to involve the local homebrewing community. Each year he hosts two or three "Local Hero Series" competitions where homebrewers enter their best beers for a chance to have one selected for production on a commercial level. Al just released the 14th brew in this series.

Distribution is only in Washington with 70% of production going to keg accounts; however, the smoked porter is one of the beers that is also bottled. When asked what is next for the brewery, Al says he is excited about the trend toward sour beers. I think some bugs may be in his future.

While discussing the smoked porter, Al says it leans toward a robust porter style. The combination of heavy doses of both roasted and chocolate malts provide the bulk of the flavor while the crystal malt adds to the residual sweetness and body. The Nugget and Fuggle hops are a good marriage to add some subdued bitterness but still allow the smokiness of the peated barley to come through. Almost black with a creamy, tan head, it is a great beer for the dark nights of winter, yet enjoyable during any season.

There will be no need to fly to Seattle to get a fine smoked porter, Colin, because now you can "Brew Your Own." For more about Big Al Brewing and their other fine beers, visit www.bigalbrewing.com. BYO

Big Al Brewing Company Smoked Porter Clone
(5 gallons/19 L, extract with grains)

OG = 1.056 FG = 1.012 IBU = 44 SRM = 45 ABV = 5.8%

Ingredients

3.3 lbs. (1.5 kg) Coopers, light, unhopped, liquid malt extract
1.5 lbs. (0.68 kg) dried malt extract
1 lb. (0.45 kg) 2-row pale malt
21 oz. (0.60 kg) crystal malt (80 °L)
21 oz. (0.60 kg) chocolate malt (350 °L)
10 oz. (0.28 kg) roast malt (450 °L)
5 oz. (0.14 kg) peat-smoked malt
11.7 AAU Nugget hop pellets (60 min.) (0.9 oz./26 g at 13% alpha acids)
1.25 AAU Fuggles hop pellets (15 min.) (0.25 oz./7 g at 5% alpha acids)
0.25 oz. (7 g) Fuggles hops (0 min.)
½ tsp. Irish moss (30 min.)
½ tsp. yeast nutrient (15 min.)
White Labs WLP004 (Irish Ale) or Wyeast 1084 (Irish Ale)
¾ cup (150 g) of corn sugar for priming (if bottling)

Step by Step

Steep the crushed grain in 2.5 gallons (9.5 L) of water at 156 °F (69 °C) for 30 minutes. Remove grains from the wort and rinse with 2 quarts (1.8 L) of hot water. Add the liquid and dried malt extracts and boil 60 minutes. While boiling, add the hops, Irish moss and yeast nutrient as per the schedule. When the boil is complete, 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). Pitch your yeast and aerate the wort heavily. Allow the beer to cool to 68 °F (20 °C) and then hold at that temperature until fermentation is complete. Transfer to a carboy, avoiding any splashing to prevent aerating the beer. Allow the beer to condition for 1 week and then bottle or keg. Allow the beer to carbonate and age for 2 weeks.

All-grain option:

This is a single-step infusion mash using an additional 8 lbs. (3.6 kg) of 2-row pale malt to replace the liquid and dry malt extracts. Mix all of the crushed grains with 4 gallons (15 L) of 173 °F (78 °C) water to stabilize at 156 °F (69 °C) for 60 minutes. Slowly sparge with 175 °F (79 °C) water. Collect approximately 6 gallons (23 L) of wort runoff to boil for 60 minutes. Reduce the 60-minute Nugget hop addition to 9.8 AAU (0.7 oz./19.8 g) to allow for the higher utilization factor of a full wort boil.

The remainder of this recipe and procedures are the same as the extract with grains recipe.

Gluten-Free Brewing

tips from the pros

by Dawson Raspuzzi

Who needs barley to make beer?

BEER CONTAINS FOUR BASIC INGREDIENTS: BARLEY, WATER, HOPS AND YEAST. OF COURSE BARLEY CONTAINS GLUTEN, SO WHAT DO YOU DO IF YOU SUFFER FROM CELIAC DISEASE? NOT DRINK BEER? WE THINK NOT! THANKFULLY, MORE AND MORE BREWERS HAVE BEGUN BREWING GLUTEN-FREE BEER. WITH ADVICE FROM THESE PROS, YOU CAN BREW YOUR OWN GLUTEN-FREE BEER TOO!

Gluten-free brewing is in its infancy. Although this poses a lot of challenges, it also presents a lot of opportunities because there are a variety of ingredients such as sorghum, buckwheat, chestnuts, millet, quinoa, amaranth, and teff to choose from that may have been underutilized and not fully explored in the past.

Our flagship beer, the Aurochs White Ale, is our spin on a witbier and utilizes millet and quinoa. We also spice the beer with orange peel, coriander, and chamomile. We chose these ingredients because they are 100% gluten-free from start to finish and taste great. Our goal from the beginning has been to create beers that can be enjoyed by anyone, and we feel we have accomplished that. Aside from being naturally gluten-free and tasting great, millet is really good in terms of its enzymatic strength, and for this particular style, we feel that quinoa is a great complement because of its high protein content.

Most gluten-free grains require a specialized step-mash profile to achieve suitable extraction levels. For example, a single-step mash with millet at traditional mash temperatures will have a 30% yield, which is significantly less than 2-row barley, which tends to have an 80% yield. More complex mash profiles can generate millet yields of 60-70%.

A second issue is the free amino nitrogen (FAN) levels tend to be slightly lower than traditional beers. For example, sorghum syrup has about 70% of the FAN of barley-based syrup. It is important to pay extra attention to oxygen levels, yeast handling, and the percentage of the grain bill devoted to adjuncts to ensure proper fermentation.

Another challenge for the all-grain gluten-free homebrewer to note is that higher gravity tends to be more challenging because the majority of gluten-free grains are small and huskless, making it more difficult to separate the wort. To add to this difficulty, the lower extraction levels of gluten-free grains tend to require a larger quantity of grains to hit desired gravities. At the same time, there are plenty of options to improve wort separation or boost gravity in the boil kettle.

I see two contrasting approaches to developing gluten-free recipes. It may be easier to replicate a style if that style derives the majority of its flavor from an aspect of the recipe other than the grain bill, such as spices, yeast, or hops. If you were trying to submit a gluten-free beer into a competition that evaluates beers based on style conformance, this would be a good approach. An alternative approach would be to examine the strengths of the gluten-free ingredients and play to those strengths whether or not it will allow you to conform to a specific barley-based style. We tend to use both approaches when developing new recipes.

My advice for homebrewers who are new to gluten-free brewing; first and foremost, take the time to understand what is and is not gluten-free. There is a lot of misinformation out there, even among the professional brewing community. For example, most liquid yeast strains are not gluten-free. Second, start with sorghum syrup and rice syrup to eliminate much of the complexity with all-grain brewing. Once you have mastered extract brewing, then make the jump to all-grain gluten-free. Third, get creative. The blessing and the curse of brewing gluten-free is that there is no guidebook.

In 2012, Ryan Bove (left) left a career as a mechanical engineer to start Aurochs Brewing Company in Emsworth, Pennsylvania, with his childhood friend, Doug Foster (right). Both co-founders are required to follow a strict gluten-free diet for medical reasons. Aurochs uses unique, ancient grains, such as millet, quinoa, and amaranth to brew great-tasting craft beers that are naturally gluten-free.

In 1992 Crawford Moran wondered why the city of Atlanta where he was born did not have its own brewery. And with one stupid question began his career in the brewing business. He founded Dogwood Brewing Co., is the Brewmaster and Co-owner at both 5 Seasons Westside and 5 Seasons North, and is Co-owner and Brewmaster at the just opened Slice & Pint Pizza/Brewery where he is busy building a new brewery.

I brewed my first gluten-free beer two to three years ago. I wouldn't say there is a high demand. I just had many guests beg me to brew a good one. We want to be the place where all the beer lovers love to go and there are some folks who are beer lovers, but whose bodies just can't handle the gluten any more. I did a tasting of all of the gluten-free beers that were on the shelves and they all sucked. The gluten-free beers I tasted were really dumbed down, much like mass-produced American beer. Barley adds the body to beer and lots of depth. But people just made the gluten-free beers so simple so they would offend no one.

Hops don't have gluten, so I thought it would be fun to make a nice American pale ale, which we call Elmer's Gluten-Free. The lack of barley definitely creates a relative lack of body compared to a "real" beer, so I think the hop additions add a layer or two of complexity. In a way, it makes up (a portion) for that lack of body and depth of character.

To make up for the lack of barley, I use sorghum and buckwheat and then I add more hops than any gluten-free beer I have tasted out there. It has about 45 IBUs with great American pine and citrus hops. At first I tried to malt my own buckwheat. I got some from a local farmer and thought it would be a good idea. It wasn't. I am a brewer and not a maltster.

I use equipment that is only used for gluten-free to avoid the risk of cross contamination. I also use a dried yeast so it is not grown up in an environment with malts that have gluten, and I do not repitch the yeast.

I don't think it is more difficult to make a gluten-free beer. Certainly there are different considerations since you can't use the basic malts. But like everything in life, you can make it better if you try. BYO

Keys to Success

Selecting hops

help me
mr. wizard
by Ashton Lewis

Q HOW MANY BATCHES DOES IT TAKE TO MAKE GOOD BEER?
KEN STARKEY
VIA FACEBOOK

A Wow, this is really the million dollar question. I don't think there is a magic number of brews that are required before a brewer successfully brews the first batch of good beer. There are some brewers who strike gold early on and others who seem to flounder about brewing mediocre beer for their whole brewing career. Once upon a time when I was a graduate student at UC-Davis I taught brewing classes, ranging from homebrew classes to classes for prospective brewery owners, and I believe that the secret to brewing success is heavily influenced by education. Reading *Brew Your Own* is a great way to learn about brewing from others and, hopefully by doing so, avoiding the mistakes that many authors discuss in their articles.

There are a few things that certainly make successful brewing at home much easier, and the sooner a new brewer pays attention to most of these details the sooner good beer is being brewed. So here is a list of things that will expedite the process:

1. The single most important thing to understand and master is the art of cleaning. You do not need an arsenal of expensive tools and exotic cleaners, but you do need a basic tool kit appropriate for the task. A few brushes, non-abrasive scrubby pads, a general purpose, mild-alkaline cleaner and a non-rinse sanitizer that leaves no off-flavors when properly air dried are the bare essentials. Great beer begins with a clean brewing environment.

2. Remember that brewers make wort and that yeast convert wort to beer by fermentation. The key ingredient and causative agent of beer production is yeast. Great beer cannot be made without great yeast. Great yeast is alive (viable), spunky (vital) and pure (contaminant free). This may sound like the description of a new-born, but is meant to describe a yeast population that has few dead cells with the majority of the population being very healthy and with very few unwanted microorganisms, such as lactic acid bacteria, that can spoil beer. Today's homebrewer has access to really great yeast sold by several well-established yeast laboratories.

> "The single most important thing to understand and master is the art of cleaning."

3. Believe the hype! Commercial brewers have advertised the importance of quality ingredients for a very, very long time. While some of the ads seem cliché and are rife with hyperbole, there is absolutely no question that ingredient quality has an enormous bearing on finished beer quality. Homebrewing is a time-consuming endeavor that has the potential to

Photo by Les Jörgensen

bring pride and joy, and also has the potential to bring embarrassment and frustration. Set yourself up for success by selecting high quality brewing ingredients.

4. When you sense that you are becoming lost, stop and ask for directions. I have never understood why so many people, especially men, refuse assistance when so obviously lost. Brewers who try to figure out everything on their own are almost guaranteed to have slow success. Remember that the history of brewing is as old as civilization and that beer brewing significantly influenced the history of scientific inquiry. Whatever the problem you are facing, it has probably been encountered and solved by someone else. I will repeat this tip; when you sense you are becoming lost, stop and ask for directions.

5. Homebrewing is a hobby and is supposed to be fun. Whenever you make a mistake, brew a batch that is less than perfect, or experience a mechanical malfunction that ruins a batch of beer, take it all in stride. If you are not having fun while homebrewing, something is not quite right. Times like these were likely the inspiration of Charlie Papazian's famous quote. So, if you find yourself taking things too seriously and not having much fun, open your beer fridge, reach for a cold one and, "relax, don't worry,[and] have a homebrew"!

Q I'VE BEEN SELECTING HOPS FOR MY BEERS BASED OFF OF TRADITIONAL METHODS. FOR EXAMPLE; EAST KENT GOLDING AND THE LIKE FOR ENGLISH STYLES, NOBLE HOPS LIKE HALLERTAUER FOR GERMAN LAGERS, AND CENTENNIAL, CITRA®, SIMCOE®, MOSAIC™, AMARILLO®, AND CASCADE FOR AMERICAN STYLES. BUT I'VE REALIZED MOST OF MY ADDITIONS ONLY TAKE INTO CONSIDERATION ALPHA ACIDS; HIGH ALPHA VARIETIES FOR BITTERING AND HOPS I'VE BEEN TOLD THAT ALL THE COMMERCIAL BREWERS USE AS FLAVOR AND AROMA ADDITIONS. SO HERE COMES THE ACTUAL QUESTION . . . WHAT ROLE SHOULD ALL THE OTHER OILS AND RESINS, LIKE COHUMULONE, MYRCENE, HUMULENE, AND THE LIKE PLAY IN A BREWER'S DECISIONS ON WHAT HOPS WILL WORK WELL WITH ONE ANOTHER AND WITH DIFFERENT TYPES OF STYLES?

JESSE PEREZ
LAKEWOOD, WASHINGTON

A I consider my knowledge on this topic typical for the average craft brewer and will answer your question from my perspective and comment on some of the topics brewers and hop researchers are looking at related to this very deep subject. In general terms, many brewers approach hops with very little numerical precision.

Hop additions continue to be primarily based upon alpha acid concentration measured shortly after hop processing. Over time, alpha and beta acids oxidize and the concentration is reduced. However, these oxidized compounds do not negate the bittering value of hops. Oxidized beta acids are bitter and some argue that these compounds offset the loss of alpha acids during storage. For this reason, many brewers simply use the post-harvest alpha acid analysis result in their brewing calculations. Brewers know hops will lose their bittering value and hop aroma due to excessive oxidation when stored in a warm environment and/or exposed to oxygen because of opened bags of pelletized hops or loose bales of whole. So hop storage temperature and duration is something that most brewers control. Alpha acid loss is variety-dependent and a common method used to assess storage qualities of different varieties is the hop storage index (HSI). High HSI values indicate lower alpha acid loss compared to low HSI values.

You mention cohumulone in your question. Cohumulone is one of five types of alpha acids, the other four being humulone, adhumulone, posthumulone and prehumulone. Hop varieties with high cohumulone concentrations are considered by many to have a harsh bittering quality. Indeed, one of the commonalities of "noble" hops and prized bittering varieties is their low cohumulone levels, which is usually less than 20% of the total alpha concentration. Brewers do use this measure when selecting hops.

For many brewers, the most tantalizing feature of hops is their wonderful array of aromas, and many of the styles of beer being brewed by craft brewers around the world fea-

ture hop aromas. So it only makes sense that hop aroma is somehow quantified and used by hop merchants and brewers when hops are bought and sold. Unfortunately, quantifying hop aroma is very far from easy and the only thing that most brewers know about the hops they purchase is the alpha acid and total oil content. It is the total oil component of the analysis that relates to aroma, but simply knowing the total oil content of hops is really not very useful. This is why brewers heavily rely on old-fashioned sensory methods to select varieties and specific lots of varieties for use in brewing. Many brewers annually travel to hop growing regions to participate in hop selection. During selection these brewers evaluate hops with their eyes and noses to determine which lots they want to purchase. Brewers also base their purchasing decision on variety, where the hops were grown, how they were processed and when they were harvested. All of these factors affect the brewing qualities of hops.

The problem with basing decisions on these hands-on methods is that the method depends on the skill and knowledge of the person conducting the evaluation. Since these methods are not quantitative, it is not possible to compare various lots without having the evaluator check out the sample. This is an obvious problem and scientists have been studying hops using a variety of chemical methods for nearly a century. Gas chromatography (GC) is the most effective tool to separate hop aroma compounds. Since GCs simply separate compounds from one another, various detectors are used to determine the identity of the various fractions that flow from the column. The most common GC detector is the mass spectrophotometer (MS). The GC-MS is used to produce a "finger print" of sorts of the aroma compounds present in a sample. Some GCs are equipped with a sniff port that allows a person to smell and describe aromas during the runtime of the sample, adding important information to the "finger print" produced by the mass spectrophotometer. Scientists are able to use these types of analytical methods to compare varieties, evaluate and describe new varieties, help brewers better understand why we prefer certain varieties and to quantify the hundreds of aroma compounds found in hops.

The practical side of this can be seen when a new variety is being evaluated for use in the brewery. Using GC-MS data is one way to determine similarities between varieties. If you know some of the key aroma compounds you like to see in aroma varieties, GC-MS data can be used to find the varieties that seem to have the properties you desire. You asked a question about a very broad topic and my objective with this answer was to give a small peek through the laboratory door into the types of things that scientists are evaluating. I hope this information begins to answer your question. BYO

"Other Smoked Beer"

Endless options with smoked malt

style profile
by Jamil Zainasheff

early on in my beer education, I tried the classic smoked beers of Germany. I found the bold smoked flavors intriguing. It reminded me of two of my favorite things: camping and barbeque. I had been playing around with different malts by that time and I quickly realized that smoked malt was a completely different flavor tool in my quest to make great beers. It did not take me long to go from drinking a classic rauchbier to thinking about how I might use smoked malt in other beer styles. The first style that came to mind was robust porter. The dark, rich malt character seemed like a natural fit for adding smoked malt. Soon after that, I found Alaskan Brewing Company's classic example of the style was readily available in my area and I began my quest to brew my own smoked porter. I still found the classic rauchbier enjoyable, but the possibilities for smoked malt in other beers was like the Wild West in my imagination and my quest to brew other smoked beer styles took off.

The "Other Smoked Beer" category is wide open as you can add smoked malt to any existing beer style. Of course, some styles might marry better with smoked character than others. The goal is a pleasing balance between the smoke character and the base beer style. You want the base beer characteristics to still be evident and to express themselves, but layered in with that needs to be a noticeable smoke character. If you are adding smoke to a hefeweizen or a delicate Munich helles, then you will want to use a very light hand with the smoked malt. A bold smoke character could easily cover the delicate notes of these beers. On the other hand, if you are looking to add smoked malt to a bockbier, robust porter or an imperial stout, then it will require a higher percentage of smoked malt to achieve a noticeable level of smoke character. Just keep in mind that you want to strike a balance and that harsh, phenolic smokiness is not appropriate.

Selecting a base beer style

When choosing a base beer style, think about how the key elements of that beer style would work alongside the smoked malt character. Would a West Coast style IPA work well with smoked malt? I do not think so. The bold hop character full of pine and citrus would mask quite a bit of smoke character. Getting enough smoke character so it was on an even footing with the hop character would probably be overwhelmingly smoky and too harsh along with the substantial hop bitterness. When you look at the classic rauchbier there is a sweetness and fullness of malt that is able to carry the more dry and phenolic smoked malt character. So beers that, as a base style, are a little on the sweet side are often a better choice.

> "The 'Other Smoked Beer' category is wide open as you can add smoked malt to any existing beer style."

When I started Heretic Brewing Company I was playing around with a variety of unusual combinations. One was a smoked dark Belgian ale that would be around 8% ABV. I knew that it would be a tricky beer to get right. Too phenolic a yeast would accentuate the phenolic smoke character. Belgian ales need to finish dry, so the sweet malt character would not be there to balance the smoked malt dryness.

I played with a variety of yeasts and mash temperatures. The best combination was with Belgian yeast

Continued on page 21

Photo by Charles A. Parker/Images Plus

Smoked Porter
(5 gallons/19 L, all-grain)

OG = 1.065 FG = 1.016
IBU = 31 SRM = 39 ABV = 6.5%

Ingredients

7.7 lbs. (3.5 kg) American 2-row (2 °L)
2.6 lbs. (1.2 kg) beech smoked malt (8 °L)
14.1 oz. (0.4 kg) Munich malt (8 °L)
14.1 oz. (0.4 kg) crystal malt (40 °L)
14.1 oz. (0.4 kg) crystal malt (75 °L)
10.6 oz. (0.3 kg) chocolate malt (350 °L)
7 oz. (0.2 kg) black patent malt (525 °L)
5 AAU Kent Goldings hops (60 min.) (1 oz./28 g at 5% alpha acids)
2.5 AAU Willamette hops (30 min.) (0.5 oz./14 g at 5% alpha acids)
2.5 AAU Willamette hops (15 min.) (0.5 oz./14 g at 5% alpha acids)
0.25 oz. (7 g) Kent Goldings hops (0 min.)
0.25 oz. (7 g) Willamette hops (0 min.)
1 tsp. Irish moss (15 min.)
White Labs WLP001 (California Ale), Wyeast 1056 (American Ale), Fermentis Safale US-05 or Lallemand BRY-97 yeast
Priming sugar (if bottling)

Step by Step

My current base malt is Great Western Pale Ale malt, but other malts of a similar nature should work well. I like Weyermann smoked malt. We use Best Malz Munich. I prefer British crystal malts as they have a huge caramel flavor and the same goes for black and chocolate malt. Feel free to substitute any high quality malt of a similar flavor and color from a different supplier. My hops are in pellet form and come from Hop Union, Willamette Valley, or Hopsteiner depending on the variety.

Mill the grains and dough-in targeting a mash of around 1.5 quarts (1.4 L) of water to 1 pound (0.45 kg) of grain (a liquor-to-grist ratio of about 3:1 by weight) and a temperature of 154 °F (68 °C). Hold the mash at 154 °F (68 °C) until enzymatic conversion is complete. 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 1.050.

The total wort boil time is 90 minutes. During boil, add hops and other additions at times indicated. Chill the wort to 67 °F (19 °C) and aerate thoroughly. The proper pitch rate is 2 packages of liquid yeast or 1 package of liquid yeast in a 2.5-liter starter.

Ferment at 67 °F (19 °C) until the yeast drops clear. At this temperature and with healthy yeast, fermentation should be complete in about one week. Allow the lees to settle and the brew to mature without pressure for another two days after fermentation appears finished. Rack to a keg and force carbonate or rack to a bottling bucket, add priming sugar, and bottle. Target a carbonation level of 2.5 volumes.

Smoked Porter
(5 gallons/19 L, extract with grains and partial mash)

OG = 1.065 FG = 1.016
IBU = 31 SRM = 39 ABV = 6.5%

Ingredients

4.9 lbs. (2.2 kg) pale liquid malt extract
2.6 lbs. (1.2 kg) beech smoked malt (8 °L)
14.1 oz. (0.4 kg) Munich malt (8 °L)
14.1 oz. (0.4 kg) crystal malt (40 °L)
14.1 oz. (0.4 kg) crystal malt (75 °L)
10.6 oz. (0.3 kg) chocolate malt (350 °L)
7 oz. (0.2 kg) black patent malt (525 °L)
5 AAU Kent Goldings hops (60 min.) (1 oz./28 g at 5% alpha acids)
2.5 AAU Willamette hops (30 min.) (0.5 oz./14 g at 5% alpha acids)
2.5 AAU Willamette hops (15 min.) (0.5 oz./14 g at 5% alpha acids)
0.25 oz. (7 g) Kent Goldings hops (0 min.)
0.25 oz. (7 g) Willamette hops (0 min.)
1 tsp. Irish moss (15 min.)
White Labs WLP001 (California Ale), Wyeast 1056 (American Ale), Fermentis Safale US-05 or Lallemand BRY-97 yeast
Priming sugar (if bottling)

Step by Step

For most extract beers I use an ultra-light extract made by Alexander's (California Concentrate Company), but any fresh, high-quality light-color extract will work well. Always choose the freshest extract that fits the beer style. If you cannot get fresh liquid malt extract, it is better to use an appropriate amount of dry malt extract (DME) instead. I like Weyermann smoked malt and we use Best Malz Munich. Ideally, both of these should be converted in a partial mash. Weyermann smoked malt extract would be a good substitute for the smoked and Munich malts.

Mill or coarsely crack the specialty malt and place loosely in a grain bag. Avoid packing the grains too tightly in the bag, using more bags if needed. Steep the bag in about 1.5 gallons (~6 liters) of water at 165 °F (74 °C). The idea is that your temperature, once you add the grain, will drop back to an ideal temperature for the malt conversion and will convert some of the starch from the Munich and smoked malt. After 30 to 60 minutes, lift the grain bag out of the steeping liquid and rinse with warm water. Allow the bag to drip into the kettle for a few minutes while you add the malt extract. Do not squeeze the bag. Add enough water to the steeping liquor and malt extract to make a pre-boil volume of 5.9 gallons (22.3 L) and the gravity is 1.055. Stir thoroughly to help dissolve the extract and bring to a boil.

The total wort boil time is 60 minutes. Add the first hop addition once the wort starts boiling and the other hop and fining additions at the times indicated. Chill the wort to 67 °F (19 °C) and aerate thoroughly. The proper pitch rate is 2 packages of liquid yeast or 1 package of liquid yeast in a 2.5-liter starter.

Ferment at 67 °F (19 °C) until the yeast drops clear. At this temperature and with healthy yeast, fermentation should be complete in about one week. Allow the lees to settle and the brew to mature without pressure for another two days after fermentation appears finished. Rack to a keg and force carbonate or rack to a bottling bucket, add priming sugar, and bottle. Target a carbonation level of 2.5 volumes.

that did not have a phenolic character and left a little residual sweetness. Even still, I did not think the results were good enough to add the beer to our lineup and I dropped the idea. Sometimes you play with ideas and styles, but they do not always work out.

If I were just starting out with other smoked beers, I would focus on the classics first in order to get familiar with making a great example. Start with bock, doppelbock, weizen, dunkel, schwarzbier, or helles. If you do not have the ability to brew a lager, start with robust porter or brown ale without a lot of hop character.

In selecting a base beer, the beer styles with minimal hop aroma and flavor work best. Not that it is impossible to marry hop character and smoke character, but the two can conflict in unusual and unpleasant ways. Keep in mind that the smoked malt character usually adds an element of dryness to the overall impression of a beer, although in some cases it can add a sweet initial impression as well. It is often necessary to adjust your hop bittering down a little depending on the amount of smoked character in the beer. It might be anywhere from none to a bunch. It is going to depend on how much smoke, how many IBUs, and the overall sweet versus dry character of the base style.

Selecting smoke

The smoke character imparted to a smoke beer comes from smoking the malt with different kinds of material. Yes, in the past all malt was smoked. Today, the classic is beech wood smoked malt, but other woods are used for different effects. For example, Alaskan Brewing Company smokes their malt using alder wood, which is classic in the smoking of salmon. Many homebrewers have played around with other woods, such as oak, hickory, maple, mesquite, pecan, apple, cherry, and more. Some are too closely associated with classic foods and can alter the character of the beer in ways you do not want. If you are not trying to make a bacon or barbeque beer, then steer away from classic smoking woods like hickory, mesquite or maple. Never get the urge to use any sort of evergreen wood, which will impart some nasty medicinal, resiny flavors.

For most of us, we will rely on our local homebrew shop to provide us with smoked malt. Different maltsters will have significantly different levels of smoke character. The age and storage conditions of the malt also impact the amount of smoke present. I remember coming across a sealed container of smoked malt that, once used, seemed to be plain Munich malt. After sitting sealed for 18 months, it had nearly zero smoked character. So the lesson there is to taste and smell the different smoked malts to be sure you are adding the right amount to your beer. Freshly

smoked malt can be a bit harsh so if you are making your own smoked malt then you should allow some time for the smoke character to mellow. If you over-smoke your malt then you can let it mellow longer.

You might come across peat-smoked malt. Do not use it. Peat-smoked malt imparts a horrible character to beer. It has a harsh and overpowering phenolic and dirt flavor and aroma that is a poor choice in any beer style. Even in small amounts, it is overwhelming.

What about smoke extract?

Technically, for brewers using steeping grains, you should not steep traditional rauch malt. It has unconverted starches, which will end up in your beer. You should do a mini-mash instead. If you are going to smoke your own malt, you might try crystal malt as the base, instead of malt that needs starch conversion.

In the past, Weyermann made a liquid malt extract from smoked malt. If you can still get it, that would be a good option. However, do not confuse that with liquid smoke flavoring, found in the supermarket. Some brewers wonder about grocery store liquid smoke extracts. In my opinion, it would be far better to steep unconverted smoked malt rather than using liquid smoke. I have never had a good smoked beer that used liquid smoke extract instead of smoked malt. In fact, the worst smoked beers I have ever tasted were made with liquid smoke. I suppose in theory it might be possible to use liquid smoke, but they make the liquid smoke for use in barbeque sauces, not beers. Those smoke extracts need a sweet, very full-flavored base to cover up their very intense flavors. The beers made with smoke extract that I have tasted ranged from tasting like an ashtray to tasting like the grease trap on a meat smoker (or what I imagine those taste like). They were all sharp, harsh, and very artificial tasting. I would avoid using liquid smoke extract, but if you insist, then try dosing a small amount first and scale up from there. It is easier to add more extract than it is to remove it if you add too much.

Amounts

It is difficult to give an amount of smoked malt to add to other smoked beers. The level of smoke in the malt is going to vary wildly and the amount of smoke needed for a given style will also vary wildly. One of the considerations is what kind and quantity of highly kilned grains are in the beer. At a certain quantity, your dark malts can accentuate the smoky character of the smoked malt. Regardless, you will probably find that most other smoked beer styles are going to use somewhere in the range of 7 – 20% smoked malt. (In comparison, the prevalence of smoked malt in rauchbier also varies widely, generally from

20% and up. One of the most prominent commercial rauchbier brands, Aecht Schlenkerla Rauchbier, brewed by the Hellerbräu of Bamberg, uses 100% smoked malt.) On the lower end of that spectrum for other smoked beer, using about 7%, is going to be for more delicate and conflict-prone beers like hefeweizen, while closer to 20% is going to be for beers like smoked porters. If the smoked malt you are using is extra bold, then maybe you cut those numbers. If it is extra mild, then maybe you increase them.

Hops

Most smoked beers do not have a huge late hop character. Generally, the malt plays the key roll and hops are just for balancing any residual sweetness. I have seen a few highly hopped smoked beers, but I never thought they were more than a curiosity. The hops always seem to overwhelm the smoke character or at best, it is an unharmonious marriage. Of course, I suppose someday someone will prove me wrong, but until then keep a couple of things in mind as you make hop additions to your smoked beers. In general, less hop flavor is better. You might have success with more of the noble hop flavors, focusing on the herbal, spicy, floral types. I suppose if you were trying to make a forest fire beer, piney hops would be the ticket. I cannot envision how citrusy or fruity hops would integrate with smoked malt character.

Yeast

The yeast you choose makes a tremendous impact on all beers, but with other smoked beer there are additional considerations. Smoked beers already have a level of phenolic character related to the amount of smoked malt and the type of smoked malt added. Using a phenolic-positive yeast strain will result in even more phenolic character. That phenolic character is not always just additive in the beer. In many cases, the result is multiplicative and a phenolic yeast can result in a huge, harsh phenolic character in the beer. I have tasted some great beers made with some phenolic-positive strains, but these always had very light smoked character. If you use phenolic-positive yeast, keep the smoked malt character very light.

The easiest yeast to use in smoked beer is "cleaner" strains, which do not produce a lot of esters or phenols. Lager yeasts or ale yeasts such as White Labs WLP001 (California Ale) or Wyeast 1056 (American Ale) can be a good choice. That does not mean you cannot use something with more fermentation character, but clean is a safe bet every time. Of course, you can always play with fermentation temperatures, pitching rates, and oxygen levels to develop a fermentation profile that is more in harmony with any smoked character in your beer. BYO

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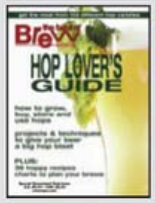

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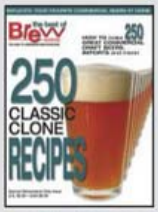

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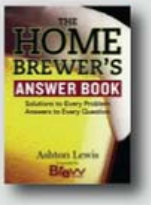

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Is it Crystal or Caramel Malt?

Story by **Terry Foster** and **Bob Hansen**

Homebrewers are often confused by the terms crystal and caramel malt and are sometimes uncertain as to whether these are basically the same thing and can be used interchangeably, or whether they are quite different animals. Partly this comes from the fact that crystal and caramel malts come in a range of different colors, and individual products from one maltster may not be identical to those from another producer. They are, in fact, proprietary products and are often given proprietary names, which only serve to increase the confusion. That's a pity because when these malts are properly used they are important cards in the discriminating brewer's hand. In this story, we'll talk about how these malts originated, and what they actually are, and see if we can't clear up that confusion.

The first point in this discussion is the fact that these are roasted malts, and the roasting is carried out in a specific manner (there are exceptions as we'll discuss later). Crystal malt came first and originated in England, some time around 1880. The roasting process to produce black malt had been practiced since 1817, when a man by the name of Daniel Wheeler took out a patent on the procedure. Black malt was widely used to replace brown malt in porter brewing, but porter drinking declined during the 19th century as the public developed a taste for pale ales. At the same time original gravities (and therefore alcohol levels) were also falling in Britain, which led to brewers producing lighter, weaker and less flavorful beers. This trend was further enhanced in 1880 when a new law was introduced that allowed brewers to substitute some base malt with sugar.

So, I presume that some bright maltster saw that there was (or would soon be) a need for a malt additive that could be added in small amounts to improve the body and flavor of pale beers, just as black malt served to give porters and stouts their characteristic flavors. So, since this maltster already had a roaster, he or she experimented with different levels of roasting and came up with crystal malt. The new product met with approval from brewers and went from strength to strength through to the present as British beer original gravities continued to decrease throughout the 20th century. Crystal malt is now the predominant colored malt used in Britain and is used in most ales brewed there.

Malting techniques improved considerably over the same period, and maltsters learned to produce crystal malts with different levels of color and flavor and suitablity for use in the whole range of British beer styles (including pale lagers). One result of this is a big part of the confusion about the difference between crystal and caramel malt. For there was a resurgence in homebrewing in Britain in the 1960s, and the country's malt extract producers were quick to see the opportunity and to develop products suitable for homebrewing. Having established a base over there, they were in a good position to expand into the US homebrewing market when the hobby started to be legalized and take off in popularity in 1978. And that brought popularity for British crystal malt too, since it was easy to add a little extra to an extract recipe by steeping some crystal malt and adding that to the brew. This at first overshadowed similar American products because by some quirk these were known as caramel malts, not as crystal. But soon these caramel malts became available to homebrewers, many of whom seemed to have thought, "If they're called caramel malts they must be different from British crystal products."

They are not different, of course, for with certain exceptions caramel malts are crystal malts, and the terms are often used interchangeably in the malting trade. Many producers, especially English and Belgian (such as Muntons, Simpsons, Hugh Baird, Crisp, Thomas Fawcett, Castle)

Photo courtesy of Briess Malt and Ingredients Co.

> “All crystal malts are caramel (type) malts, but not all caramel malts are crystal malts.”

Photos courtesy of Briess Malt and Ingredients Co.

Roaster-produced crystal-type caramel malt will have 90%+ of the kernels containing only glassy crystal-like converted sugar. Kiln produced caramel malt will have a large proportion, usually about 50%, of the kernels mealy and starchy on the inside, just like high dried or Munich malt. Top: Roasted (note >90% glassy) Bottom: Kilned (note about 50% mealy).

refer to them as crystal malts, though some (Briess, Weyermann) call them caramel malt. Though there are unique house flavors particular to every specialty maltster and varietal (and quality differences of course), the truth is most caramel malts produced by the same method have very similar flavor at the equivalent Lovibond color. This is because the flavors produced are mainly a function of the process.

There are, however, two distinct processes for producing caramel-type malts, namely kilning and roasting. It's important to understand the differences between them and find out what your supplier is using so you can properly formulate your beer. This is sometimes difficult as terminology is not consistent from supplier to supplier and is further complicated and obscured by trade and brand names.

The basic information you need to know to differentiate these two malts is this: Caramel malt is applied to both kiln and roaster-produced caramel malts, but the term crystal malt is normally reserved for caramel malts produced in a roaster. Logically, the term crystal malt should be reserved to describe malts that are truly crystal in that they exhibit even and consistent crystal-like, glassy kernels which is possible only by roasting (see the photos that show the malts after grinding, left). If we accept this terminology as being appropriate, then it should be realized that all crystal malts are caramel (type) malts, but not all caramel malts are crystal malts.

Which Malt is Which?

So, what's the difference between roasted crystal and kilned caramel malts? This becomes clear when we look at the difference in the two processes. Let's start with crystal-type caramel malts produced in a roaster. To start, sprouted barley after four days of germination is fed directly into rotating drum roasters similar to those used to produce coffee or cocoa. The malt is still "green" and growing and contains about 42% moisture. The drum is rotated and slowly heated to bring the grain temperature up to starch conversion temperature, roughly 150 °F (65.6 °C), just as is done in the mashing process in the brewery. As in mashing, the native amylase enzymes activate and turn the wet starch in the kernel into simple sugars. Because there is so little moisture, this gooey sugar stays inside the kernel. It's like millions of little mash vessels with wort trapped inside. Once conversion is complete, the maltster turns up the heat and begins drying out the malts. Very quickly the sugars are concentrated and the temperatures are taken high enough (>300 °F, 149 °C) to achieve caramelization of the sugars.

Caramelization is a term used to describe interactions between sugars under the influence of heat. This is really pyrolysis of sugars, and does not involve nitrogen compounds, as occurs with the so-called Maillard reactions, which more commonly occur in kilning of malt. Thus true caramelization is responsible for many of the colors and flavors associated with crystal malt. These flavors are "pure" candy-like caramel flavors since they are subjected to a shorter and more complete

Characteristic flavor compounds from carmelization and Maillard reaction.

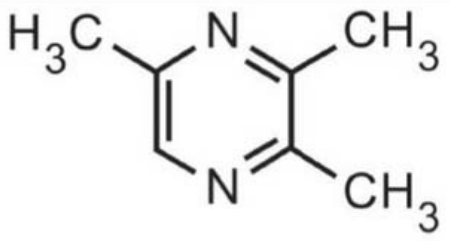
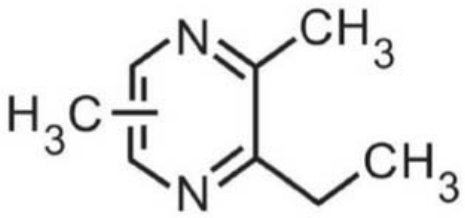
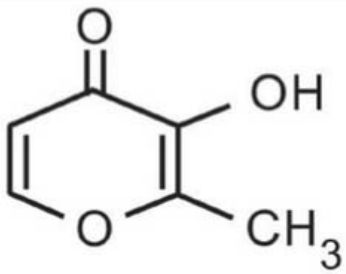
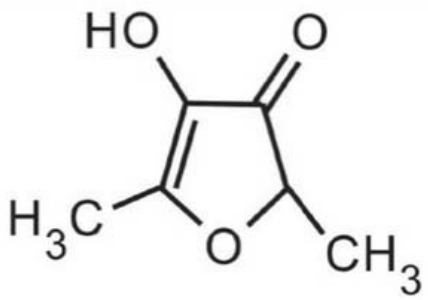
Compound structure	Name	Flavor	Reaction
	2, 3, 5-trimethylpyrazine	roasted, potato	MAILLARD
	2-ethyl-3, 5-dimethylpyrazine	nutty, roasted	MAILLARD
Compound structure	**Name**	**Flavor**	**Reaction**
	Maltol	sweet, caramel, fruity	CARMELIZATION
	Furaneol	sweet, sugar, caramellic	CARMELIZATION

Photo courtesy of Northern Brewer

conversion time as well as a controlled and rapid increase to high temperatures during the roasting process. Crystal malts have been through a truer caramelization process than a kilned caramel has, and therefore will have flavor attributes similar to candy, such as caramel and toffee. Some of the main compounds and their flavors are shown in the figure on page 37. Note that these compounds do not contain nitrogen as they come from the sugar-sugar interactions of caramelization. These clean, sweet, candy-like flavors present themselves unadulterated by biscuity, bready or other baked flavors more associated with the Maillard reaction and kilned caramel malts.

The maltster can control the level of caramelization and color of caramel/crystal malt by varying the time and temperature of heating of the sugar-containing grain. Consequently most maltsters offer a range of these malts, with increasing caramel levels and color increasing from pale gold to a dark red-brown hue, accompanied by increasing intensity of flavor. It should be understood that these malts are all produced in individual batches, and on a much smaller scale than that for regular pale malts. In one sense, crystal/caramel malts are very much a "craft" product. When you remember that the whole malting process starts with a natural product, barley, which varies from year to year and growing place to growing place, you will understand that producing malt of consistent quality is no easy task. That is because although the roasting process takes up to four hours, the caramelization stage of the process is quite rapid and takes place only during the last 15–20 minutes of the procedure. The green malt used for crystal/caramel production has not been kilned and can germinate further, depending upon how long it stands before roasting, adding yet further possible variations. The extent of caramelization is therefore controlled by an experienced roaster relying upon taste and color comparison with standard samples. The finished product will be checked by various scientific tests for consistency and color, but these take too long to complete for them to be used during the rapid stage of the process. Each batch is a little bit different, each produced by hand and relying on the roaster's skill in making a consistent product with an ever-changing raw ingredient. We brewers often take the quality of crystal/caramel malts for granted, and do not reflect enough upon the skill and science required to produce them.

On the other hand, the term caramel malt can also refer to malts dried in a kiln, rather than being roasted. These malts have been treated at much lower temperatures than that of crystal malts as well as more variable temperatures due to a larger surface area. Due to the location of grain in the kiln bed and the temperature of the kiln this creates a mixture of malts, some of it with the glassy, caramelized center typical of caramel malt, but some with the malty, mealy character typical of high dried malt. The top layers of grain are subjected to quick drying under moisture and temperature conditions which does not permit the formation of crystal malt but does allow for a high-temperature, dry environment to produce Munich malt. Conversely, the inside layers of the bed are not penetrated as easily by the airflow required to dry the grains. These conditions create an environment that is high in moisture and at high temperature, allowing for continued conversion of the starchy inside of the malt kernel. This conversion creates simple sugars, which caramelize in the high kiln temperatures, just as happens in a roaster. Therefore, unlike true roasted caramel malts, kilned caramel malt is not homogeneous, and a significant proportion of the kernels from it will not have the same glassy appearance as the roasted caramels. The kiln-dried versions will have some candy-like caramel flavor but will also be "adulterated" with the intense, malty flavor of high temperature kilned malt.

Many beers and brewers do quite well with the mix of caramel/maltiness that comes from a kilned caramel malt. This has obvious advantages for commercial brewers looking to simplify grain inventories. For example, Caramel Munich and Caramel Vienne are two products produced by Briess Malting and Ingredients Co. meant to be used by brewers in this way. Since Briess typically does not manufacture kilned caramels, they achieve the same effect by blending caramel malts with Munich or Vienna malt. While this process creates a similar product to that obtained by direct kilning, the result is a more consistent product. There are many combinations that can be made using this idea, producing a range of hues and flavors suited to many different beer styles. The all-grain homebrewer might see things differently and would

want to add Munich and caramel malts separately if he was looking for more control with this type of flavor combination. Malt extract brewers would also have to carry out a partial mash with this type of mixture, or kilned caramel as they contain starchy endosperms that must be mashed. They might prefer to simply stick to the use of straight caramel or crystal malt and an extract containing Munich malt.

Types of Caramel Malts

Weyermann, Dingemans, Castle, Muntons, Crisp, Briess (a European immigrant) and most European specialty malt producers produce caramel-type malts in a roaster. How do you know which type of caramel malt you have? Well the name doesn't always help much, since trade names are often prefixed by the term "Cara," which may be applied to both roasted and kiln-dried types. But no craft or homebrewer should ever overlook the importance of taste, sight and smell. So the first thing to do is to simply look at a number of kernels. Roaster produced crystal type caramel malt will have 90% + of the kernels containing only glassy crystal like converted sugar. Kiln produced caramel malt will have a large proportion, usually about 50% of the kernels mealy and starchy on the inside, just like high-dried or Munich malt. (See pictures of cross cut malts on page 36) The second thing to do is to taste a kernel or two. Depending upon the degree of roasting, roasted caramels will have candy, nutty, or even raisin-like flavors; kiln-dried caramels may show some of these flavors, but to a lesser extent, and they will be masked by the grainy malty notes from the grains, which have not been caramelized.

As stated earlier, for the same Lovibond color, roasted caramel/crystal malts from different maltsters are comparable in their effect on beer, and for the record there appears to be no significant difference between those produced from 2-row or 6-row barley. There are a wide range of these malts available to craft and homebrewers, although European, and especially British products, are often towards the high end of the color range, from 50–60 °L up to as high as 140 °L. For example, Muntons offers two crystal malts at roughly 65 and 170 °L . Of US suppliers, Briess has an extensive series of caramel malts ranging from 10 °L to 120 °L, which contribute flavor intensity from mild caramel sweetness to more intense toffee and raisin notes. Great Western Malting also produces quite a wide range (from 13–17 °L up to 145–155 °L).

Color and Hue of Caramel and Crystal Malts

It has been shown that the color contribution to wort and beer of all caramel and high-dried malt is nearly exactly the same. That is the coloring compounds generated in these processes absorb light in the same way. What is different is the amount of these compounds contributed by each type of malt. Darker malts contribute more color compounds and make it possible to achieve darker colors and the associated unique hues.

Choosing Caramel Malts

There is more than meets the eye to finding a malt or combination of malts that will give you the flavor and other characteristics you desire while having the right amount of coloring compounds.

As an example, say you wanted an Abbey-style beer to have a deep, rich mahogany color. This color is achieved by having a 35 °L beer made with the red-hued malt from caramel roasting or kilning processes. If you tried to do it with a 10 °L caramel malt you would have to use 3 lbs. (1.3 kg) of caramel malt per gallon (6.8 L) and it would be 100% of your grist. Impossible right? Use caramel 60 and it will be 17% of your grist. Use caramel 120 and it will be 8% of your grist. See why we say you need to use caramel 120 to get a mahogany shade in your beer? It's not because its color is different than what you get from caramel 60 it's that you need so much of the coloring compounds that it's impractical to do it with any other malt. Plus the darkest caramels are the only way of providing the complex, burnt sugar and raisin notes that have become associated with this beer type.

For a less straightforward example, say you are formulating an American amber lager and you want the color to be 12 °L. There are a host of caramel malts that could be successfully used and the differences are subtler than the earlier example. If you wanted a beer along the lines of an American-style Märzen/Oktoberfest, the malt character should be, "Light toasted not strong caramel (though a low level of light caramel is acceptable)" according to Great American Beer Festival (GABF) style guidelines (www.greatamericanbeerfestival.com/the-competition/beer-styles/). To be very

Photo courtesy of Northern Brewer

malty you could use 50% Munich 10 °L or 25% Munich 20 °L with Vienna or base pale malt. The same beer could be formulated slightly less malty and more to style with Vienna or base pale malt, 20% Munich 10 °L and 5% Caramel 60 °L. Either a crystal 60 °L, a kilned caramel 60 °L or Caramunich 60 °L would work here, with the latter versions providing a slightly stronger malty note. It would not be within style guidelines if you formulated this beer with base pale malt and crystal malt alone, unless the base malt carried a strong malty note, such as 90% Vienna malt and 10% crystal (or kilned caramel) 60 °L. This last example is the most traditional recipe according to George Fix, author of *Vienna-Märzen Oktoberfest* (Brewers Publications, 1991), which is part of the *Brewing Classic Styles* series.

If you wanted a beer along the lines of an American-style amber lager or California common, traditional GABF style guidelines would favor crystal-style caramel malts as these beers have, "A noticeable degree of caramel-type malt character in flavor and often in aroma" and "low to medium low" malt character. Using 10% of a Caramunich 60 °L or a 10% kilned caramel 60 °L to get the desired color may result in too strong of a malty character for style. Your best choice would be a smaller proportion, say 5–7% of a 60 °L caramel/crystal malt.

Know your Crystal (or Caramel)

We have endeavored to clarify the situation with crystal and caramel malts and to explain the differences between the wide ranges of products on the market. These are products of inestimable value to the craft and homebrewer, and can help you to establish a signature for your beers. Commercial brewers often use these malts to adjust the color of their brews and we have given some examples of this approach. However, these malts are also an important flavoring tool, especially in ales, porters and stouts. The practical use of these two malts in homebrewing is discussed in more detail, including a recipe for a bitter ale, in the "Techniques" column of this issue on page 87. BYO

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Photo by Forrest Whitesides

Story by **Forrest Whitesides**

RETHINKING GLUTEN-FREE HOMEBREWING

Techniques for Celiac sufferers

The widening awareness of Celiac disease over the last several years has given rise to a huge new segment of food and beverages nationwide: Gluten-free. From cookies, pasta, bread and jams, to brewed libations, gluten-free is big business. And while there is a relative bevy of fermented beverages available to gluten-free beer connoisseurs on the market (and more arriving on the scene all the time), the homebrew world seems to be lagging woefully behind.

We know from mountains of clinical research that Celiac disease is not a simple black-or-white matter. There are many people who do not meet the medical definition for Celiac but who still have gluten insensitivity that can make "standard" beer unpleasant (or worse) to consume. In the interest of the most extreme sensitivities on the entire gluten insensitivity spectrum, this article is focused on being 100% gluten-free, although there are ways to brew that are very low-gluten for those who are less sensitive (which I will address at the end).

Generally speaking, there are essentially no pre-malted/kilned gluten-free grains available in small quantities for the homebrew market. There are 50+ options for malted barley and related grains, but similarly processed gluten-free grains (see the table on page 44 for a list of popular gluten-free grains) just don't seem to exist in the same numbers and quantities. Of course, you can malt, kiln, and roast your own gluten-free grains, such as amaranth, quinoa, millet, or buckwheat, among others. The process is time consuming but results in base malt ingredients much closer to traditional malted barley. Homebrewers who have roasted their own barley will recognize some of the steps in this process.

However, in the interest of keeping the article within the scope of extract brewers and keeping things simple, I will stick with what is essentially one of the most viable options as a main fermentable: sorghum extract.

Sorghum: The Last Resort

Let's not kid ourselves here. As a substitute for malt extract, sorghum extract just doesn't measure up. Barley and sorghum are totally different creatures, and their extracts resemble each other mainly in the facts that they are gooey, light brown and contain fermentable sugars. And while sorghum is used in many beers across Africa, such as the sour and low-alcohol Umqombothi or Chibuku, it simply does not produce the type of flavor and mouthfeel that American and European palates have come to expect from beer. As the base malt for a beer, it is less than ideal. But to be fair to sorghum, it really isn't barley, and we should not

Gluten-Free Grains

Grains
• Millet
• Quinoa
• Buckwheat
• Sorghum
• Amaranth
• Corn
• Wild Rice
• White and brown rice

expect it to produce comparable results as a mere drop-in replacement for malted barley. We need to adjust our expectations — and tweak our recipes a bit — to get the most out of sorghum extract.

If you follow the typical gluten-free recipe you may encounter in magazines or on websites, the resulting beer is typically thin, fizzy and seriously lacking in body. It may also have a cider-like flavor not unlike acetaldehyde (a cause of the "green apple" off-flavor in barley-based beers). And while there are many adjuncts that are gluten-free (see table on page 48 for a list of gluten-free adjuncts), the vast majority do not contribute body since they ferment out nearly completely.

You can use the same adjuncts that macro-brewers such as InBev and SABMiller use, such as corn and rice, but these ingredients add very little to the flavor, color, or body. Lactose will add body, as it is not fermentable, but it can also add residual sweetness. Gluten-free malto-dextrin is also an option for adding mouthfeel; it is made from corn, is not fermentable and has no sweetness. Dark Belgian candi sugar will add some color and some caramel notes (which can substitute for the sorely missing roasty malted barley flavors), but will not noticeably help with body. As an alternative, you could use jaggery, piloncillo, brown sugar, or even make your own caramel on the stovetop.

Brown rice syrup also has a growing reputation as a suitable replacement for malt extract in gluten-free recipes. It is reportedly superior to sorghum extract in reproducing common beer styles, such as IPAs, stouts,

Gluten-Free Homebrew Recipes

Sans Glutonne Saison
(by Forrest Whitesides)
(5 gallons/19 L, extract only)
OG = 1.055 FG = 1.010
IBU = 20 SRM = 24 ABV = 5.8%

Ingredients
6.6 lbs. (3 kg) light sorghum syrup (3 °L)
1.0 lb. (0.45 kg) dark Belgian candi sugar (275 °L)
2 AAU Hallertau Hersbrucker leaf hops (60 min.) (0.5 oz./14 g of 4% alpha acids)
2 AAU Hallertau Hersbrucker leaf hops (40 min.) (0.5 oz./14 g of 4% alpha acids)
2 AAU Hallertau Hersbrucker leaf hops (20 min.) (0.5 oz./14 g of 4% alpha acids)
2 AAU Hallertau Hersbrucker leaf hops (10 min.) (0.5 oz./14 g of 4% alpha acids)
0.5 oz. (14 g) Juniper Berries, crushed (15 min.)
1 pkg Danstar Belle Saison dry yeast
Priming sugar (if bottling)

Step by Step
Add 6.0 gallons (23 L) of spring water to the brew kettle. For smaller kettles, add 3–4 gallons (11–15 L) initially and top off after boiling with the remainder. Bring the water to 150 °F (66 °C) and begin stirring in the sorghum syrup. Continue stirring until all of the syrup is in solution. Make sure none is collecting at the bottom, as it can scorch just like malt extract. Stir in the Belgian candi sugar and keep working the crystals until they are dissolved. Or if you bought the syrup version, just dump it in and stir briefly. When the wort comes to a boil, add 0.5 oz. (14 g) of Hallertau Hersbrucker leaf hops. Add additional 0.5 oz. (14 g) increments of hops with 40 minutes, 20 minutes, and 10 minutes remaining in the boil. With 15 minutes remaining in the boil, add the crushed juniper berries to the kettle. After 60 minutes of boiling, remove from heat and chill to approximately 70-75 °F (21-24 °C). Transfer the cooled wort to a fermentation vessel and aerate. If the collected wort is less than 5 gallons (19 L), top off with bottled spring water. Pitch the dry yeast directly into the fermenter. Ferment for approximately 7-10 days in the range of 70-76 °F (21-24 °C)

Pilsner Geben Frei
(by Desiree Knott)
(5 gallons/19 L, extract with grains)
OG = 1.046 FG = 1.011
IBU = 54 SRM = 3 ABV = 4.7%

Ingredients
6 lbs. (2.7 kg) brown rice syrup (2 °L)
12 oz. (0.35 kg) oat malt (2 °L)
12 oz. (0.35 kg) flaked rice (1 °L)
2 oz. (56 g) turbinado sugar (10 °L)
12 AAU Saaz hops (60 min.) (3 oz./ 84 g at 4% alpha acids)
4 AAU Saaz hops (15 min.) (1 oz./28 g at 4% alpha acids)
2 AAU Saaz hops (5 min.) (0.5 oz./14 g at 4% alpha acids)
White Labs WLP001 (California Ale), Wyeast 1056 (American Ale), Fermentis Safale US-05 or Lallemand BRY-97 yeast
Priming sugar (if bottling)

Step by Step
Crush or grind the grains and place in a muslin or paint strainer bag. Dough-in with 3 qts. (2.8 L) water to target a temperature of 150 °F (66 °C). Hold the mash at 150 °F (66 °C) until enzymatic conversion is complete. Raise the temperature to mash out at 168 °F (76 °C) and hold for 5 minutes. Raise the grain bag out of wort and wash the grains with 168 °F (76 °C) water. Top off your boil kettle to 6 gallons (23 L) and add rice syrup off heat. Stir until syrup is dissolved, then return the kettle to heat and bring to a boil. Boil the wort 60 minutes, adding hops at times indicated. Chill the wort to 68 °F (20 °C), aerate thoroughly and pitch yeast. Ferment at 68 °F (20 °C) until the yeast drops clear. Rack to a keg and force carbonate or rack to a bottling bucket, add priming sugar, and bottle. Target a carbonation level of 2.4 volumes.

Brown Rice Pale Ale
(by Desiree Knott)
(5 gallons/19 L, extract with grains)
OG = 1.061 FG = 1.016
IBU = 47 SRM = 6 ABV = 6.3%

Ingredients
6 lbs. (2.7 kg) brown rice syrup (2 °L)
1 lb. (0.45 kg) buckwheat, roasted (3 °L)
1 lb. (0.45 kg) oat malt (2 °L)
1 lb. (0.45 kg) quinoa, sprouted (1 °L)
8 oz. (0.23 kg) brown sugar, dark (50 °L)
6.5 AAU Chinook hops (60 min.) (0.5 oz./14 g at 13% alpha acids)
6.5 AAU Chinook hops (15 min.) (0.5 oz./14 g at 13% alpha acids)
5.5 AAU Citra® hops (15 min.) (0.5 oz./14 g at 11% alpha acids)
5.5 AAU Citra® hops (5 min.) (0.5 oz./14 g at 11% alpha acids)
White Labs WLP001 (California Ale), Wyeast 1056 (American Ale), Fermentis Safale US-05 or Lallemand BRY-97 yeast
Priming sugar (if bottling)

Step by Step
Crush or grind the grains and place in a muslin or paint strainer bag. Dough-in with 5 qts. (4.7 L) water to target a temperature of 154 °F (68 °C). Hold the mash at 154 °F (68 °C) until enzymatic conversion is complete. Raise the temperature to mash out at 168 °F (76 °C) and hold for 5 minutes. Raise the grain bag out of wort and wash the grains with hot water. Top off your boil kettle to 6 gallons (23 L) and add rice syrup off heat. Stir until syrup is dissolved, then return the kettle to heat and bring to a boil. Boil the wort 60 minutes, adding hops at times indicated. Chill the wort to 65 °F (18 °C), aerate thoroughly and pitch yeast. Ferment at 65 °F (18 °C) until the yeast drops clear then drop the temperature to 52 °F (11 °C) and store for 3 weeks at this temperature. Rack to a keg and force carbonate or rack to a bottling bucket, add priming sugar, and bottle. Target a carbonation level of 2.4 volumes.

** Note: While both White Labs and Wyeast products contain gluten in their growth medium, when diluted in 5 gallons (19 L) of wort, it will contribute less than 1 ppm gluten to the finished beer.*

Photo courtesy of Briess Malt and Ingredients Company

Sorghum extract is much like barley-based liquid malt extract in texture. However, you will need to tweak your homebrew recipes with adjuncts to get more mouthfeel from sorghum.

Photo by Forrest Whitesides

One of the hallmarks of gluten-free brewing is being sure to keep your equipment separate from any of your regular barley-based homebrew equipment to prevent cross contamination.

and other ales, and there are a great many gluten-free homebrewers who prefer it. It has a clean flavor with none of the aftertaste of sorghum. Briess also adds dextrins to their brown rice syrup to help compensate for the lack of body. However, I have not used it myself so I have not included it in this story. If you want to try some brown rice syrup recipes, however, gluten-free homebrewer Desiree Knott of High Gravity Homebrewing & Winemaking Supplies in Tulsa, Oklahoma shared a few of her favorites on page 45 (along with my sorghum-based recipe).

Embrace the Strengths

Given that sorghum extract is ubiquitous, inexpensive and easy for any brewer to implement into their brewing system, it makes sense to try to work around its characteristics that do not compare well to malt extract and focus more on what sorghum does well. After all, not every beer style requires a potent malt punch in order to be "to style."

So what does sorghum do well? It finishes light in color and body and is somewhat fruity on the palate. So it doesn't make a particularly "accurate" barleywine or big malty brown ale, but some styles it can be used to mimic include saison, lambic and many recipes/styles that rely on fruity, sour, spicy, or "wild" flavor profiles. I suspect that sorghum could even make a convincing Berliner weiss-alike, despite not being able to use any wheat in the malt bill, because of the tartness of the original style and its light color. A sorghum-based brew could be a great platform for fresh local fruit, or maybe you'd like to try out a wacky high-temperature Belgian concoction. Don't limit yourself style-wise when coming up with sorghum-based homebrew recipes, because you will likely be disappointed if you expect a middle-of-the-road pale ale out of this type of grain.

Brew Gear Considerations

In a lot of ways, brewing gluten-free is similar to brewing with *brettanomyces*, *lactobacillus*, *pediococcus*, and other members of the "funky bunch" with respect to gear. Keep your gluten-free equipment separate from your standard brew gear. As with *brett*, cross-contamination of equipment is a real concern. Simply cleaning and sanitizing your standard brewing equipment is not sufficient. If you are going to brew beer that you can be confident is truly gluten-free, you need keep your equipment separate to be absolutely sure you're not cross contaminating.

Know Your Ingredients

Make sure that every ingredient you are using is gluten-free. That includes anything that will go in the kettle or the fermenter, such as finings, yeast nutrient, and other non-flavor additives. If you cannot verify that a given ingredient is not gluten-free, do not use it. People with Celiac, or even less-severe

gluten insensitivity, can get very sick from even very low levels of gluten.

The "Brewers Clarex™" Option

Up until very recently, brewing gluten-free beers has required sticking strictly to the practices of avoiding all grains and ingredients that contain gluten and keeping any equipment used for gluten-free brewing quarantined from anything that touches glutenous grains. However, brewers have discovered that an enzyme released several years ago that is used traditionally to prevent chill haze can also break down proteins, including gluten, in beer. Brewers Clarex™, which was developed by DSM Food Specialties, can produce a beer made from traditional barley or wheat that can test below 20 ppm of gluten, which is the current international standard to be considered truly gluten-free. To use Brewers Clarex™, brewers simply add the enzyme to a batch of beer when pitching the yeast and it does its thing during fermentation. In fact, there are now commercial craft brews produced in this same way. For example, Omission beers, which are brewed by Widmer Brothers in Portland, Oregon, are brewed with Brewers Clarex™ in conjunction with a strict cleaning and sanitation process in the brewhouse and recipes utilizing lower-gluten grains to keep gluten levels below the 20-ppm threshold in their finished beers. While many gluten-free and gluten-sensitive beer drinkers have responded very well to beers brewed this way, this process should be approached on a case-by-case basis in homebrewing depending on the gluten-free drinker, and plan on lab testing your finished beers to be sure that the gluten level is low enough. If

Photo courtesy of Briess Malt and Ingredients Company

Gluten-Free Adjuncts

Processed Sugars	Natural Sugars	Non-Fermentables
Table sugar (sucrose)	Honey	Lactose
Invert sugar syrup	Agave Nectar	GF Malto-Dextrine
Corn sugar/corn syrup	Fruits/juices (fructose)	
Belgian candi sugar		
Homemade caramelized sugar		

you want to try homebrewing with Brewers Clarex™, White Labs has it available for homebrewers under the name CLARITY-FERM (WLN4000). White Labs also offers gluten testing for homebrews as an add-on to their Beer Test Kit or Alcohol Test Kit Plus, which will let you know if your homebrew meets the 20-ppm criteria. These test kits are available in homebrew shops and directly from White Labs by creating an individual account at Yeastman.com. For more information about Brewers Clarex™, visit www.dsm.com/products/brewers-clarex/en_US/home.html.

Go Gluten-Free

Even if you're not gluten-free yourself, chances are you have a friend who is, so it's not a bad idea to try experimenting with gluten-free brewing. After all, the more beer drinkers at your next homebrew get-together the better, right? BYO

Related Links:

- Get some tips for homebrewing with other gluten-free grains, and try two more gluten-free recipes: http://byo.com/story/698
- Get some gluten-free advice from *Brew Your Own*'s Mr. Wizard: http://byo.com/story/2505
- If you're an all-grain brewer, learn about malting grains to make your own gluten-free malt: http://byo.com/story/1108
- For more about a homebrewer who had to go gluten-free (and now malts his own grains), visit: http://byo.com/story700

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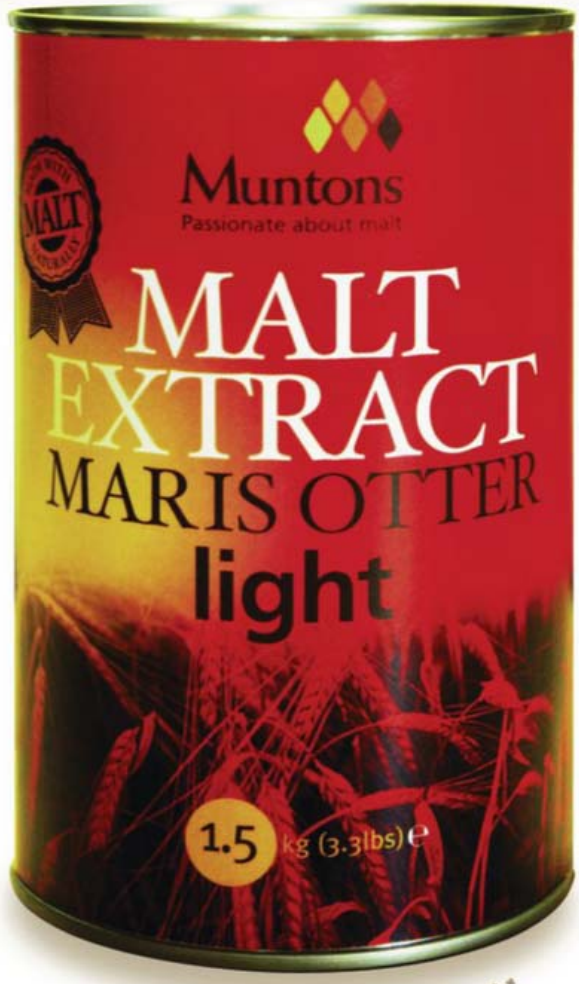

Developed by Dr G.D.H Bell and his team at Cambridge, England in the 1960s, *Maris Otter* is a two-row barley with unrivalled heritage in the UK brewing industry.

Dr Bell bred *Maris Otter* barley from a cross of *Proctor* and *Pioneer* - two top quality traditional malting barley varieties. To this day, *Maris Otter* seed is only sold to a select group of farmers who are specially chosen to grow the variety.

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Maris Otter is still highly prized in today's craft brewing industry providing independent brewers with a rare opportunity to create beers of unparalleled individuality and quality.

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Photos courtesy of Boston Beer Company

BREWING UP A REVOLUTION

The homebrew roots and culture of Samuel Adams

by **Betsy Parks**

When making plans to visit Boston and the Samuel Adams brewery for this story, I discussed my itinerary with a friend living in the city's South End, who seemed confused. "But isn't Sam Adams, so – you know – big?" she asked me with one eyebrow cocked quizzically, implying what many of today's well-rounded beer aficionados probably also think – that Sam Adams is one of the major players in commercial beer – akin to an Anheuser-Busch InBev or SABMiller, and perhaps no longer a craft brewery. And I have to confess, I didn't have an answer for her at the moment. Because Sam Adams IS big. Like, really big . . . at least compared to many of the other breweries in the US that are classified as "craft" breweries (but they're still a small player compared to A-B, SABM, etc.). The Boston Beer Company brews just over 2 million barrels of beer each year under the Samuel Adams label. And since Boston Lager was released in 1985, the company has built exponentially on the success of that flagship beer — founder Jim Koch was even recently revealed by the Bloomberg Billionaires Index this year to be one of the US' newest billionaires. So I have to admit, I was a little surprised to find a bunch of homebrewers brewing up crazy concoctions at will and a pilot system that was essentially a homebrew setup the morning that I visited Sam Adams' Jamaica Plain brewery. In fact, homebrewing is a vital part of Sam Adams' corporate culture as well as its success.

Founder, Homebrewer

Right from the start Sam Adams had a leg up over other microbreweries that were testing the commercial brewing waters in the 1980s: Founder Jim Koch. Koch is the sixth generation in a family of commercial brewers, so beer was already in the blood when he picked up the homebrewing hobby as a young man. By the time he started tinkering with batches of Boston Lager in 1984, he felt good about the beer he would eventually sell.

"I had an advantage over the other startup microbreweries," Koch said. "I was both a homebrewer and came from a long line of pro brewers. With that came an approach with quality and consistency." Back in the 80s, he said, almost nobody came from a brewing background — home or commercial. "The skill level today is so much higher. A really experienced homebrewer today will have made more of a variety of beers today than we as commercial brewers would have in 1984."

The original copper vessels that were used to brew Samuel Adams when the brewery opened in 1985 are still in operation today at the Boston, Massachusetts location.

At the time that Koch decided to open a brewery in 1985, "craft" brewing was a very different scene, however ("craft beer" is a term that Sam Adams actually helped to define. See sidebar on page 61). When Boston Lager first rolled out, the beer market featured a small handful of microbreweries and was dominated by mass-market pale lagers, and a "fancy" beer would have been, perhaps, a European import that often suffered greatly during transport to the US.

"You couldn't go to the grocery store and get a world-class beer in a variety of styles like you can now," Koch said. Back then a full-flavored beer option would have been, "an oxidized Sam Smiths."

The challenge for Koch before people embraced beers like Boston Lager was getting past distributors and skeptics and getting his beer into the glasses of beer drinkers, which often meant going from pub to pub, bar to bar, pouring his beer for bartenders and persuading them to carry it on their draft or bottle list. Koch also realized that a great way to market his beer was to educate people about what good beer tasted like and how beer is made, an effort that has not only endeared Sam Adams to millions of craft beer drinkers, but has also been a boon to the rest of the craft beer movement. Because of Jim Koch, small-batch, flavorful beer is no longer a tough sell on the commercial market.

"What he has done is amazing," David Geary, president of D.L. Geary Brewing in Portland, Maine said recently to *The Boston Globe* of Koch's success and marketing efforts. "He's very focused, a brilliant marketer and he sort of taught us all how to sell beer."

The Brewery

One of the hallmarks of Koch's marketing — educating people about beer — begins at the original Sam Adams Brewery in Boston's Jamaica Plain. Since its early days, the home base has become part brewery, part welcome center. For lots of people, Boston Lager is the first craft beer they have ever tasted, and the brewery tour is the first time they see and touch some of the ingredients that are used to make beer. Tours are led every 45 minutes, Monday through Saturday, and lead guests right into the heart of the brewery to see the iconic brewing system and the brewers who star in the Sam Adams commercials, as well as the oak barrels in their aging program. And, of course, they get to sample the beers. When I visited, first thing on a Friday morning, I watched a tour group touch and smell a bowl of hops – each person slowly passing it along to the next. Behind them, another group of twenty or so people were waiting for the next tour to start, and a third collection of people had started gathering outside the front door of the brewery.

Since it opened in 1995, the physical presence of the Boston Beer Company has expanded past the walls of the Boston brewery to employ more than 800 people and encompass additional breweries in Cincinnati, Ohio and Breinigsville, Pennsylvania (where much of its year-round bottle and canned offerings are brewed). In Boston, however, the brewers get to play with more of the experimental stuff as it is also the home of Sam Adams' barrel-aged beer program, the small batch series and houses the brewery's pilot brewing system, — a 10-gallon, three-tier MoreBeer! stand that would make any homebrewer proud.

The Boston pilot brewing system is also where some of the ingredients that make up the brewery's 50-plus offerings are tested. Jennifer Glanville, the Brewery Manager and a brewer at the Boston location, who is most often the person sourcing a lot of those ingredients, showed me during my visit that while Sam Adams' operations are big, they have an approach to brewing that I can only best describe as scientific homebrewing. An idea for a new beer is born, the ingredients are sourced, and they give it a try on the pilot system. They will often brew batches over and over again with slightly different ratios of ingredients or ferment them with different yeasts at varying temperatures and then gather all the brewers together to taste the results side by side to find the one that's just right. For example, a recent spiced beer experiment involved 16 batches of beer with 16 different spice profiles. Another experiment might include 10 fermentations of the same wort, or 12 of the same beer with 12 different hopping schedules.

"It's always about experimentation

and tasting," Glanville said, describing the tasting days as an "organized chaos" of tables covered with glasses and brewers tasting and retasting each sample.

Glanville's experiments also extend to testing ingredients that are used in existing Sam Adams beers already in the marketplace to see if anything has changed in quality or if certain ingredients could be improved upon.

"We are always trying to get the best out of our ingredients," she said. "For example, it used to be that harvesting hops was a beauty contest to get the biggest, brightest green hops. We did some trials with our hop farmers, however, and the data we ended up with showed that we got better aroma and quality when we harvested the hops a little earlier than normal – around Labor Day."

A Culture of Homebrewing

When Koch wanted to become a brewmaster, he dusted off his grandfather's recipe in 1984 and made his first batches of beer in his Newton, Massachusetts kitchen, just like lots of homebrewers still do to this day. And because of those early days, Koch has maintained a strong homebrewing culture in his company, including encouraging all of his employees to homebrew and holding some of the largest (and most visible) homebrewing competitions in the country. This is because not only was Koch a homebrewer himself, but also because he believes that Sam Adams owes a lot of its success to homebrewers.

"In the early days homebrewers were the only ones who appreciated what we were doing," Koch said, "and it was a mutual embrace. To me, the homebrewing community is the roots of craft brewing."

Like the craft beer scene at the time when Sam Adams started, the homebrewing scene and the resources required to homebrew when Koch started getting into the hobby were just as drastically different. The changes we modern homebrewers enjoy (and sometimes even take for granted) today amaze him.

"Back then we had a hard time

Continued on page 60

Samuel Adams Clone Recipes

Latitude 48 IPA clone
(5 gallons/19 L, all-grain)

OG = 1.060 FG = 1.015
IBU = 55 SRM = 13 ABV = 6%

Ingredients

11 lbs. (5 kg) 2-row pale malt (2 °L)
1.4 lbs. (0.64 kg) honey malt (23 °L)
0.5 lbs. (0.23 kg) caramel malt (60 °L)
11 AAU Zeus pellet hops (60 min.) (0.7 oz./20 g at 15.8% alpha acids)
2.1 AAU Hallertau pellet hops (15 min.) (0.4 oz./11 g at 5.2% alpha acids)
3.8 AAU Simcoe® pellet hops (15 min.) (0.3 oz./9 g at 12.8% alpha acids)
1.4 AAU East Kent Golding pellet hops (15 min.) (0.2 oz./6 g at 6.9% alpha acids)
5.1 AAU Simcoe® pellet hops (5 min.) (0.4 oz./11 g at 12.8% alpha acids)
1.9 AAU Hallertau pellet hops (5 min.) (0.3 oz./9 g at 6.3% alpha acids)
0.5 tsp. yeast nutrients (15 mins.)
1.5 oz. (42 g) Hallertau pellet hops (dry hop)
0.7 oz. (20 g) Simcoe® pellet hops (dry hop)
0.3 oz. (9 g) Mosaic™ pellet hops (dry hop)
White Labs WLP001 (California Ale), Wyeast 1056 (American Ale), Fermentis Safale US-05 or Lallemand BRY-97 yeast
Priming sugar (if bottling)

Step by Step

This is a single infusion mash. Mix the crushed grains with 5 gallons (19 L) of 165 °F (74 °C) strike water to stabilize the mash at 153 °F (67 °C). Hold at this temperature for 45 minutes. Vorlauf for 15 minutes then begin sparge. Run off into kettle to achieve volume and pre-boil gravity around 1.049 SG. Boil for 60 minutes, adding hops and yeast nutrients according the ingredients list. Turn off the heat, give the wort a stir for about a minute to create a whirlpool and let it spin and settle out for 15 minutes before beginning to chill the wort. Cool the wort down to slightly below fermentation temperature, about 65 °F (18 °C). Aerate the wort with filtered air or pure O_2 and pitch yeast. Ferment at 68 °F (20 °C) for one week or until signs of fermentation have died down. Rack to a secondary vessel and cool beer to 60 °F (16 °C). Condition for an additional two weeks, adding dry hops for the final 10 days of conditioning. Bottle or keg, carbonating to 2.4 volumes of CO_2.

Latitude 48 IPA clone
(5 gallons/19 L, extract with grains)

OG = 1.060 FG = 1.015
IBU = 55 SRM = 13 ABV = 6%

Ingredients

6.6 lbs. (3 kg) light liquid malt extract
1.2 lbs. (0.54 kg) 2-row pale malt (2 °L)
1.4 lbs. (0.64 kg) honey malt (23 °L)
0.5 lbs. (0.23 kg) caramel malt (60 °L)
11 AAU Zeus pellet hops (60 min.) (0.7 oz./20 g at 15.8% alpha acids)
2.1 AAU Hallertau pellet hops (15 min.) (0.4 oz./11 g at 5.2% alpha acids)
3.8 AAU Simcoe® pellet hops (15 min.) (0.3 oz./9 g at 12.8% alpha acids)
1.4 AAU East Kent Golding pellet hops (15 min.) (0.2 oz./6 g at 6.9% alpha acids)
5.1 AAU Simcoe® pellet hops (5 min.) (0.4 oz./11 g at 12.8% alpha acids)
1.9 AAU Hallertau pellet hops (5 min.) (0.3 oz./9 g at 6.3% alpha acids)
0.5 tsp. yeast nutrients (15 mins.)
1.5 oz. (42 g) Hallertau pellet hops (dry hop)
0.7 oz. (20 g) Simcoe® pellet hops (dry hop)
0.3 oz. (9 g) Mosaic™ pellet hops (dry hop)
White Labs WLP001 (California Ale), Wyeast 1056 (American Ale), Fermentis Safale US-05 or Lallemand BRY-97 yeast
Priming sugar (if bottling)

Step by Step

Place crushed grains in a muslin bag and steep in 6 qts. (5.7 L) water at 153 °F (67 °C) for 45 minutes. Remove the grain bag and slowly wash the grains with 1 gallon (3.8 L) hot water. Transfer wort to brew kettle and top off to make 6 gallons (23 L) in your brew kettle. Just before the water reaches boil, remove from heat and stir in the malt extract until all extract is dissolved. Your pre-boil gravity should be around 1.049 SG. Boil for 60 minutes, adding hops and yeast nutrients according to the schedule above. Once you turn off the heat, give the wort a stir for about a minute to create a whirlpool and let that spin and settle out for about 15 minutes before beginning to chill the wort. Cool the wort down to slightly below fermentation temperature, about 65 °F (18 °C). Aerate the wort with filtered air or pure O_2 and pitch yeast. Follow the remainder of the all-grain recipe (at left).

Samuel Adams Clone Recipes

Cream Stout clone
(5 gallons/19 L, all-grain)

OG = 1.057 FG = 1.020
IBU = 28 SRM = 55 ABV = 4.9%

Ingredients

8 lbs. (3.6 kg) 2-row pale malt (2 °L)
1.5 lbs. (0.68 kg) white wheat malt (2 °L)
0.9 lbs. (0.41 kg) caramel malt (60 °L)
0.9 lbs. (0.41 kg) chocolate malt (350 °L)
0.6 lbs. (0.27 kg) roasted barley (500 °L)
4 oz. (0.11 kg) Weyermann Carafa® I malt (350 °L)
0.7 AAU East Kent Golding pellet hops (60 min.) (0.1 oz./3 g at 6.9% alpha acids)
1.4 AAU East Kent Golding pellet hops (30 min.) (0.2 oz./6 g at 6.9% alpha acids)
0.6 AAU UK Fuggle pellet hops (30 min.) (0.1 oz./3 g at 5.7% alpha acids)
1.1 AAU UK Fuggle pellet hops (15 min.) (0.2 oz./6 g at 5.7% alpha acids)
4.8 AAU East Kent Golding pellet hops (5 min.) (0.7 oz./20 g at 6.9% alpha acids)
0.5 tsp. yeast nutrients (15 min.)
White Labs WLP001 (California Ale), Wyeast 1056 (American Ale), Fermentis Safale US-05 or Lallemand BRY-97 yeast
Priming sugar (if bottling)

Step by Step

This is a single infusion mash. Mix the crushed grains with 4.5 gallons (17 L) of 167 °F (75 °C) strike water to stabilize the mash at 155 °F (68 °C). Hold at this temperature for 45 minutes. Vorlauf for 15 minutes then begin sparge. Run off into kettle to achieve volume and pre-boil gravity around 1.046 SG. Boil for 60 minutes, adding hops and yeast nutrients according the ingredients list. Once you turn off the heat, give the wort a stir for about a minute to create a whirlpool and let that spin and settle out for about 15 minutes before beginning to chill the wort. Cool the wort down to slightly below fermentation temperature, about 65 °F (18 °C). Aerate the wort with filtered air or pure O_2 and pitch yeast. Ferment at 68 °F (20 °C) for 1 week or until signs of fermentation have died down. Cool beer to 60 °F (16 °C) and condition for an additional 1-2 weeks. Bottle or keg and carbonate to 2 volumes of CO_2.

Cream Stout clone
(5 gallons/19 L, extract with grains)

OG = 1.057 FG = 1.020
IBU = 28 SRM = 55 ABV = 4.9%

Ingredients

3.3 lbs. (1.5 kg) light liquid malt extract
3.3 lbs. (1.5 kg) liquid wheat malt extract
0.9 lbs. (0.41 kg) caramel malt (60 °L)
0.9 lbs. (0.41 kg) chocolate malt (350 °L)
0.6 lbs. (0.27 kg) roasted barley (500 °L)
4 oz. (0.11 kg) Weyermann Carafa® I malt (350 °L)
0.7 AAU East Kent Golding pellet hops (60 min.) (0.1 oz./3 g at 6.9% alpha acids)
1.4 AAU East Kent Golding pellet hops (30 min.) (0.2 oz./6 g at 6.9% alpha acids)
0.6 AAU UK Fuggle pellet hops (30 min.) (0.1 oz./3 g at 5.7% alpha acids)
1.1 AAU UK Fuggle pellet hops (15 min.) (0.2 oz./6 g at 5.7% alpha acids)
4.8 AAU East Kent Golding pellet hops (5 min.) (0.7 oz./20 g at 6.9% alpha acids)
White Labs WLP001 (California Ale), Wyeast 1056 (American Ale), Fermentis Safale US-05 or Lallemand BRY-97 yeast
Priming sugar (if bottling)

Step by Step

Place crushed specialty grains in a muslin bag and steep in 1 gallon (3.8 L) water at 150–160 °F (66–71 °C) for 20 minutes. Remove the grain bag and slowly wash the grains with 2 qts. (1.9 L) hot water. Transfer the wort to brew kettle and top off to make 6 gallons (23 L) in your brew kettle. Just before the water reaches a boil, remove from the heat and stir until all the extract is dissolved. Your pre-boil gravity should be around 1.046 SG. Boil for 60 minutes, adding hops and yeast nutrients according to the ingredients list. Turn off the heat, give the wort a stir for about a minute to create a whirlpool and let that spin and settle out for 15 minutes before beginning to chill the wort. Cool the wort down to about 65 °F (18 °C). Aerate the wort with filtered air or pure O_2 and pitch yeast. Follow the remainder of the all-grain recipe (at left.)

Samuel Adams Clone Recipes

Double Agent IPL clone
(5 gallons/19 L, all-grain)

OG = 1.053 FG = 1.015
IBU = 43 SRM = 10 ABV = 5%

Ingredients

7.7 lbs. (3.5 kg) 2-row pale malt (2 °L)
3.5 lbs. (1.6 kg) Munich malt (10 °L)
6.3 AAU Zeus pellet hops (60 min.) (0.4 oz./11 g at 15.8% alpha acids)
1.4 AAU Citra® pellet hops (15 min.) (0.1 oz./3 g at 13.7% alpha acids)
1.3 AAU Simcoe® pellet hops (15 min.) (0.1 oz./3 g at 12.8% alpha acids)
1.9 AAU Ahtanum™ pellet hops (15 min.) (0.4 oz./11 g at 4.7% alpha acids)
3.8 AAU Simcoe® pellet hops (5 min.) (0.3 oz./9 g at 12.8% alpha acids)
2.5 AAU Cascade pellet hops (5 min.) (0.4 oz./11 g at 6.3% alpha acids)
0.5 tsp. yeast nutrients (15 mins.)
0.5 oz. (14 g) Centennial pellet hops (dry hop)
0.5 oz. (14 g) Simcoe® pellet hops (dry hop)
0.5 oz. (14 g) Nelson Sauvin pellet hops (dry hop)
0.5 oz. (14 g) Cascade pellet hops (dry hop)
White Labs WLP830 (German Lager), Wyeast 2206 (Bavarian Lager) or Mangrove Jack Bohemian Lager yeast (~ 4 qts./3.9 L starter, or 2 sachets dry yeast)
Priming sugar (if bottling)

Step by Step

This is a single infusion mash. Mix the crushed grains with 4.5 gallons (17 L) of 165 °F (74 °C) strike water to stabilize the mash at 153 °F (67 °C). Hold at this temperature for 45 minutes. Vorlauf for 15 minutes then begin sparge. Run off into kettle to achieve volume and pre-boil gravity of 1.042 SG. Boil for 60 minutes. Add hops and yeast nutrients according the ingredients list. Turn off the heat, stir the wort for a minute to create a whirlpool and let settle for 15 minutes. Cool the wort to around 53–55 °F (12–13 °C). Aerate the wort with filtered air or pure O_2 and pitch yeast. Ferment at 57 °F (14 °C) for 2 weeks or until signs of fermentation slow down. Rack to a secondary and lager for 3 weeks at 40 °F (5 °C). Add the dry hops for the final two weeks of the lagering phase. If signs of diacetyl are apparent during racking, a diacetyl rest is recommended. Give the beer 2 days at 70 °F (21 °C) to allow the yeast to process any diacetyl before racking over to the secondary vessel. After the lager period is complete, bottle or keg and carbonate to 2.4 volumes of CO_2.

Double Agent IPL clone
(5 gallons/19 L, extract with grains)

OG = 1.053 FG = 1.015
IBU = 43 SRM = 10 ABV = 5%

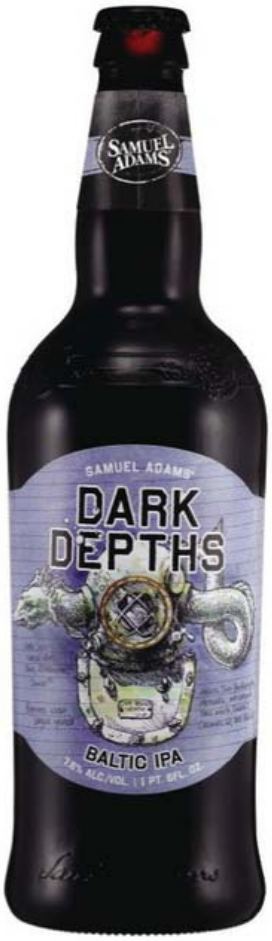
Ingredients

3.3 lbs. (1.5 kg) light liquid malt extract
3.3 lbs. (1.5 kg) Munich liquid malt extract
0.7 lbs. (0.32 kg) extra light dried malt extract
6.3 AAU Zeus pellet hops (60 min.) (0.4 oz./11 g at 15.8% alpha acids)
1.4 AAU Citra® pellet hops (15 min.) (0.1 oz./3 g at 13.7% alpha acids)
1.3 AAU Simcoe® pellet hops (15 min.) (0.1 oz./3 g at 12.8% alpha acids)
1.9 AAU Ahtanum™ pellet hops (15 min.) (0.4 oz./11 g at 4.7% alpha acids)
3.8 AAU Simcoe® pellet hops (5 min.) (0.3 oz./9 g at 12.8% alpha acids)
2.5 AAU Cascade pellet hops (5 min.) (0.4 oz./11 g at 6.3% alpha acids)
0.5 tsp. yeast nutrients (15 mins.)
0.5 oz. (14 g) Centennial pellet hops (dry hop)
0.5 oz. (14 g) Simcoe® pellet hops (dry hop)
0.5 oz. (14 g) Nelson Sauvin pellet hops (dry hop)
0.5 oz. (14 g) Cascade pellet hops (dry hop)
White Labs WLP830 (German Lager), Wyeast 2206 (Bavarian Lager) or Mangrove Jack Bohemian Lager yeast
Priming sugar (if bottling)

Step by Step

Heat 6 gallons (23 L) soft water in your brew kettle. If you have hard water (> 150 ppm calcium carbonate), you can soften by boiling the water for half an hour and decanting off the precipitated chalk or by cutting your tap water with distilled or reverse osmosis (RO) water. Just before the water reaches boil, remove from heat and stir in the malt extract until all extract is dissolved. Your pre-boil gravity should be around 1.042 SG. Boil for 60 minutes, adding hops and yeast nutrients according to the ingredients list. Turn off the heat, give the wort a stir for a minute to create a whirlpool and let that settle for 15 minutes. Follow the remainder of the all-grain recipe (at left).

Samuel Adams Clone Recipes



Dark Depths Baltic IPA clone
(5 gallons/19 L, all-grain)

OG = 1.079 FG = 1.020
IBU = 55 SRM = 30 ABV = 7.6%

Ingredients

8.1 lbs. (3.7 kg) 2-row pale malt (2 °L)
6.9 lbs. (3.1 kg) munich malt (10 °L)
1.8 lbs. (0.82 kg) caramel malt (60 °L)
0.5 lbs. (0.23 kg) Weyermann Carafa® I malt (350 °L)
9.5 AAU Zeus pellet hops (90 min.) (0.6 oz./17 g at 15.8% alpha acids)
2 AAU Saaz pellet hops (15 min.) (0.6 oz./17 g at 3.4% alpha acids)
2.8 AAU Ahtanum™ pellet hops (15 min.) (0.6 oz./17 g at 4.7% alpha acids)
2.8 AAU Ahtanum™ pellet hops (5 min.) (0.6 oz./17 g at 4.7% alpha acids)
5.3 AAU Simcoe® pellet hops (5 min.) (0.4 oz./11 g at 13.2% alpha acids)
0.5 tsp. yeast nutrients (15 mins.)
1 oz. (28 g) Simcoe® pellet hops (dry hop)
0.5 oz. (14 g) Topaz pellet hops (dry hop)
0.5 oz. (14 g) East Kent Golding pellet hops (dry hop)
White Labs WLP830 (German Lager), Wyeast 2206 (Bavarian Lager) or Mangrove Jack Bohemian Lager yeast (~ 6 qts./5.7 L starter or 2.5 sachets dry yeast)
Priming sugar (if bottling)

Step by Step

This is a single infusion mash. Mix the crushed grains with 6 gallons (23 L) of 167 °F (75 °C) strike water to stabilize the mash at 153 °F (67 °C). Hold at this temperature for 45 minutes. Vorlauf for 15 minutes then begin sparge. Run off into kettle to achieve volume and pre-boil gravity of 1.058 SG, about 6.8 gallons (26 L). Boil for 90 minutes, adding hops and yeast nutrients according the ingredients list. Turn off the heat, stir the wort to create a whirlpool and let settle for 15 minutes. Cool the wort to 53–55 °F (12–13 °C). Aerate the wort with filtered air or pure O_2 and pitch yeast. Ferment at 57 °F (14 °C) for 2 weeks or until signs of fermentation slow. Rack to a secondary and lager for four to six weeks at 40 °F (5 °C). Add the dry hops for the final two weeks of the lagering phase. If diacetyl is apparent during racking, give the beer 2 days at 70 °F (21 °C) to allow the yeast to process any diacetyl before racking to the secondary vessel. After the lager period is complete, bottle or keg, carbonating to 2.1 volumes of CO_2.

Dark Depths Baltic IPA clone
(5 gallons/19 L, extract with grains)

OG = 1.079 FG = 1.020
IBU = 55 SRM = 30 ABV = 7.6%

Ingredients

9.9 lbs. (1.5 kg) munich liquid malt extract
1.8 lbs. (0.82 kg) caramel malt (60 °L)
0.5 lbs. (0.23 kg) Weyermann Carafa® I malt (350 °L)
9.5 AAU Zeus pellet hops (90 min.) (0.6 oz./17 g at 15.8% alpha acids)
2 AAU Saaz pellet hops (15 min.) (0.6 oz./17 g at 3.4% alpha acids)
2.8 AAU Ahtanum™ pellet hops (15 min.) (0.6 oz./17 g at 4.7% alpha acids)
2.8 AAU Ahtanum™ pellet hops (5 min.) (0.6 oz./17 g at 4.7% alpha acids)
5.3 AAU Simcoe® pellet hops (5 min.) (0.4 oz./11 g at 13.2% alpha acids)
0.5 tsp. yeast nutrients (15 mins.)
1 oz. (28 g) Simcoe® pellet hops (dry hop)
0.5 oz. (14 g) Topaz pellet hops (dry hop)
0.5 oz. (14 g) East Kent Golding pellet hops (dry hop)
White Labs WLP830 (German Lager), Wyeast 2206 (Bavarian Lager) or Mangrove Jack Bohemian Lager yeast (~ 6 qts./5.7 L starter or 2.5 sachets dry yeast)
Priming sugar (if bottling)

Step by Step

Place crushed specialty grains in a muslin bag and steep in 1 gallon (3.8 L) water at 150–160 °F (66–71 °C) for 20 minutes. Remove the grain bag and slowly wash the grains with 2 qts. (1.9 L) hot water. Transfer wort to brew kettle and top off to make 6.5 gallons (25 L) in your brew kettle. Just before the water reaches boil, remove from heat and stir in the malt extract until all extract is dissolved. Your pre-boil gravity should be around 1.058 SG. Boil for 90 minutes, adding hops and yeast nutrients according to the ingredients list. Turn off the heat, give the wort a stir for a minute to create a whirlpool and let that settle for about 15 minutes. Cool the wort down to about 53–55 °F (12–13 °C). Follow the remainder of the all-grain recipe (at left).

Samuel Adams Clone Recipes

Noble Pils clone
(5 gallons/19 L, all-grain)

OG = 1.048 FG = 1.012
IBU = 34 SRM = 5 ABV = 4.9%

Ingredients

7.4 lbs. (3.4 kg) 2-row pale malt (2 °L)
2.5 lbs. (1.1 kg) Bohemian Pilsner malt (2 °L)
7.4 AAU Hallertau pellet hops (90 min.) (2 oz./56 g at 3.7% alpha acids)
1.5 AAU Tettnang pellet hops (5 min.) (0.4 oz./11 g at 3.8% alpha acids)
2.3 AAU Saaz pellet hops (5 min.) (0.6 oz./17 g at 3.8% alpha acids)
0.5 tsp. yeast nutrients (15 mins.)
1 oz. (28 g) Tettnang pellet hops (dry hop)
0.75 oz. (21 g) Saaz pellet hops (dry hop)
0.5 oz. (14 g) Strisselspalt pellet hops (dry hop)
0.25 oz. (7 g) Hersbrucker pellet hops (dry hop)
White Labs WLP830 (German Lager), Wyeast 2206 (Bavarian Lager) or Mangrove Jack Bohemian Lager yeast (~ 3 qts./2.9 L starter or 1.5 sachets dry yeast)
Priming sugar (if bottling)

Step by Step

This is a single infusion mash. Mix the crushed grains with 3.75 gallons (14 L) of 165 °F (74 °C) strike water to stabilize the mash at 153 °F (67 °C). Hold at this temperature for 45 minutes. Vorlauf for 15 minutes then begin sparge. Run off into kettle to achieve volume about 6.8 gallons (25 L) and pre-boil standard gravity of 1.035. Boil for 90 minutes, adding hops and yeast nutrients according the ingredients list. Turn off the heat, give the wort a stir for a minute to create a whirlpool and let that settle for about 15 minutes. Cool the wort down to 53–55 °F (12–13 °C). Aerate the wort with filtered air or pure O_2 and pitch yeast. Ferment at 57 °F (14 °C) for 2 weeks or until signs of fermentation have died down. Rack to a secondary and lager for an additional three weeks at 40 °F (5 °C). Add the dry hops for the final two weeks of the lagering phase. If signs of diacetyl are apparent during racking, then a diacetyl rest is recommended. Give the beer 2 days at 70 °F (21 °C) to allow the yeast to process any diacetyl before racking over to the secondary vessel. After the lager period is complete, bottle or keg and carbonate to 2.4 volumes of CO_2.

Noble Pils clone
(5 gallons/19 L, extract with grains)

OG = 1.048 FG = 1.012
IBU = 34 SRM = 5 ABV = 4.9%

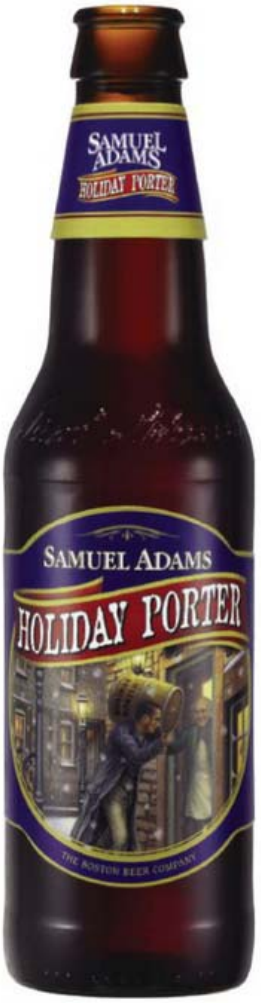
Ingredients

3.3 lbs. (1.5 kg) light liquid malt extract
3.3 lbs. (1.5 kg) Pilsner liquid malt extract
3 oz. (90 g) extra light dried malt extract
7.4 AAU Hallertau pellet hops (90 min.) (2 oz./56 g at 3.7% alpha acids)
1.5 AAU Tettnang pellet hops (5 min.) (0.4 oz./11 g at 3.8% alpha acids)
2.3 AAU Saaz pellet hops (5 min.) (0.6 oz./17 g at 3.8% alpha acids)
0.5 tsp. yeast nutrients (15 mins.)
1 oz. (28 g) Tettnang pellet hops (dry hop)
0.75 oz. (21 g) Saaz pellet hops (dry hop)
0.5 oz. (14 g) Strisselspalt pellet hops (dry hop)
0.25 oz. (7 g) Hersbrucker pellet hops (dry hop)
White Labs WLP830 (German Lager), Wyeast 2206 (Bavarian Lager) or Mangrove Jack Bohemian Lager yeast (~ 3 qts./2.9 L starter or 1.5 sachets dry yeast)
Priming sugar (if bottling)

Step by Step

Heat 6.25 gallons (24 L) soft water in your brew kettle. If you have hard water (> 150 ppm calcium carbonate), you can soften by boiling the water for half an hour and decanting off the precipitated chalk or by cutting your tap water with distilled or reverse osmosis (RO) water. Just before the water reaches boil, remove from heat and stir in the malt extract until all extract is dissolved. Your pre-boil standard gravity should be around 1.035. Boil for 90 minutes, adding hops and yeast nutrients according to the ingredients list. Turn off the heat, stir the wort for about a minute to create a whirlpool and let that settle for about 15 minutes. Cool the wort to 53–55 °F (12–13 °C). Aerate the wort with filtered air or pure O_2 and pitch yeast. Ferment at 57 °F (14 °C) for 2 weeks or until signs of fermentation have died down. Rack to a secondary and lager for an additional three weeks at 40 °F (5 °C). Add the dry hops for the final two weeks of the lagering phase. Follow the remainder of the all-grain recipe (at left).

Samuel Adams Clone Recipes



Holiday Porter clone
(5 gallons/19 L, all-grain)

OG = 1.063 FG = 1.020
IBU = 40 SRM = 35 ABV = 5.8%

Ingredients

10.1 lbs. (4.6 kg) 2-row pale malt (2 °L)
1.4 lbs. (0.64 kg) munich malt (10 °L)
1.2 lbs. (0.54 kg) caramel malt (60 °L)
0.5 lbs. (0.23 kg) Weyermann Carafa® III malt (350 °L)
0.3 lbs. (0.14 kg) flaked oats
4.25 AAU Spalt pellet hops (60 min.) (1.25 oz./35 g at 3.4% alpha acids)
1.25 AAU UK Fuggle pellet hops (60 min.) (0.25 oz./7 g at 5% alpha acids)
6 AAU Spalt pellet hops (5 min.) (1.75 oz./50 g at 3.4% alpha acids)
4.4 AAU East Kent Golding pellet hops (5 min.) (0.75 oz./21 g at 5.8% alpha acids)
0.5 tsp. yeast nutrients (15 min.)
White Labs WLP001 (California Ale), Wyeast 1056 (American Ale), Fermentis Safale US-05 or Lallemand BRY-97 yeast
Priming sugar (if bottling)

Step by Step

This is a single infusion mash. Mix the crushed grains with 5 gallons (19 L) of 167 °F (75 °C) strike water to stabilize the mash at 155 °F (68 °C). Hold at this temperature for 45 minutes. Vorlauf for 15 minutes then begin sparge. Run off into kettle to achieve volume and pre-boil gravity around 1.051 SG. Boil for 60 minutes, adding hops and yeast nutrients according to the ingredients list. Once you turn off the heat, give the wort a stir for about a minute to create a whirlpool and let that spin and settle out for about 15 minutes before beginning to chill the wort. Cool the wort down to slightly below fermentation temperature, about 65 °F (18 °C). Aerate the wort with filtered air or pure O_2 and pitch yeast. Ferment at 68 °F (20 °C) for 1 week or until signs of fermentation have died down. Rack to a secondary vessel and cool beer to 60 °F (16 °C). Condition for an additional 1–2 weeks. Bottle or keg and carbonate to 2.2 volumes of CO_2.

Holiday Porter clone
(5 gallons/19 L, extract with grains)

OG = 1.063 FG = 1.020
IBU = 40 SRM = 35 ABV = 5.8%

Ingredients

3.3 lbs. (1.5 kg) light liquid malt extract
3.3 lbs. (1.5 kg) munich liquid malt extract
1.5 lbs. (0.68 kg) 2-row pale malt (2 °L)
1.2 lbs. (0.54 kg) caramel malt (60 °L)
0.5 lbs. (0.23 kg) Weyermann Carafa® III malt (350 °L)
0.3 lbs. (0.14 kg) flaked oats
4.25 AAU Spalt pellet hops (60 min.) (1.25 oz./35 g at 3.4% alpha acids)
1.25 AAU UK Fuggle pellet hops (60 min.) (0.25 oz./7 g at 5% alpha acids)
6 AAU Spalt pellet hops (5 min.) (1.75 oz./50 g at 3.4% alpha acids)
4.4 AAU East Kent Golding pellet hops (5 min.) (0.75 oz./21 g at 5.8% alpha acids)
0.5 tsp. yeast nutrients (15 min.)
White Labs WLP001 (California Ale), Wyeast 1056 (American Ale), Fermentis Safale US-05 or Lallemand BRY-97 yeast
Priming sugar (if bottling)

Step by Step

Place crushed grains in a muslin bag and steep in 1.5 gallons (5.7 L) water at 155 °F (68 °C) for 45 minutes. Remove the grain bag and slowly wash the grains with 1 gallon (3.8 L) hot water. Transfer wort to brew kettle and top off to make 6 gallons (23 L) in your brew kettle. Just before the water reaches boil, remove from heat and stir in the malt extract until all extract is dissolved. Your pre-boil gravity should be around 1.051 SG. Boil for 60 minutes, adding hops and yeast nutrients according the schedule above. Once you turn off the heat, give the wort a stir for about a minute to create a whirlpool and let that spin and settle out for about 15 minutes before beginning to chill the wort. Cool the wort down to slightly below fermentation temperature, about 65 °F (18 °C). Aerate the wort with filtered air or pure O_2 and pitch yeast. Ferment at 68 °F (20 °C) for 1 week or until signs of fermentation have died down. Cool beer to 60 °F (16 °C) and condition for an additional 1–2 weeks. Bottle or keg and carbonate to 2.2 volumes of CO_2.

Large barrels of Kosmic Mother Funk (KMF), a *Brettanomyces*-fermented beer, that is blended in various percentages into each of Sam Adams' Barrel Room Collection beers.

even scrounging up glass carboys — you had to try and steal them from the Poland Springs water delivery guy. You had to use Blue Ribbon malt extract that you got at the grocery store. A homebrewer today can get better equipment and ingredients than a pro brewer could get in 1984."

To encourage his employees to make their own beer when Sam Adams started to grow, Koch started an in-house homebrew competition. In the mid 1990s, the company decided to open the competition up to all US homebrewers and it is now known as the Longshot American Homebrew Contest — one of the largest homebrew competitions in the world. The Longshot is judged in stages and regional semifinals in an attempt to fairly evaluate each entry based on the Beer Judge Certification Program (BJCP) guidelines. Koch and the panel of expert judges then taste the winning beers from those semifinals and choose what they believe are the four best beers — including the contest winner. Those four finalists are then invited to the Great American Beer Festival in Denver, Colorado where the winners are announced (two homebrewers and one employee brewer), and the resulting beers are brewed by Sam Adams and distributed nationally in mixed packs.

Homebrewers in New England have also competed in the the Samuel Adams Patriot Homebrew competition, which ran every year from 2007 to 2012. The winner of that competition was awarded a chance to brew their homebrew at Sam Adams and their homebrew earned a spot amongst the taps at Gillette Stadium in Foxboro, Massachusetts during the Patriots football season.

"The homebrewing community continues to be the source of nourishment and creative energy," said Koch. "Craft brewing gets all the attention, but the creativity comes from these roots. Any practicing craft brewer would benefit from contact with homebrewers."

Brewing the Samuel Adams Way

The secret to brewing the Sam Adams way, according to Koch, is three pronged. In addition to the aforementioned experimentation, you must also master and appreciate the classic beer styles, and you must always brew balanced, drinkable beers consistently.

A Sam Adams beer, Koch said, is flavorful, balanced and complex. It's not enough for the beer to just have a lot of flavor.

"If there is a 'Boston Beer' way, it's probably respect for tradition," said Koch, "and a relentless desire to innovate and push boundaries. You can throw a lot of hops and malts and do some over-the-top techniques," Koch said, "but it has to be balanced. I believe beer should be simply a pleasure to drink. As a beer drinker I drink ultimately for pleasure."

And there would be no Sam Adams success story without emphasizing consistency. One of the biggest reasons why some of the first-wave microbreweries that started around the same time as Sam Adams but didn't make it, said Koch, is because many of them simply weren't releasing good beer with regularity, which turned off consumers.

"I was appalled when I heard craft brewers say that eighty percent of their batches were good," said Koch of confessions he heard from fellow microbrewers in the early days. "I just knew that you could not build a customer base or an industry if we didn't raise the quality standards. There was a lot of bad beer at the time and as a result the industry was struggling. In addition to Sam Adams, some of the only other breweries that were making great beer every time were Sierra Nevada and Anchor — and today we are the ones who are still around."

So if you want your beers to get the Sam Adams stamp of approval, get the classic styles down pat, and perfect brewing practices to the point where you can brew the same beer exactly the same way every time. This means really nailing down your ingredients by brewing test batches (as Sam Adams does) to find what works best, making sure your water source is consistent, and hitting the same targets and temperatures from batch to batch. The best way to do this, as a homebrewer, is to take good notes throughout the brew day and refer back to those notes when you brew that recipe the next time. (For more about brewing consistency, visit http://byo.com/story177 or read Terry Foster's "Techniques" column in the September 2013 issue of *Brew Your Own*.)

As for experimenting, well that's

Sam Adams Defines Craft Beer

It's easy to look at the craft beer industry today and think it was all destined to work out and that craft beer was always going to be a big success. But that wasn't the case back when Sam Adams came onto the market. Back then, breweries like Sam Adams were called "microbreweries."

"In the beginning, there were just a dozen or so of us," Koch said of the first American microbrewers. "There was discussion about 'what is a microbrewery' at the time and we figured that nobody's every going to get bigger than 15,000 barrels a year," so that's where they drew the line at the time. "We were like medieval people thinking you'd fall off the Earth if you sailed too far."

But of course Sam Adams DID get bigger than 15,000 barrels. Much bigger. And the term "micro" didn't really apply anymore. But at the same time, they weren't in a league with Anheuser-Busch. Craft beer still claims only about 6.5 percent of the overall beer market. But the fact is, we wouldn't even call breweries "craft" breweries if it weren't for Sam Adams.

"When we got there," Koch said of exceeding 15,000 barrels, "there was no real name. For a while we were considered a 'regional specialty brewer,' and there were a lot of other words thrown around like 'cottage' and 'artisan.'" Ultimately, though, the industry settled on the word "craft." "Michael Jackson liked it," Koch said, so it stuck.

A few years back the size limit for a craft brewery was defined by the Brewers Association as a, "small, independent and traditional" brewery with an annual production of 2 million barrels of beer or less. When Sam Adams, the largest craft brewery in the US, tipped that scale at 2.7 million barrels in 2012, however, the numbers changed to 6 million barrels.

"The largest craft brewery and the one that sort of dictates how the industry is defined as far as volume is Sam Adams, or the larger company Boston Beer Co.," IBISWorld analyst Hayden Shipp said in a recent interview for CNBC.

And should Sam Adams get even bigger, expect the numbers to change again.

"I didn't think it would ever be as big as it's become," said Koch of the craft beer industry, whose sales growth is estimated at 10.9 percent annually and generated around $3.9 billion in sales in 2012. "Nobody believed this was anything more than a small and struggling group of homebrewers that had gone pro."

easy for homebrewers, right? After all, we don't have to sell our beer, we just have to like it enough to drink it. Glanville says that doing experiments with ingredients and techniques much like she does at Sam Adams might not always produce the beer you want to drink, but you always learn something.

"I wish I could do what you guys do," said Glanville of the constraints every commercial brewery has in that they need to be able to sell the beer that they make. "You have the opportunity to do more experimentation than we do."

So you want to try using jalapeños in your next batch of homebrew? Go ahead! Glanville said one of the things she likes best about working at Sam Adams is that Jim gives the brewers his blessing to give any beer style or ingredient a chance. Try splitting up a

batch or two of your next homebrew into 1-gallon (3.7-L) factions and ferment it at different temperatures or with a different yeast strain, or use a different hopping program to see if you could be brewing your favorite homebrew a little better, make it a little more exciting or to discover a new flavor profile entirely.

"What's the worst that could happen?" said Glanville with a smile. "So what if it doesn't come out exactly the way you want it. You're either going to drink it or throw it away. Try experimenting with flavors that you might not think about for brewing beer. You will learn from everything you do."

Modern Day Sam Adams

So how does a commercial brewery that has enjoyed so much sustained success stay relevant with a new brewery opening every other week? The trick, said Koch and Glanville, is to do a good job brewing the classics while periodically catering to the drinkers who have become progressively more educated and esoteric in their appreciation of beer.

"There is so much variety in the market these days that the most relevant beers are the ones that have become classics," Koch said. "Think of Macallan single malt Scotch. It's always relevant because it sets the standard for all other single malts." And Koch feels that same way about Boston Lager, describing it as the "measuring stick" for all other American craft lagers. For him, there is a difference between a great beer and an interesting beer, and what he is looking for from a Sam Adams offering is a great beer — something that is, "reliably rewarding." "This is why Boston Lager has been the leading craft beer for 30 years," he said.

And for those who are always looking for the next new style, Sam Adams has you on the radar as well.

"Jim encourages us to brew what we want," said Glanville of the creative process at the brewery. "Many (of the beers we brew) never see the commercial light of day," while others might go on to be brewed as part of the Sam Adams lineup for several years. This includes their small batch series (see the recipe for Dark Depths on page 57) as well as their Barrel Room Collection, which are Belgian-style, bottle-conditioned, barrel-aged beers. Each beer in this series is blended and aged with a percentage of a beer they call Kosmic Mother Funk (or KMF), which they define as, "Our special beer aged in wooden vessels for over six months. This beer is very fruity and sour due to a secondary fermentation with *brettanomyces* yeast." (See the photo of the KMF aging in barrels on page 60.)

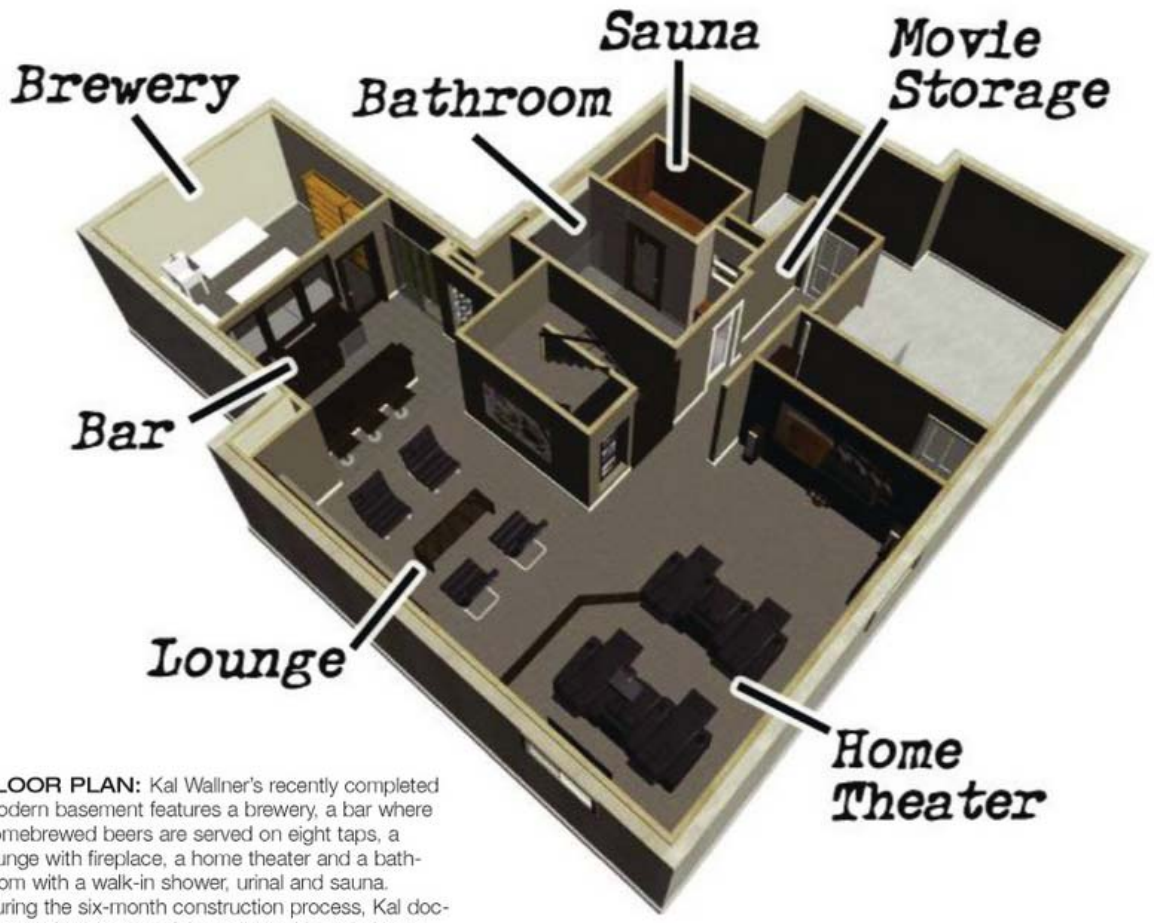
"There are a lot of great beer styles that have yet to be made," said Koch of what he sees for the future of Samuel Adams beers and the Boston Beer Company. "There are techniques to be discovered. I want to be one of the brewers who creates those styles."

And sometimes the next new thing is really just bringing back an old thing. For example, Glanville recently headed up an eight-year project to brew a centuries-old Finnish Sahti that is aged with juniper berries — a style that was originally brewed by Scandinavian women. Glanville spent eight years getting the recipe and resulting beer the way she wanted it, which is now offered nationwide as Norse Legend, a part of their Small Batch Series. The Sam Adams approach is to look for inspiration from the classics, and give them a modern approach with ingredients and techniques.

"It is important to have principles, standards and philosophy, but not be fanatic about it," Koch explained, comparing his brewing philosophy to those of other craft breweries. "Not everybody agrees," he said, adding that he has a lot of respect for differing opinions and enjoys drinking beers made by brewers who have a different approach. "I'm glad we are all in this together."

For more information about the Boston Beer Company and Samuel Adams beers, the Longshot American Homebrew Contest or touring the Boston brewery, visit their website at www.samueladams.com or call (617) 368-5000. BYO

THE ELECTRIC HOMEBREW BAR



FLOOR PLAN: Kal Wallner's recently completed modern basement features a brewery, a bar where homebrewed beers are served on eight taps, a lounge with fireplace, a home theater and a bathroom with a walk-in shower, urinal and sauna. During the six-month construction process, Kal documented each step of the build on his website at www.theelectricbrewery.com/basement.

Story and photos by **Kal Wallner**

In the Fall of 2008, after years of experimenting with malt extract kits and 100% wort kits, Kal Wallner of Ottawa, Canada, decided it was time to graduate to an all-grain system where he could be 100% in control of the final product. Unable to find a commercially-available set up that met his specific requirements, he designed his own 100% electric set up and built his first homebrewery in the family's cold room — the only available space in the house.

When the family moved into a newly built home with an unfinished basement in 2011, it was an opportunity for Kal to rebuild and expand the original brewery to his exact specifications and to create a space for him and his wife to entertain.

"Both my wife and I have similar tastes and both like a modern style," said Kal of his design. "We do a lot of entertaining so we wanted to do something special."

While Kal says that no project is ever quite finished, the major renovations were finished in the fall of 2012. In the past year they have been entertaining in the new space quite a bit.

"Having everybody come over here rather than pay for babysitters and going out and buying beer is much less expensive for us and our friends and family. Building a basement like that isn't inexpensive, of course, but it's what we wanted to do."

Kal Wallner pours a pint of homebrew from his 8-tap draft system, which is a part of his sleek and modern all-electric homebrewing home hangout.

THE BAR: "Eight beers are available on this home tap, served from a keg freezer (keezer) located just inside the brewery. Two of the taps use a nitrogen/CO_2 blend for beer styles that benefit from a creamy Guinness-style pour. The tower and taps are chilled continuously with RV antifreeze that is re-circulated using a pond pump and 50 feet (~50 m) of copper coil located in a separate small freezer."

THE BREWERY: "When I designed this new brewing room in 2012, I was able to expand the original brewery to my exact specifications and combine everything relating to brewing (wort creation, fermentation, conditioning, packaging, and serving) into one room, simplifying the brewing process. Commercial stainless steel tables along with an oversized sink equipped with a pre-rinse faucet make for easy cleaning of kegs and kettles."

CONTROL PANEL AND KETTLES: "The all-grain brewing setup was designed to be 100% electric. Three 20-gallon (75-L) kettles are used, two of which are fitted with heating elements. The control panel allows for precise step mashes and holds temperature to within 0.1 degrees Celsius. To ensure long-term serviceability, the brewery setup uses only standard off-the-shelf industrial electrical components, along with stainless steel fittings and pharmaceutical grade silicon tubing (no plastic parts)."

BREWERY FRIDGE AND GRAIN SHELVES: The brewery includes a commercial fridge that holds a variety of yeast samples and six kegs so that beer can be conditioned or lagered. A 5-pound CO_2 tank is integrated into the fridge and carbonates the beer as it conditions so that it is ready to be served as soon as it is put on tap. Grain is stored in airtight buckets and kept on shelves.

HOME THEATER: "A home theater with a nine-foot screen and seating for six (with cup holders for beer, of course!) is the perfect way to relax and unwind after a long brew day and adds an element to the basement that can be enjoyed by the whole family."

LOUNGE: "The lounge features a sitting area and fireplace, perfect for entertaining. Extra seating can be pulled in for larger groups. The windows behind the bar allow guests to view the brewery, with spotlights on the kettles creating a brewpub feel. BYO

INDIA PALE LAGER ROUNDTABLE

Story by **Dawson Raspuzzi**

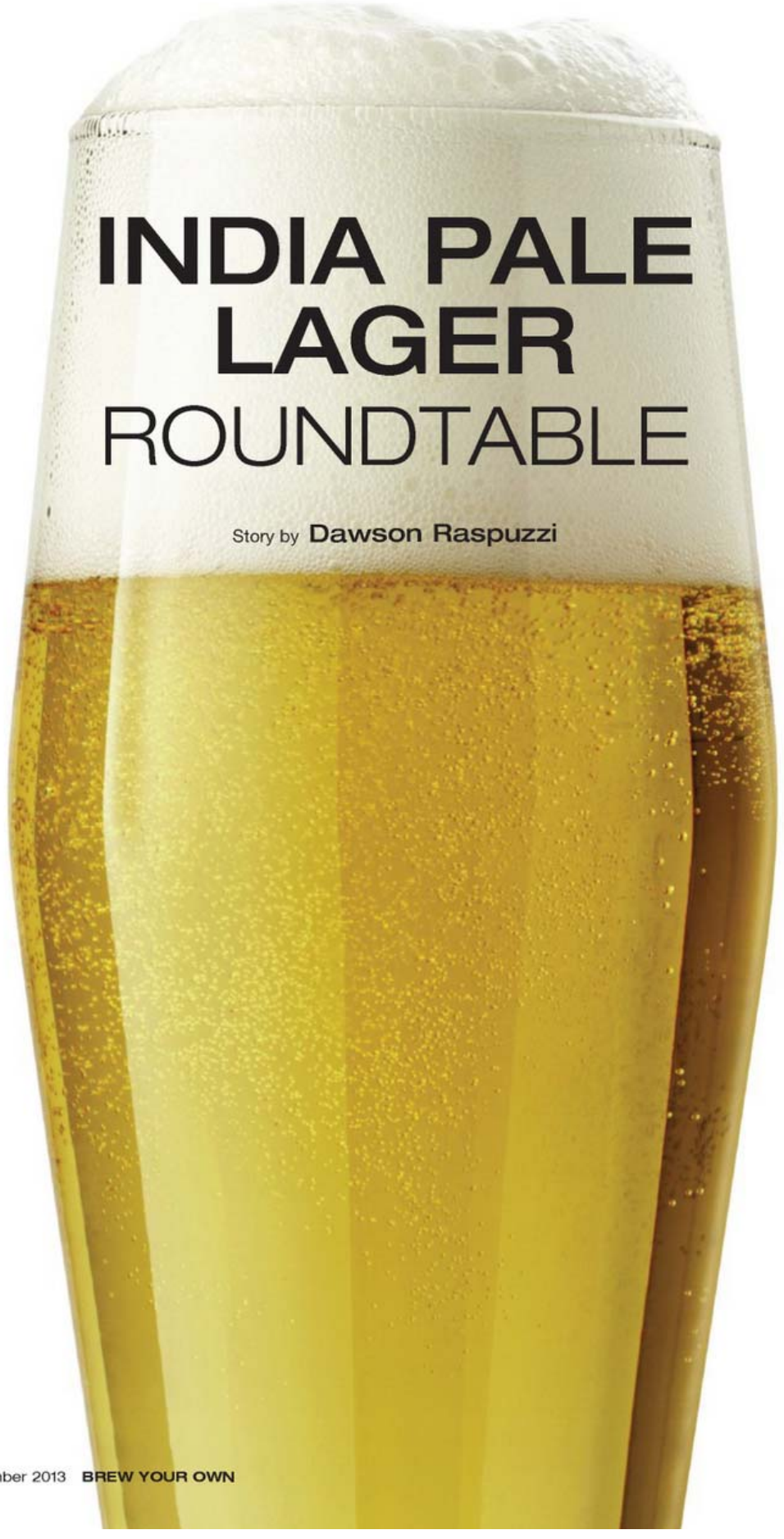


Photo by Istockphoto.com

Bryan Egan
Creemore Springs Brewery
Creemore, Ontario

Bryan is the Production Manager for Creemore Springs Brewery as well as the Brewmaster for its Craft Beer Exploration Series called Mad & Noisy Brewing. He has been working in the brewing industry for 10 years, in 3 different breweries, and holds diplomas in brewing and beverage packaging from the Institute of Brewing and Distilling.

Justin Fay
Base Camp Brewing Company
Portland, Oregon

Justin is the Brewmaster and Owner of Base Camp Brewing. Justin began brewing for Klamath Basin Brewing Co. in 2006, while enrolled in Oregon State University's Fermentation Science program. He graduated from the program later that year and on the strength of his recipes and exacting attention to detail, KBBC shared top honors at the 2008 West Coast Brew Fest with five top-three recipes. In 2010, recently relocated to Portland, Oregon, Justin threw all his energy into starting Base Camp Brewing. Justin's brewing style produces unique beers that bring tradition and innovation together.

Tony Hansen
Short's Brewing Company
Elk Rapids, Michigan

Tony is the Head Brewer at Short's Brewing Co. Tony met Joe Short while attending a homebrew club meeting in late 2006. Joe expressed an inspiring vision of what brewing could be and offered Tony a part-time job as a pub brewer. In 2007, Tony's role quickly transformed into the lead brewer position at the brewpub in Bellaire, Michigan. Since 2009, Tony has managed production operations in the Elk Rapids production brewery, overseen pub production along with R&D brewing, and designed the beer, the branding, and the names for many of Short's brews.

Jack Hendler
Jack's Abby Brewing
Framingham, Massachusetts

Jack is the Head Brewer and Co-owner of Jack's Abby Brewing. Like many American craft brewers, Jack started as a homebrewer in college. From there he earned a joint diploma in brewing technology from the Siebel Institute in Chicago and Doemens Academy in Germany. Before opening the brewery with his brothers, Jack was the Head Brewer at Canal Street Boston Beer Works in Boston. The name "Jack's Abby Brewing" is a nod to Jack's wife, Abby, and also to the traditions of the European monks who handcrafted beer in their abbeys.

Oliver Roberts
Wolverine State Brewing Company
Ann Arbor, Michigan

Oliver began homebrewing in 2000 before attending Oregon State University's Food Science Program to specialize in Fermentation Science. Later, through his hometown connections, he was hired to be the Head Brewer for Wolverine State Brewing, then a contract brewing company looking to have their own brick and mortar production facility. Oliver is in charge of all brewing operations and development at Wolverine State. Since opening in November of 2010, Oliver has brewed 50 different styles of beer at Wolverine State — 95% of which are either classic or new takes on lager styles.

As hoppy beers have become the trend — or obsession even — of craft beer lovers over the years, it has become hard to find a brewery in the United States that does not brew their own version of the IPA. But traditional IPAs are not always enough to quench the thirst of hopheads looking for new and different hop-forward flavors and aromas — leaving brewers constantly adding more hoppy options to their beer lineups. So, maybe the introduction of the India pale lager (IPL) was inevitable.

IPLs contain a similar hop characteristic as that of their popular, older cousin the IPA, but the lager yeast strain brings the character of the hops and malts even more to the forefront. As Jack Hendler, Brewer of Jack's Abby puts it, "Craft brewers of the past few decades have begun using more neutral ale yeast strains to highlight hop flavor. IPLs go a step further because the best way to minimize yeast character and maximize hop flavor is with a lager yeast."

The IPL style has caught on quickly over just the last year or two, as is reflected in the number of breweries adding an IPL to their arsenal. There is a lot of intrigue around the IPL, in part because the style has not been around long enough to truly be defined. The Beer Judge Certification Program has not (yet) identified the India pale lager as a style. The characteristics of an IPL are unlike any lagers it does identify. The IBUs of an IPL vary, but are generally in line with IPAs from 45-70 (and greater in double IPLs). The hoppiest lager recognized by the BJCP is the German Pilsner, coming in at 45 IBUs. Giving a brewer the opportunity to explore such unchartered territory is one that many cannot resist, whether they're brewing commercially or in their basement.

If you are a homebrewer considering your own twist on the hoppy lager, read what these experienced pros have to say before you get started. Their advice may make all the difference in your groundbreaking brew.

What is it about IPLs that are attracting more and more brewers to come out with their own version?

Bryan Egan - I think it's two things. There's a lack of definition to the style, allowing brewers to make their own interpretation and get a little creative with it. There's also the idea that you can make something different from the IPAs that have popularized craft brewing the last few years, but every bit as flavorful and enjoyable.

Justin Fay - India pale lagers are a great bridge for many craft beer drinkers; so many people are very familiar with a good IPA, but are less so with the rest of the craft beer universe. We've found that our In-Tents IPL is opening the eyes of lots of beer geeks and craft newbies alike, delivering the big hoppy and malty beer that they've come to love in an IPA but with a new way to deliver that same satisfying experience. This beer shakes up the expectation of what a lager is. It's educational!

Tony Hansen - Mainly, I think brewers are attracted to IPLs because it's a fairly new style that is still open to interpretation. There is still room to brew an exciting, unique version that will be new to everyone drinking it.

Jack Hendler - I believe that India pale lagers are the inevitable product of the most recent trend in hoppy beers. Craft brewers of the past few decades have begun using more neutral ale yeast strains to highlight hop flavor. IPLs go a step further because the best way to minimize yeast character and maximize hop flavor is with a lager yeast.

Oliver Roberts - The attraction of craft lagers in general is catching on as more and more breweries are diversifying their beer lineups to include more lagers. Straying from the more traditional ale brewery model gives a brewer something else to talk about. An IPL-style beer is a natural progression as the style is not saturated like the IPA segment. Plus, people love hops!

What kind of hops do you like to use for an IPL?

Bryan Egan - I use a blend of English and American varieties. Willamette, Glacier, Cascade, Target, and Fuggle. This was done to pull elements from both the traditional English IPA as well as the more assertive American IPA styles.

Justin Fay - In our In-Tents India Pale Lager, we use Summit for bittering, then Zythos™, Centennial, Glacier, and Mt. Hood in the lager tank for flavor and aroma; it really comes down to what you want for your beer.

Tony Hansen - I prefer to use American varieties that lean towards heavy citrus flavors, sometimes blending some piney or dank notes in. I don't care for spicy or earthy varieties to be the main flavor in my hop-forward beers.

Jack Hendler - We prefer using the most aromatic American hops we can get our hands on. When brewing with a lager yeast, even the subtlest hop flavors can shine.

Oliver Roberts - We stick to traditional American varieties found in big, citrusy, fruity IPAs — like Cascade, Chinook, and Columbus. We have a different dry hopping method where we use higher alpha, dual-purpose hops, rather than aroma varieties typically used for dry hopping.

What considerations must be put into selecting hops for an IPL?

Bryan Egan - You must consider the flavor profile you are looking for and the hops available to you. If you have a thinner "lager-like" grist bill you may want more bitterness with a sharper piney aroma. A beer with a heavier, sweet or roasted malt backbone may blend better with some softer tropical or earthy aromas.

Justin Fay - In considering hops for our In-Tents IPL, we started by trying to pin down the kind of hop character

> "It is less about the types of hops, but how they are used."

we'd like — and would fit well — in the finished beer. Summit™ hops work nicely for bittering, thanks to their good alpha levels, and the high-trellis crops from the Yakima Valley present particularly well. We wanted the beer's malt bill and oak character to shine through, and avoid going overboard with too much palate-smothering soapy hop taste; our obvious choice was to deliver all that good hoppiness via dry hop additions.

Tony Hansen - Keep in mind that the hops will be significantly prominent in this style of beer, so choose each variety wisely! Also, I'd suggest going lighter on the bittering addition to let the flavor and aroma additions shine.

Jack Hendler - Think outside the box. I know that centuries of brewing say only noble hops can go in lagers, but it's for no other reason than, "because I said so." Or as my German brewing professor so eloquently put it, "This is fact." — it's not.

Oliver Roberts - It is less about the types of hops, but how they are used. We stay away from overuse of hops that are more resinous or piney. We tried a few different varieties early on and found that good ol' Cascades worked best with our yeast to bring out the flavors and essence of that hop.

Do you do dry hopping, late wort hop bursting or any other different techniques?

Bryan Egan - We do a late wort hopping in the whirlpool as well as using whole leaf hops in a hopback. We prefer the hopback method to dry hopping because it gives a fuller and smoother hop flavor because the wort spends a little less time on the hops and really only dissolves the oils into the beer.

Justin Fay - Lots of dry hopping.

Tony Hansen - We have done it all when it comes to hops. I am a big fan of blending hops and hop bursting in our IPLs. I also like to use unconventional hop addition times.

Jack Hendler - All of the above, plus a hopback. We tend to minimize bittering addition and use the majority of our hops at the end of the boil, hopback and dry hopping. When adding hops at the end of a boil on a commercial scale we find that we will get almost full bittering contributions.

Oliver Roberts - Our process for Gulo Gulo IPL was a work in progress trying from the outset. We first found hops we liked then tweaked the process. It ended up where we shifted a lot of the IBUs into late kettle additions, hopping in the whirlpool, and we employed a slurry method for dry hopping using an old chocolate melter with a mixing arm. It certainly gave us more aroma than just dropping pellets in the top of a fermenter.

Do you use a different grain bill for an IPL than a traditional lager?

Bryan Egan - We use a very different grain bill. The goal of our IPL was to create a beer that could play in the same space of an IPA because we are largely a lager brewery. The decision was to do everything we would have done for an IPA in the brewhouse and then ferment at lower temperatures with a lager yeast and provide 2–3 weeks of lagering before packaging.

Justin Fay - As with any beer, your ingredients are very dependent on what you're going for! In our In-Tents IPL, we use Vienna, naked oats, crystal C30, and melanoidin. We tweaked the grain bill over about a two-year-long recipe development process. The resulting recipe really delivers exactly what we were hoping for.

Tony Hansen - I keep it pretty close to a traditional lager recipe, but I have not used any adjuncts like rice or corn . . . yet.

Jack Hendler - For extra-hoppy American-hopped IPLs, a neutral 2-row malt works best to minimize competing flavors. Why buy expensive and unique base malt when those flavors will only get muted out and negatively affect the hop character?

Oliver Roberts - Our IPL recipe is one of the most basic in our portfolio. Pale ale malt base, some wheat, mid-range caramel malt, and we use about 10% brown rice syrup to boost the ABV a smidge and keep the crisp edge. The grain bill gave us such a nice malty backbone that we were able to load up on the hops without taking out any of the malt goodness.

What type of balance are you looking for in your IPL?

Bryan Egan - Perfect balance. There is a lot of residual sweetness to match nicely with the 60 IBUs and abundant hop aroma. Roasted flavors were kept to a minimum but there is some nuttiness in the background as well.

Justin Fay - Our In-Tents IPL has a deep and complex malt character that provides the backbone you need for a full-of-hoppy-goodness beer. Clocking in at 55 IBUs, the IPL is solidly bittered but still lets through all the specialty malts we use. An additional layer in the In-Tents is a bit of in-house milled and toasted red and white oaks that we add in lager; this adds some vanillin

sweetness and body to the mid-taste, then a nice tannic astringency to keep everything light and clean on the back end. Riding over all of this is a piney, floral, touch-of-citrus hop aroma that ties everything together.

Tony Hansen - We normally like to go heavy on the hops here at Short's. But, with an IPL, we dial the bittering addition back a bit and concentrate more on heavy flavor and aroma additions.

Jack Hendler - Balance can come in many forms, it's not just a malt-to-hop balance. You can balance bitterness with aroma, yeast flavor with hops, malt with alcohol, etc. Most of our IPLs tend to minimize malt and highlight hops.

Oliver Roberts - When it comes to balance I chose to make the Gulo Gulo IPL a simple experience with nuances throughout. An intense hop aroma with sweetness and light alcohol, followed by a meld of malt and big hop flavors, and finishes with a lingering bitterness that doesn't overpower your palate but satisfies the desire for some tongue lashing. Each part of the experience needs to be balanced, if one of the elements stands out it can detract from the rest of them.

What type of yeast do you use in your IPL? What yeast strains would you recommend for a homebrewer making an IPL?

Bryan Egan - We use our house lager yeast and a fermentation profile almost identical to the one used for our premium lager. I would recommend a yeast that ferments as cleanly as possible so that the hops remain the hero of the beer and malt can be used to achieve whatever balance is desired. I would also recommend being aware of the alcohol tolerance of the yeast if you are looking to make something over the 5.5% ABV range.

Justin Fay - Again, it really comes down to what you're going for. We use our in-house lager yeast strain. It's

robust, consistent, and contributes a unique yeast character into our finished beer that's just perfect for the In-Tents. We'd recommend that a homebrewer try a number of different yeasts before deciding that any one of them is "the one."

Tony Hansen - We primarily stick with a standard American lager strain. However, we have recently used a Bohemian Pilsner strain for a black session IPL that we were very pleased with.

Jack Hendler - Use any lager strain that has worked well for you in the past. Our ideal yeast has high attenuation, clean fermentation profile, and will drop brite during lagering. The yeast flavors should take a backseat to your other ingredients.

Oliver Roberts - We started off using a bock yeast specifically for the IPL and it had a lot of balance in the flavors. When we had a culture that didn't do well, we switched to our house lager yeast and were pleasantly surprised by the fruitier aromas we got. It was like "WHOA! Where did that come from?" I won't say the yeast specifically, but it's from Mexico . . .

What temperature do you ferment at? For how long?

Bryan Egan - Fermentation starts at 51 °F (11 °C), free rises to 54 °F (12 °C) until fermentation is 60-70% complete, then free rises again to 56 °F (13 °C) and is held until fermentation is complete. This will take 6-7 days.

Justin Fay - Mid-50s Fahrenheit (12-13 °C) works well for our yeast and the IPL. We hit about seven days for primary fermentation and then an additional 2+ weeks in the lager tank.

Tony Hansen - We ferment at 54 °F (12 °C) with the American lager strain and dial it up to 58 °F (14 °C) with the Bohemian strain. We try to condition our IPL for at least 2 weeks after transferring into the secondary.

Jack Hendler - Ferment at normal lager temperatures 50-55 °F (10-13 °C). Allow the beer to warm up to 60 °F (16 °C) the last day of fermentation. This will allow for a diacetyl rest, but more importantly the warmer temperature is better for a dry hop flavor extraction. This is an odd caveat for lagers because dry hopping works best the warmer the product.

Oliver Roberts - Our lagers typically start in the 50-52 °F (10-11 °C) range but we do our IPL between 52-55 °F (11-13 °C). The Gulo Gulo IPL has a five-day primary, 5- to 10-day diacetyl rest raised by ambient temperatures, then slowly chilled one degree Fahrenheit per day until we hit 38-42 °F (3-6 °C). We dry hop it and let it sit on the hops for about 7-10 days. Lastly, we filter onto whole leaf hops in the bright tank before packaging.

What advice could you give homebrewers who have never made an IPL?

Bryan Egan - Be creative. There are no constraints with this style, so make it the way you think an IPL should taste. Make it something you will enjoy drinking.

Justin Fay - Same as any other beer — have fun and share what you brew! We put a lot of love and effort into developing our IPL; it was a really fun project to flex our creative muscle.

Tony Hansen - Don't overthink it; it's just a hoppy lager, but avoid harsh bitterness.

Jack Hendler - Like I said before, think outside the box. Lager doesn't mean yellow fizz. Everything you've ever believed about "lager" need not apply (because it's not true). It can be anything you want it to be.

Oliver Roberts - In brewing an IPL, I would say consider your yeast and your hops first. Use a yeast strain you are familiar with if possible. Then go ahead and use a typical malt bill for an IPA. Lastly, focus on flavor and aroma additions in the kettle, dry-hop liberally, and move the beer along. If you ferment cold you don't necessarily need to lager for all that long to mature the beer.

What potential pitfalls should a homebrewer creating their first IPL look out for?

Bryan Egan - Don't get too out of balance. IPAs work because of a strong malt backbone to work with the bitterness. Thinning out the sweetness and maltiness too much could bring a whole new definition to the term hop-bomb.

Justin Fay - Out-of-whack hop character. "More" doesn't always mean "Better." Seek balance; hopefully you'll be able to pick up malt and fermentation character amongst that wonderful hop character.

Tony Hansen - Remember to give your IPL a healthy diacetyl rest just like any other lager. You don't want a bitter butter bomb.

Jack Hendler - The key to an IPL versus an IPA is the fermentation. If you can't control the temperature well, it may not be worth the effort to use a lager strain.

Oliver Roberts - Over-hopping for bitterness could be an issue because of the crisp, dry character that can come with lager yeasts. The bitterness can completely deter from the rest of the hops if it dominates. Also, oxidation from dry-hopping could be a concern. If I were still homebrewing I would put my hops into another vessel, rack the beer onto the hops and purge the vessel with CO_2 beforehand. BYO

Related Links:

• For a great IPL recipe, turn to page 56 of this issue. For more tips on basic lagering practices before brewing your first IPL, check out "10 Keys to Great Lagers" from the *BYO* archives at http://byo.com/story009 or "Lagering Without a Refrigerator" at http://byo.com/story973.

PERFECT POUR

Tips for pouring better homebrew from kegs

A great glass of draft beer poured from a keg can seem tricky on the first few pours. You may pour a beer and get a glass full of foam, and other times you may pour and get no foam at all. It takes more than just a glass tilted at a 45 degree angle, but if you pay close attention to all the key dispensing elements (temperature, pressure, tube length, keg and glass) you should not have any issues.

Pouring consistent glasses requires a practical understanding of how carbonated beverages work in a dispensing system. Beer is not like water — it pushes back where non-carbonated liquids will simply flow with gravity or the push of air and other gases. To understand how this push operates you should understand beer's carbonation level and the carbonation's relationship to temperature. You can then begin to understand how to calculate CO_2 push, preferred beer line length and the proper serving temperature for each style of beer you plan to dispense from your kegerator.

The Keg

In order to fill a glass with a well-balanced beer, the keg's dispensing gas must be balanced and fully saturated into solution for that specific beer's style. Moving kegs around after carbonation has been completed will cause agitation and release some of the infused gas. The result is extreme foam when immediately tapped and served.

The key to solving this problem is to allow the beer to settle and return to optimal serving temperatures in your kegerator. It is best to let a keg sit 24 hours after vehicle transport, but

Story by **Christian Lavender**

often this is not practical. Try to hold off, however, for at least an hour if you are just moving it from, say, the garage to the keg fridge.

Tube Lengths

The length of the beer line and the length of the gas line can also affect the amount of push needed for optimal pouring. Most home draft systems will have beer line of 3/16-inch inner diameter (ID), but it is good to check and make the adjustments necessary. Look at the type of beer line and CO_2 gas line that comprise your home draft system. If possible, note the restriction value of the line. Some beer and gas lines may have the same inner diameter, but because of the materials they are made from, they will expand or contract at different rates. This quality of your line is called the restriction value.

There will be some restriction from gravity and from draft hardware such as any shank and the spigot, but it is pretty negligible. Gravity has an effect, and it is only 0.5 pounds per foot of rise or fall of additional restriction.

Rule of Thumb: For determining the beer line length you can take the ideal pressure, add five and then divide by the beer line's restriction value per foot. If the beer isn't flowing fast enough for you, you can try cutting down the beer line length a little at a time until it feels right.

There are some other considerations as well, such as making sure that your beer line is cold and the possible use of beer gas (CO_2 and Nitrogen mix). There are some people

Photo courtesy of Christian Lavender

with more complicated formulas than this to accommodate for various factors, but I have found this one to work quite well.

If you have more than one type of beer that is being served from the same gas source, you will want to either split your CO_2 line or add a secondary regulator to step down the pressure to the keg of beer that will be served at the lesser pressure. The most expedient solution is to daisy chain secondary regulators to your primary CO_2 regulator. This will allow you to adjust the pressure according to the rule of thumb I just mentioned, so that if you have two beers that are being served from the same cooling chamber, you can adjust the pressure on the different kegs to match the ideal pressure for the non-ideal temperature.

Cleaning Beer Lines

Cleaning the beer lines of your home draft system with a beer cleaner is vital to maintaining good flowing beer. The beer line cleaning chore should be undertaken on a regular basis. It is a good idea to clean the beer lines in between each keg change. If this seems like too much for you, then at least once every month is recommended. You will notice the results of regular beer line cleaning: keeping your beer lines fresh improves taste and prevents particles from causing over-foaming from the tap.

Just like all your brewing equipment, cleaning your beer lines requires two steps: cleaning and then sanitizing. Beer Line Cleaner (BLC) or Powdered Brewery Wash (PBW) are both good choices for the cleaning step, and Iodophor is a good sanitizer. Iodophor is used to create a water-based solution (the ratio comes on the Iodophor bottle) in a bucket of water. There are also many different types of cleaners these days that have emerged specifically for the purpose of cleaning beer lines. These products are specially developed to remove the sediment that builds up in the lines as a result of yeast particles that cling to the insides of the beer lines. The theory is that any little rough spot in the beer lines, the spigot, or even the glass, gives the CO_2 infused into the beer a chance to escape, creating excess foam. Ideally, you want a cleaner that will take away the yeast and malt sediment without "roughing" up the plastic tube or any other part of the draft system on the inside. This is why nonabrasive products are used exclusively for the purpose of cleaning beer lines. BLC has been a very popular all-purpose cleaner for a while now, but Power Punch 22 is a newer product from Perma that has been specifically tailored to more efficiently remove yeast residue from your beer lines with less caustic effects. Both products are biodegradable, and both are made especially for beer line use. No matter which beer line cleaner you use for cleaning and maintaining beer lines, however, the actual process for cleaning and sanitizing the lines will be the same. The choice of chemicals is up to you — find a cleaner and sanitizer that you can afford and live with.

Once you have your cleaning and

Photo by Christian Lavender

Moving kegs around after carbonation is completed will result in agitation, release some of the infused gas and cause foaming. If you move your kegs, try to wait at least an hour before dispensing any beer. If you transported the keg in your car, it's best to wait 24 hours.

Force Carbonation Featuring Pressure vs. Temperature in Degrees Fahrenheit

PSI (Pounds Per Square Inch)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
30°F	1.82	1.92	2.03	2.14	2.23	2.36	2.48	2.60	2.70	2.82	2.93	3.02	3.13	3.24	3.35	3.46	3.57	3.67	3.78	3.89	4.00	4.11	4.22	4.33	4.44	4.66	4.77	4.87	4.98	4.98
31°F	1.78	1.88	2.00	2.10	2.20	2.31	2.42	2.54	2.65	2.76	2.86	2.96	3.07	3.17	2.28	3.39	3.50	3.60	3.71	3.82	3.93	4.03	4.14	4.25	4.35	4.46	4.57	4.68	4.78	4.89
32°F	1.75	1.85	1.95	2.05	2.15	2.27	2.38	2.48	2.59	2.70	2.80	2.90	3.00	3.11	3.21	3.31	3.42	3.52	3.63	3.73	3.84	3.94	4.04	4.15	4.25	4.36	4.46	4.57	4.67	4.77
33°F	1.71	1.81	1.91	2.01	2.10	2.23	2.33	2.43	2.53	2.63	2.74	2.84	2.96	3.06	3.15	3.25	3.35	3.46	3.56	3.66	3.76	3.87	3.97	4.07	4.18	4.28	4.38	4.48	4.59	4.69
34°F	1.68	1.78	1.86	1.97	2.06	2.18	2.28	2.38	2.48	2.58	2.69	2.79	2.90	3.00	3.09	3.19	3.29	3.39	3.49	3.59	3.69	3.79	3.90	4.00	4.10	4.20	4.30	4.40	4.50	4.60
35°F	1.63	1.73	1.83	1.93	2.02	2.14	2.24	2.34	2.43	2.52	2.63	2.73	2.83	2.93	3.02	3.12	3.22	3.32	3.42	3.52	3.62	3.72	3.82	3.92	4.01	4.11	4.21	4.31	4.41	4.51
36°F	1.60	1.69	1.79	1.88	1.98	2.09	2.19	2.29	2.38	2.47	2.57	2.67	2.77	2.86	2.96	3.05	3.15	3.24	3.34	3.43	3.53	3.63	3.72	3.82	3.92	4.01	4.11	4.21	4.30	4.40
37°F	1.55	1.65	1.74	1.84	1.94	2.04	2.14	2.24	2.33	2.42	2.52	2.62	2.71	2.80	2.90	3.00	3.09	3.18	3.27	3.37	3.46	3.56	3.65	3.75	3.84	3.94	4.03	4.13	4.22	4.32
38°F	1.52	1.61	1.71	1.80	1.90	2.00	2.10	2.20	2.29	2.38	2.48	2.57	2.66	2.75	2.85	2.94	3.03	3.12	3.21	3.30	3.40	3.49	3.59	3.68	3.77	3.87	3.96	4.06	4.15	4.24
39°F	1.49	1.58	1.67	1.77	1.86	1.96	2.06	2.15	2.25	2.34	2.43	2.52	2.61	2.70	2.80	2.89	2.98	3.07	3.16	3.25	3.34	3.44	3.53	3.62	3.71	3.81	3.90	3.99	4.08	4.18
40°F	1.47	1.56	1.65	1.74	1.83	1.92	2.01	2.10	2.20	2.30	2.39	2.47	2.56	2.65	2.75	2.84	2.93	3.01	3.10	3.19	3.28	3.37	3.46	3.55	3.64	3.73	3.82	3.91	4.01	4.10
41°F	1.43	1.52	1.61	1.70	1.79	1.88	1.97	2.06	2.16	2.25	2.34	2.43	2.52	2.60	2.70	2.79	2.88	2.96	3.05	3.14	3.23	3.32	3.41	3.50	3.59	3.68	3.77	3.86	3.95	4.04
42°F	1.39	1.48	1.57	1.66	1.75	1.85	1.94	2.02	2.12	2.21	2.30	2.39	2.48	2.56	2.65	2.74	2.83	2.91	3.00	3.09	3.18	3.26	3.35	3.44	3.53	3.62	3.70	3.79	3.88	3.97
43°F	1.37	1.46	1.54	1.63	1.72	1.81	1.90	1.99	2.08	2.17	2.26	2.34	2.43	2.52	2.61	2.69	2.78	2.86	2.95	3.04	3.13	3.21	3.30	3.39	3.47	3.56	3.65	3.74	3.82	3.91
44°F	1.35	1.43	1.52	1.60	1.69	1.78	1.87	1.95	2.04	2.13	2.22	2.30	2.39	2.47	2.56	2.64	2.73	2.81	2.90	2.99	3.07	3.10	3.24	3.33	3.41	3.50	3.58	3.67	3.76	3.84
45°F	1.32	1.41	1.49	1.58	1.66	1.75	1.84	1.91	2.00	2.08	2.17	2.26	2.34	2.42	2.51	2.60	2.69	2.77	2.86	2.94	3.02	3.11	3.19	3.28	3.36	3.45	3.53	3.62	3.70	3.79
46°F	1.28	1.37	1.45	1.54	1.62	1.71	1.80	1.88	1.96	2.04	2.13	2.22	2.30	2.38	2.47	2.55	2.64	2.72	2.81	2.89	2.98	3.06	3.15	3.23	3.31	3.40	3.48	3.57	3.65	3.74
47°F	1.26	1.34	1.42	1.51	1.59	1.68	1.76	1.84	1.92	2.00	2.09	2.18	2.26	2.34	2.42	2.50	2.59	2.67	2.76	2.84	2.93	3.02	3.09	3.18	3.26	3.35	3.43	3.51	3.60	3.68
48°F	1.23	1.31	1.39	1.48	1.56	1.65	1.73	1.81	1.89	1.96	2.05	2.14	2.22	2.30	2.38	2.46	2.54	2.62	2.71	2.79	2.88	2.96	3.04	3.13	3.21	3.30	3.38	3.46	3.54	3.63
49°F	1.21	1.29	1.37	1.45	1.53	1.62	1.70	1.79	1.86	1.93	2.01	2.10	2.18	2.25	2.34	2.42	2.50	2.58	2.67	2.75	2.83	2.91	3.00	3.07	3.15	3.23	3.31	3.39	3.47	3.56
50°F	1.18	1.26	1.34	1.42	1.50	1.59	1.66	1.74	1.82	1.90	1.98	2.06	2.14	2.21	2.30	2.38	2.46	2.54	2.62	2.70	2.78	2.86	2.94	3.02	3.10	3.17	3.25	3.33	3.41	3.49
51°F	1.18	1.26	1.34	1.42	1.49	1.57	1.64	1.71	1.79	1.87	1.95	2.02	2.10	2.18	2.26	2.34	2.42	2.49	2.57	2.65	2.74	2.82	2.90	2.97	3.05	3.13	3.19	3.27	3.34	3.42
52°F	1.16	1.23	1.31	1.39	1.46	1.54	1.61	1.68	1.76	1.84	1.92	1.99	2.06	2.14	2.22	2.30	2.38	2.45	2.53	2.61	2.68	2.76	2.84	2.92	3.00	3.06	3.13	3.22	3.30	3.37
53°F	1.14	1.21	1.29	1.36	1.44	1.51	1.59	1.66	1.74	1.81	1.89	1.96	2.03	2.10	2.18	2.26	2.34	2.41	2.49	2.57	2.64	2.71	2.79	2.86	2.94	3.01	3.09	3.16	3.24	3.31
54°F	1.12	1.19	1.27	1.34	1.41	1.49	1.56	1.63	1.71	1.78	1.86	1.93	2.00	2.07	2.15	2.22	2.30	2.37	2.45	2.52	2.59	2.66	2.74	2.81	2.89	2.96	3.04	3.10	3.17	3.24
55°F	1.10	1.17	1.24	1.31	1.39	1.46	1.53	1.60	1.68	1.75	1.82	1.89	1.97	2.04	2.12	2.18	2.26	2.33	2.40	2.47	2.54	2.62	2.69	2.76	2.83	2.89	2.97	3.04	3.11	3.18
56°F	1.07	1.15	1.22	1.29	1.36	1.43	1.50	1.57	1.65	1.72	1.79	1.86	1.93	2.00	2.08	2.15	2.22	2.29	2.36	2.43	2.50	2.57	2.64	2.71	2.78	2.85	2.92	2.99	3.06	3.13
57°F	1.05	1.12	1.19	1.26	1.33	1.40	1.47	1.54	1.62	1.70	1.77	1.83	1.90	1.97	2.04	2.11	2.18	2.25	2.32	2.39	2.46	2.53	2.60	2.66	2.73	2.80	2.87	2.94	3.00	3.08
58°F	1.03	1.10	1.17	1.24	1.30	1.37	1.44	1.51	1.59	1.67	1.74	1.80	1.87	1.94	2.01	2.08	2.15	2.21	2.28	2.35	2.42	2.48	2.55	2.62	2.69	2.75	2.82	2.88	2.95	3.02
59°F	1.02	1.09	1.16	1.22	1.29	1.36	1.43	1.49	1.56	1.64	1.71	1.77	1.84	1.91	1.98	2.04	2.11	2.17	2.24	2.31	2.38	2.43	2.50	2.57	2.64	2.70	2.77	2.84	2.91	2.97
60°F	1.01	1.08	1.15	1.21	1.28	1.34	1.41	1.47	1.54	1.62	1.62	1.75	1.82	1.88	1.95	2.01	2.08	2.14	2.21	2.27	2.34	2.40	2.47	2.53	2.60	2.66	2.73	2.79	2.86	2.92
61°F	0.99	1.05	1.12	1.18	1.24	1.31	1.37	1.44	1.50	1.57	1.63	1.69	1.76	1.82	1.89	1.95	2.02	2.08	2.14	2.21	2.27	2.34	2.40	2.47	2.53	2.59	2.66	2.72	2.79	2.85
62°F	0.96	1.02	1.09	1.15	1.21	1.27	1.34	1.40	1.46	1.52	1.59	1.65	1.71	1.78	1.84	1.90	1.97	2.03	2.09	2.15	2.22	2.28	2.34	2.41	2.47	2.53	2.59	2.66	2.72	2.78
63°F	0.93	0.99	1.06	1.12	1.18	1.24	1.30	1.36	1.42	1.49	1.55	1.61	1.67	1.73	1.79	1.85	1.92	1.98	2.04	2.10	2.16	2.22	2.28	2.35	2.41	2.47	2.53	2.59	2.65	2.71
64°F	0.91	0.97	1.03	1.09	1.15	1.21	1.27	1.33	1.39	1.45	1.51	1.57	1.63	1.69	1.75	1.81	1.87	1.93	1.99	2.05	2.11	2.17	2.23	2.29	2.35	1.41	2.47	2.52	2.58	2.64
65°F	0.88	0.94	1.00	1.06	1.11	1.17	1.23	1.29	1.35	1.41	1.46	1.52	1.58	1.64	1.70	1.76	1.82	1.87	1.93	1.99	2.05	2.11	2.17	2.23	2.28	2.34	2.40	2.46	2.52	2.58

Blue = Under-Carbonated, 0 - 1.40 volumes CO_2

Gray = Stouts and porters, 1.50 - 2.20 volumes CO_2

Green = Lagers, Ales, Ambers, most beers, 2.20 - 2.60 volumes CO_2

Yellow = Highly carbonated ales, Lambics, Wheat beers 2.60 - 4.0 volumes CO_2

Red = Over-carbonated (except for certain specialty ales) 4.1 + volumes CO_2

* This chart is for use in force carbonating draft beer. Use this force carbonation chart at your own risk. Never exceed the pressure rating of the carbonating vessel as injury to yourself or others may result.

TYPE OF BEER	CO_2 VOLUME	CO_2 PSI	TEMPERATURE
Lager	2.8	17 PSI	45 °F (7 °C)
Pale Ale	2.6	16 PSI	45 °F (7 °C)
Amber Ale	2.4	16 PSI	50 °F (10 °C)
Brown Ale	2.2	11 PSI	40 °F (4 °C)
Stout	1.8	11 PSI	55 °F (13 °C)
Porter	1.5	6 PSI	50 °F (10 °C)
Belgian White	2	9 PSI	45 °F (7 °C)

Here are some examples by style of the relationship between temperature and pressure when serving beer. The proper temperature is needed to maintain the proper carbonation.

sanitizing solutions ready to go, it's time to get started. The process goes like this: take your nozzle and hoses apart and soak and clean them with your cleaning solution followed by a thorough rinse. Next, let the parts soak, submerged, in a bucket with Iodophor solution for ten minutes or so. Unwanted bacteria will be destroyed — and, if your Iodophor and water solution is in the correct ratio, you will not have to rinse. An additional technique is as follows: make an extra a gallon or two (3.8–7.5 L) of Iodophor solution and run it through your beer lines for a few minutes. Next, take your taps apart as you did with your lines and thoroughly clean them followed by a 10-minute soak in your sanitizing solution. Keep in mind that the outsides of your beer lines should be sanitized as well.

Temperature Flux

If the temperature and/or CO_2 push of the beer in your draft system is only a little bit off it can greatly effect the carbonation level of the beer, and also the beer's taste. The first thing to understand is that each beer type has a certain temperature that it should be served at and a certain pressure that the beer should be dispensed with while at that temperature. If the temperature changes even two degrees Fahrenheit (1 °C) it can cause the beer to taste either flat or cause over foaming.

This is because beer is a solution of gas and liquid. The saturation point of beer changes dramatically with temperature. If you are a homebrewer then you know that it is easier to add malt syrup to hot boiling wort than to mix it into a solution with cool or even warm water. With CO_2 it is different — the opposite relationship to temperature is true. The lower the temperature of the beer the easier it is to infuse the beer with CO_2 gas. As the temperature of the beer goes up the saturation level goes down. This causes the CO_2 gas to be forced out of the beer and that is one of the causes of over foaming beer served out of a home draft system.

This is why it is so important to maintain the correct temperature recommended for serving the beer that is being dispensed from your home draft system. Highly carbonated beer is in the 2.8–3.0 volume range; normally carbonated beer is in the 2.6–2.8 range; moderate is 2.4.–2.6; low is 2.2–2.4. Very low is 2.0-2.2; really low is 1.8–2.0. The chart above gives you some very basic examples by style for understanding the relationship between temperature and pressure when serving beer.

CO_2 volume measures how much CO_2 is actually in the beer. The CO_2 PSI is the amount of push you need at a given temperature to keep the CO_2 that is already in the beer from coming out of the beer. Any more pressure than that and you will have the beer gushing out a little too fast and foaming. Any less pressure and you will have beer that foams at first and then begins to taste flat after the first round of draughts. This is based on the beer being served at the right temperature. These cause and effects rules of thumb are tied to the draft system itself, however, and if you were to modify your draft system you could pour beer with higher carbonation.

For the homebrewer, serving at the ideal temperature is a little complicated. You can't just call up the brewery and ask them the ideal serving temperature if you are the brewery (although you could geek out next time you visit your favorite brewery and bring along a quick-read thermometer and dip it in your glass of beer to get an idea). It is important that you understand both the relationship between the CO_2 volume and temperature and also how to attain that volume of CO_2 in your beer. You can carbonate naturally, or, if you either are in a hurry or prefer to work with gas, you can force carbonate your beer. Force carbonation is the process of using CO_2 exclusively to attain the CO_2 volume you are shooting for in your beer.

Some kegerators are harder to dial in than others. Fortunately, there are many ways to control the temperature of your kegerator, even if the kegerator does not already come with an accurate thermostat built in. There are thermostats available in both mechanical and digital varieties from Johnson Controls and other manufacturers, which are, basically, plug and play units. There are more complicated units as well, such as the Ranco Digital Temperature Controller, which require some wiring in and electrical component ability on the part of the installer.

One often-overlooked aspect of serving beer at the right temperature is the glass that it is served in. There are, of course, many types of beer glasses, from pint glasses to frosty mugs, to specialty glasses, like the interesting goblets used by Chimay. Often, people like to serve beer in a frosty mug, but

this is not ideal. It can initially bring down the temperature of the beer past the ideal serving temperature. The best way to store beer glasses is to keep them in a refrigerator, at a temperature that is about the same as the serving temperature of the beer — or just a little colder. Not frozen, only chilled. We will talk a bit more more about glasses later on.

CO_2 Push

If you want to get the most out of your home draft system and the beer dispensed by it, you should know the ideal serving temperature and CO_2 or beer gas push.

Remember that the idea is to maintain the pressure specified at the temperature specified. Too little CO_2 gas can be as much of a problem as too much CO_2 gas. In the former case, by having too little pressure you are making room for the CO_2 already trapped inside the beer-CO_2 solution to escape. If you use too much pressure it can also cause the beer to over foam as a result of too much CO_2 trying to force its way into the solution.

One book that can help homebrewers to understand how this relationship of pressure and temperature interface with specific recipes for brewing is *Brewing Classic Styles* by Jamil Zainasheff and John J. Palmer. This book contains 80 recipes for brewing beer that include the volumes of CO_2 that should be present in the beer. You can also reference the CO_2 pressure chart on page 81, or check out that same chart online at http://www.kegerators.com/carbonation-table.php.

The Glass

A clean beer glass always receives liquid with the least amount of agitation. Make sure your beer glass has been emptied then thoroughly washed, rinsed, sanitized, dried and then rinsed well with cold water before making a pour. The final rinse will remove any residual sanitizer and also bring the glass temperature closer to that of the beer being dispensed. (As I mentioned earlier in this story, do not freeze glassware, as the ice formations lining the

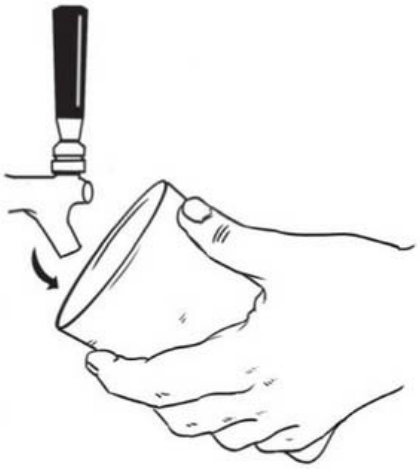


Illustration by Chris Champine

The proper way to pour from a tap is to start out at a 45-degree hold. Then, tilt the glass vertically when it is about half full to finish.

glass can cause foaming).

Start with a 45-degree hold on your beer glass and pour along the side, then about halfway through, tilt the glass vertically (see figure at left). You want an inch or so of head at the top of the glass. Allow the beer to settle slightly and top off if necessary. Present the beer to your guest or yourself and savor the flavor.

Make sure to pay close attention to your beer and air-line tube lengths as this can cause foaming issues also.

Pour and Taste

Once you have followed all the steps detailed earlier, it's time to put your draft system to the test — your taste test, that is. When you have everything reassembled, carbonated and chilled properly, pour yourself a glass of homebrew and see if you have made any improvements on what you were pouring before. If you've done everything right it should be a very good glass of beer. If you are careful to keep your kegs at the proper temperature and keep up with regular cleaning and sanitizing of your lines you'll consistently pour your best beer. BYO

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Add sweetness, mouthfeel to any beer style

by Terry Foster

You do not know how lucky you are! When I came to the US in 1977, supplies of brewing ingredients and equipment were very limited compared to what is available today. This situation started to improve in 1978 when homebrewing was made legal on a federal basis, but it took a while before the situation improved substantially. Indeed, every time I returned to England on business I took with me a sample loop and some sterilized jars. Whenever I visited a brewery I would pick up a sample of their yeast (often directly from the fermenter), bring it back to the US and culture it up to use in my own brewing. Now, I can get all kinds of strains in ready to use packs from several suppliers.

Back then someone gave me what they said was some American crystal malt, without any further details that might have been useful such as Lovibond (°L). This crystal seemed to be somewhat different from the British types I had been used to, and I thought it might be a good idea to make a beer entirely from this crystal malt. I did so, keeping it quite simple with an OG around 1.040 and a modest hop rate; as I remember it fermented out reasonably well and I had thought my idea had worked. Then I bottled it, waited for it to condition and tasted it. Even now a description of the taste is beyond me; all I remember it that it had such a powerful and somewhat unpleasant flavor that I could not actually drink a whole glassful. I think I still have a few bottles under a pile of debris in my garage and maybe I'll summon up the courage to try one sometime!

You will see in the accompanying article on caramel/crystal malts that begins on page 34 of this issue that roasted products are virtually identical for the same color level (°L). I shall consider here only roasted, not kilned caramel malts so I'll just use the term crystal for the sake of simplicity. You will also have seen that there are a wide range of them available, and not all of them are suited for use in brewing all beers. The table on this page will give you some idea as to which crystal malt might be suitable for the popular beer styles.

This table is not meant to be definitive or exclusive, but merely reflects my opinions (although it is based on commercial brewing practice and style definitions where possible). The point is that these roasted malts (as the table indicates) add not only color and flavor, but also add body and mouthfeel, since a proportion of the extract they yield is unfermentable. This is perhaps the main reason why British commercial brewers favor their

Suggested Crystal/Style combinations

Crystal Color °L	Beer Style	Proportion of grist (% of total weight)	Flavor/color	Comments
10, 20, 40	Pilsner;	3-8	Sweet, subdued caramel; yellow/gold	Adds relatively low color, sweetness and body
	Pale ale; Vienna; Märzen; Belgian ales	5-15		
60	Pale and Amber ales; Oktoberfest; DoppelBock: Mild and Brown ales	5-10	Definite toffee/caramel; gold to red	Adds pale red hue, sweetness and body. Particularly good with low-hopped sweet stout
	Sweet stouts Scotch ales, Brown and Robust porters; Oatmeal Stout	10-15		
80, 90	Bitter ales; Strong ales; Barleywines; IPAs; Dark lagers; Dry stouts; Foreign Extra stouts; Robust Porter; Baltic Porter	5-10	Strong toffee/caramel, dried fruit (raisin), some burnt sugar; reddish color	Adds definite red shade, but limited sweetness, mouthfeel. Main choice for English bitt er ales
120	Premium Bitter ales; Barleywines; Red Ales; American Stouts; Imperial Stouts	5-10	More intense burnt and dried fruit flavors and strong caramel; red color	Contributes quite deep red shades, less sweet but still adds body and mouthfeel
150	Robust Porter,	5	Intense caramel and burnt flavors; deeper red in color	Adds deep red shades, low sweetness, mouthfeel, roasted notes. Best used (with care) in beers with complex flavors
	American and Imperial Stouts	5-10		

use in brewing their regular bitter ales. Many of these are brewed at less than 4% ABV, and might well taste somewhat thin without the addition of crystal malt to the grist. The red color of 80 °L and 90 °L crystal malts also gives bitters a copper hue, which brewers like as it gives the beer more visual appeal.

In short, crystal malts are a valuable tool for the brewer and can be used in a variety of ways. This is especially true if you are brewing to taste and are not particularly concerned about producing a beer that is not exactly to style. For example, if you wanted to brew something close to a Pilsner but with a little more color you might want to add some 60 °L crystal malt instead of any of the lower roasted options. But if you did, you would use less (say 1-3%) than the 3-8% recommended in the chart for 20 °L crystal so the beer is not unbalanced in terms of flavor.

From the way I set up the table you may think I was referring only to all-grain brewing, but it can be applied just as much to extract brewing. All the extract of crystal malt can be leached out by a simple steeping technique so that these malts are very well adapted to extract brewing. But malt extracts are really concentrated worts, which is to say that pound for pound they give a higher yield of brewing extract than does grain malt. In other words, for the same original gravity you would require less malt extract than you would grain. Therefore, if you base it on weight (as in the table), then you need a higher percentage of crystal malt for an extract brew than an all-grain one. For a simple example, 6 lbs. (2.7 kg) of extract syrup in a 5-gallon (19-L) brew would give an OG of (6 x 36)/5 = 1.043, while for the same OG from all-grain you would need 9 lbs. (4.1 kg) of pale malt. If you were aiming for a 10% addition rate for the all-grain beer, that comes to 0.9 lb. (0.41 kg) of, say, 70 °L crystal malt. But you need the same weight of crystal in 5 gallons for the same color and flavor effect; that comes to (0.9/6) x 100 = 15% of the weight of malt extract.

There is another wrinkle to be considered when adding crystal malt to an extract brew. This is that some extracts have been produced with a proportion of crystal malt, and you should allow for that when making further additions. Your supplier may well not be able to tell you how much crystal was used in making the extract, so what do you do then? Well, you likely do nothing; the manufacturer knows what he was trying to do and the chances are you won't improve on his efforts by just adding more crystal. You are better off taking a straight pale extract and steeping an amount of crystal malt in order to get the color and flavor you want.

Making your choice

The best approach (as I have said often in this column before) is to think before you do. The first point is deciding

what kind of beer you want to brew before you buy any grain or extract. If you want to make something true to style, then that will decide how much crystal you'll need to get in the right color and flavor range. If you want to make something entirely your own then the business becomes more complicated. That's because you want to get some balance between alcohol level, hop bittering rates, hop character, body, and the depth of color. In other words you probably wouldn't want to use so much of 90 °L crystal malt in a pale lager that it becomes a deep red and tastes of nothing but caramel. Nor would you want to add more than a dash of 150 °L crystal in a pale ale brew where you want hop flavor and aroma to be dominant, whereas you might use a bigger proportion in a bigger beer such as an imperial stout, where you are aiming for more body and complexity. In fact, it would take me a month or two to put together a chart showing relationships between all the possible beer styles, all the available crystal malts and all the possible addition rates! That was why I drew up the table on page 87 as a framework so someone with a limited knowledge of the possibilities of crystal malts would have a starting point to work from.

The above statements may sound a little wishy-washy and not be of much help to you, so perhaps an example may be more instructive.

Example: Welsh Archer's Bitter Ale

This is going to be a modest 5-gallon (19-L) all-grain beer, let's say with an OG of 1.040, finishing at 1.010 for an ABV of 4% and with only 28 IBU. Using our gravity points notation, we'll need (40 x 5)/24 = 8.3 lbs. (3.8 kg) of pale malt for that OG ("24" is the expected yield from 1 lb. pale malt at our 65% brewhouse efficiency).

Now we want to use crystal malt to give it some extra flavor and body, and more importantly to make it copper colored rather than pale gold in hue. We can easily do this by using one of the higher roasted crystal malts which contribute a red hue. Let's opt for one at 80 °L, which will do exactly that, and from the table we could use up to 10% of this for bitter ale. However, I would see that as too much because this is a soft, gentle, and not very bitter beer. So I would prefer to go with only 5% of the weight of pale malt, which is 0.42 lb. (0.19 kg). I'll round this up to 7 oz. (0.2 kg), which will actually be 5% of the total grain bill in this case; if we used other malts we would have to take these into account in this calculation. But note that we will get extract from the crystal malt of (7/16 x 22)/5 = 1.002, so our actual OG will be 1.042. So if we want 1.040, we need 1.038 from the pale malt. That means (38 x 5)/24 = 7.9 lbs. (3.6 kg) of pale malt.

But what will this crystal addition do to the color? Well 7.9 lbs. of pale malt at 2 °L will result in a beer at (roughly) (7.9 x 2)/5 = 3 °L. Adding 7 oz. of 80 °L crystal malt will add (7/16 x 80)/5 = 7 °L, for a finishing color of 10 °L malt color units (MCU). That's still relatively pale for bitter ale but is as much as we want for such a light beer; if I felt I wanted to use more crystal malt I would up it with the lighter-roasted 60 °L product. [Do note that these color calculations do not accurately give the color of the beer; they are very approximate but are convenient for comparative purposes].

So, the final recipe that I have come up with, if you want to try it at home, is:

Welsh Archer's Bitter Ale
(5 gallons/19 L, all-grain)

OG = 1.040 FG = 1.010
IBU = 28 SRM = 8 ABV = 4%

Ingredients

7.9 lbs. (3.6 kg) pale 2-row malt
7 oz. (0.2 kg) English dark crystal malt (80 °L)
7.5 AAU UK Fuggles hops (90 min.) (1.5 oz./42 g at 5% alpha acids)
1 tsp. Irish moss (15 min.)
White Labs WLP002 (English Ale), Wyeast 1968 (London ESB Ale), or Danstar Windsor Ale yeast.

Step by Step

This is a single-step infusion mash. Mash in the grains with 3 gallons (11 L) of water to reach 151–153 °F (66–67 °C) and hold for 60 minutes. Run off and sparge with hot liquor to collect 6.5 gallons (24.6 L) of wort. Boil 90 minutes, adding the hop addition at the beginning of the boil and adding the Irish moss with 15 minutes remaining. Run off and cool to around 68 °F (20 °C). Once cool, pitch the yeast and aerate thoroughly. Ferment at 65-68 °F (18-20 °C) until kräusen falls, then rack to secondary if you so desire. Follow standard kegging or bottling procedures.

Welsh Archer's Bitter Ale
(5 gallons/19 L, extract with grains)

OG = 1.040 FG = 1.010
IBU = 28 SRM = 8 ABV = 4%

Ingredients

5.3 lbs. (2.4 kg) pale liquid malt extract
7 oz. (0.2 kg) English dark crystal malt (80 °L)
7.5 AAU UK Fuggles hops (90 min.) (1.5 oz./42 g at 5% alpha acids)
1 tsp. Irish moss (15 min.)
White Labs WLP002 (English Ale), Wyeast 1968 (London ESB Ale), or Danstar Windsor Ale yeast.

Step by Step

Steep the grains (in a muslin bag) in 2 quarts (2 L) water at 150–160 °F (65–71 °C) for 20 minutes. Remove the bag and rinse with 2 quarts (2 L) hot water. Transfer the liquid to the boiler and top off to at least 3 gallons (11 L). Then slowly stir the malt extract into the wort. Bring to a boil. Add hops and then continue to boil 90 minutes, adding the Irish moss with 15 minutes remaining. Siphon wort from the trub and top up to 5 gallons (19 L). Cool the wort to around 68 °F (20 °C). Pitch with yeast and aerate thoroughly. Ferment at 65-68 °F (18-20 °C) until kräusen falls, then rack to secondary if you so desire. Follow standard kegging or bottling procedures. BYO

Centrifugal Pumps

Moving liquids in the homebrewery

Brewing systems that are used by homebrewers span a very broad range in terms of complexity, application of technology and automation. It is quite possible to brew great beer using a very basic and manually intensive brewing system. Conversely, it is also possible to make great beer using a brewing system that incorporates sensors, automation and control systems that rival commercial brewing operations. One of the most important components within a homebrewery that is somewhat more technologically advanced is a pump.

Homebrewers may use a pump to move hot liquor to the mash vessel, to move wort from the mash vessel to the boiling kettle, or to move liquid from the boiling kettle to the fermentation vessel. The use of a pump to move the liquid becomes more and more important as the scale of the brewing operation increases. It is one thing to physically lift and pour 2–3 gallons (7.5–11 L) of post-boil wort from a stove-top boil, but quite another to transfer 20+ gallons (76+ L) of post-boil liquid from a larger brewing operation.

The humble pump

Although there are many, many different types of pumps available in the marketplace, the kind of pump that is most often used to move the liquids in a homebrewery is a centrifugal pump. A centrifugal pump is a fairly simple machine that is designed to impart energy to a fluid. The energy can cause the fluid to rise against gravity or flow through a closed system (pipes). The pump achieves this movement by "slinging" the fluid out of the impeller using centrifugal force. The two main parts of the pump are the impeller and the diffuser (or volute). The impeller is the only moving part within the pump head. The impeller spins within the pump head housing and the diffuser captures and directs the flow of liquid from the impeller. Liquid is drawn into the pump head near the center of the impeller and pushed outwards by the movement of the blades on the impeller. See Figure 1 below for an illustration of a centrifugal pump head.

Pumping liquids, pressure, flow and energy requirements

Pumps are generally and broadly characterized by the liquid flow rate that can be achieved when pumping against a certain amount of pressure.

Specifications by manufacturers might state that a pump is, "capable of 3.5 gpm flow at 14 feet of head." This means that this particular pump would be able to pump liquid at a rate of 3.5 gallons/minute against a back-pressure that is equivalent to the pressure exerted by a column of water that is 14 feet high (0.43 PSI per foot of water). For a centrifugal pump, the flow rate that can be achieved is an inverse function of pressure. A centrifugal pump will deliver less flow when pumping against a higher back-pressure. The specific way in which this relationship holds true depends upon the details of the pump design. In general, as back-pressure increases, flow decreases. It is also worth noting that the velocity of fluid flow within a particular piping system is an important consideration as it directly impacts the overall restive pressure associated with moving liquid through the system. Higher liquid flow rates will result in higher resistive pressure within the system due to pipe friction.

> "A centrifugal pump is a fairly simple machine that is designed to impart energy to a fluid."

Figure 1: Centrifugal Pump

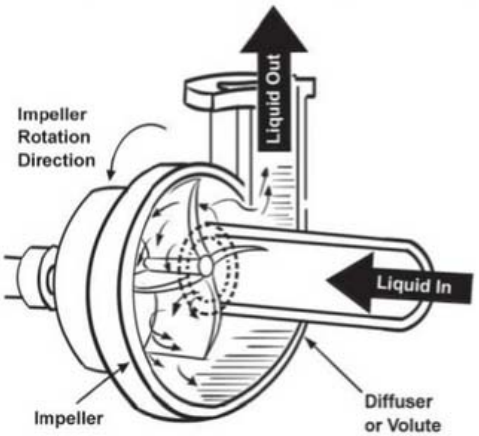

Illustration by Chris Champine, adapted from the Bureau of Energy Efficiency (India)

Figure 2: Pump Power Requirements

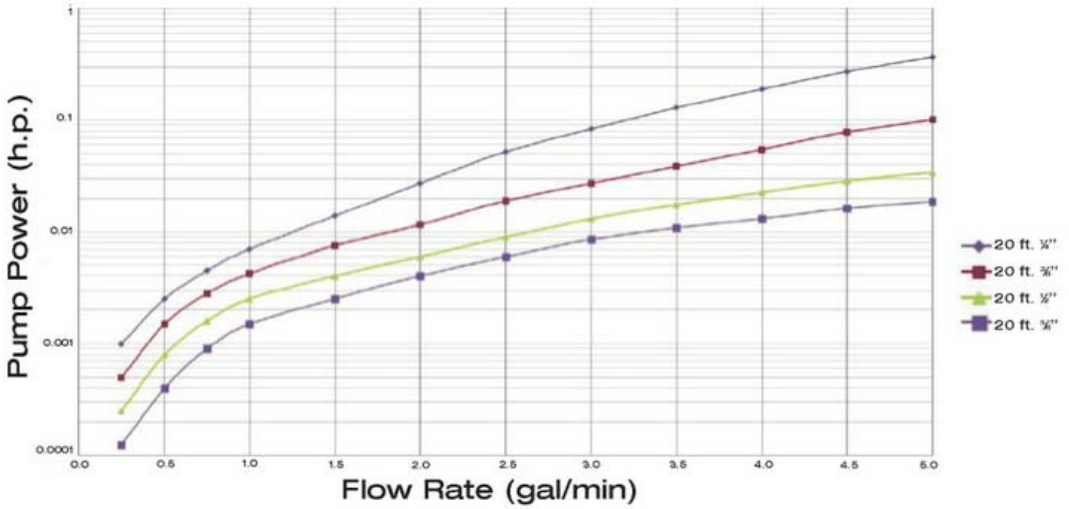

Illustration by Chris Bible

In order for a pump to move liquid, the pump must do work on the liquid, and work requires energy. Doing more work requires more energy. The rate at which work is done (work per unit time) is the definition of power. Moving more liquid requires more power. Moving liquid faster requires more power. Moving liquid against a greater resistance (pressure) requires more power. The power to drive the pumps used by homebrewers is supplied by an electric motor. The amount of power required to move a liquid is dependent upon the liquid flow rate, the back pressure within the system and, lastly, the efficiency of the motor. The following equation (at the top of the next page) shows the relationship:

$$P = \frac{Q\,\Delta P_{total}}{1714\,\eta}$$

Where:
P = Power (h.p.)
Q = Flow rate (gallons/minute or gpm)
ΔP_{total} = total system pressure (pounds/in^2 or psi)
η = overall pump efficiency
Overall pump efficiency is expressed as the decimal form of a % (e.g. 85% = 0.85). For small pumps being driven by small electrical motors, overall efficiencies are usually low (e.g. 45–55%). P_{total} is comprised of several components including the overall system pressure due to friction from the flow of liquids, and also pressure associated with the need to pump liquid vertically against the force of gravity ("head" pressure of the system). P_{total} is the sum of these:

$$\Delta P_{total} = \Delta P_{friction} + \Delta P_{heat}$$

Using the equation above, it is possible to estimate the amount of power required to pump liquids through piping systems associated with a home brewery. Figure 2 on the facing page shows a family of curves derived from applying the above equations to a hypothetical homebrewery system in which the liquid must be pumped vertically 8 feet, and through tubing of various diameters (¼", ⅜", ½" and ⅝") with an overall equivalent length of 20 feet. The calculations assume an overall pump efficiency of 50%. Note that the power requirements increase for increasing flow rate, and with decreasing tube diameter. Power requirements increase with increasing flow rate because it takes more energy to move more fluid in a given amount of time. Power requirements increase with decreasing tube size because there is more friction due to the faster fluid velocities within the smaller pipes. More friction causes more back-pressure.

Practical discussion

Pumps make a great addition to the homebrewery and are essential equipment when the scale of the brewing operation is large. Use the pump curves and specification information provided by the manufacturer to help you select a pump with wetted parts comprised of food-grade material (e.g. polysulfone, Teflon, Ryton or glass) that can withstand the temperature of boiling wort, and that can deliver the flows you want to the places that you desire within your brewery. Be sure to mount the pump very low in the brewery setup in a place that allows easy, gravity-flow-enabled priming. Ensure that the pump's electrical power supply circuit is properly insulated and routed to minimize the potential for shock hazards due to potential contact with liquids, and includes a ground-fault-interrupt (GFI) device. BYO

Bottle Rack

Cleaning, sanitizing bottles with ease

projects
by Walter Diaz

Most homebrewers would agree that the better part of brewing beer at home is spent cleaning and sanitizing equipment. A lot of dedication goes into every batch and after waiting weeks for fermentation to be done you are ready for some payback. There is only one step that separates you from drinking that beer, and that is bottling or kegging. Bottling beer takes a lot of work — mostly spent cleaning and sanitizing each bottle.

Some of the most common methods for cleaning/sanitizing bottles that I am aware of are using chemicals and soaking the bottles in cleaning/sanitizing solutions, putting the bottles through the steam cycle in the dishwasher, or using a dry heat cycle in the kitchen oven.

In my experience, the first of these methods takes the most work. Bottles are dipped in cleaning solutions and you have to physically brush the insides and then rinse each bottle in preparation for sanitizing. The dishwasher method has the advantage of using wet heat, which is much more effective than dry heat in the oven, but there is the problem that the bottles have to be placed in upside down. That makes it hard to have a uniform coverage of steam deep inside of the bottle. The dry heating method in the oven works well by itself for sanitizing provided the bottles are already clean.

The bottle rack described in this project uses the oven as a source of heat to generate steam inside of the bottle for cleaning and sanitizing purposes. This enhances the cleaning power of the dry method.

The bottle rack in this project is made of aluminum sheet metal and holds 24 bottles. It can be used in two positions: drying position (bottles upside down) and steaming position (bottles upright). I chose 24 bottles to make it easily portable, and because that is the number of bottles that come in a case. The reasons to use aluminum for its construction are several: It does not corrode easily in high moisture environments, it is lightweight, it withstands high temperatures, it does not need painting (so there is no risk of toxic fumes) and it is easy to work with (as opposed to stainless steel).

> "The rack makes it easy to transport the bottles into and out of the oven once they have cooled."

To use this bottle rack, I add approximately 50 milliliters of water into every bottle and then put it in the oven for one hour at 250 °F (121 °C) so the bottles are steam cleaned and sanitized. The rack makes it easy to transport the bottles into and out of the oven once they have cooled. The time and temperature I leave the bottles in the oven could probably be adjusted to a higher temperature and shorter heating time. In any case, one important detail to keep in mind is to add enough water to support the length of time in the oven so that there is continuous formation of steam. Adding too little may result in the water evaporating too quickly without really getting the benefits of wet heat (as mentioned above, dry heat is not as effective and takes a much longer heat cycle to obtain the same sanitizing effects). Also, note that if your bottles are extremely dirty they may require a second pass through the oven. Some bottles are not even worth the effort.

Parts & Tools

Aluminum sheet metal (16–14 gauge)
¼-inch drill bit
1.5-inch hole saw
(4) #6 screws and nuts
Hand drill
Pair of vice grips
Black Sharpie marker

STEPS TO BUILD

1. LAY OUT BOTTLE PATTERN AND DRILL BOTTLE NECK HOLES

Cut one piece of sheet metal 12-inches by 24-inches (30 x 61 cm) and another piece of sheet metal 12-inches by 32-inches (30 x 81 cm). Most metal supply stores will cut sheet metal pieces to your desired dimensions for a small fee. This is the easier way to go, but you may also use a regular hand saw. Using a black Sharpie, lay out the bottle pattern on the 12 x 24-inch (30 x 61 cm) piece of aluminum sheet metal. This bottle pattern is the same as they come in a 24-bottle case. Each bottle occupies a 2.5-inch (6.3 cm) square in an area of 10 x 15 inches (25 x 38 cm) centered on the 12 x 24-inch (30 x 61-cm) aluminum sheet. Using a hand drill with a 1.5-inch hole saw, drill the holes that are going to receive the bottle-necks on the 12 x 24-inch (30 x 61-cm) sheet.

2. BEND SHEET METAL PIECES

Draw a vertical line on the 12 x 24-inch (30 x 61-cm) sheet 3.5 inches (8.9 cm) from each end, and a line on the 12 x 32-inch (30 x 81-cm) sheet 7.5 inches (19 cm) from the ends.

After marked, bend the metal at 90 degrees. The easiest way to do this is with a sheet metal bending brake. If you don't own one, most shops have one and will charge next to nothing for this simple job (it takes less than 5 minutes to do these bends). As a last resort (as shown here), you could do the bends by clamping the sheet metal on a metal table with a clean edge and gently tapping the sheet metal with a rubber mallet.

3. DRILL PIN HOLES AND ASSEMBLE BOTTLE RACK

Use a hand drill with a ⅛-inch bit to drill pivoting/locking holes on corners of sheet metal parts. The location of these holes is going to determine the height of the bottles that will fit in the bottle rack. For the standard 12-ounce bottle, there should be a 7-inch gap between the bottom and top sheet metal layers. It would be useful to drill several of these holes approximately ¼ inch apart so that the rack can accommodate bottles of different heights. Then lay sheet metal pieces on top of each other and secure by running #6 screws and nuts.

STEPS TO USE

1. INSERT BOTTLES UPSIDE DOWN

Insert bottles upside down in drying position and swing the cover over the bottom of the bottles and secure with pins. The bottles have to be compressed tightly between the layers of sheet metal so that no bottles come loose in the rack in the next step. For this reason, it is very important that all bottles be the same height.

2. FILL EACH BOTTLE WITH ½ INCH OF WATER

Flip the whole rack with bottles to upright position and add about 50 milliliters of water into each bottle (filling the bottles with approximately ½ inch of water) with a hose, moving from one bottle to another in a continuous fashion to save time. The amount of water going into each bottle does not have to be precisely measured as long as you are in the ball park. Just make sure no bottles are filled too low that the boiling will stop too quickly or too high that it will take much longer for the water in a given bottle to start boiling. While doing this, begin preheating the oven at 250 °F (121 °C).

3. "COOK" THE BOTTLES IN THE OVEN

Put the bottle rack in the kitchen oven that is now warmed up to 250 °F (121 °C) for 60 minutes. This will steam clean and sanitize the bottles. Let the bottles cool down after the heating cycle has finished, then take bottle rack out from the oven and flip to drying position. The bottles are now ready to be filled.

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last call
by Rick Schultz

Chris' "Turn"

Opportunity of a lifetime

> "I dumped four of the five gallons all over the garage floor . . . We were like Wisconsin deer in headlights."

Few homebrewers have an opportunity like the one I recently enjoyed.

A high school friend of mine, Chris Ranson, took a job at Lakefront Brewery in Milwaukee, Wisconsin, where she does public outreach and is a Jane of all trades. Chris holds this place together. She hires and herds the nationally renowned tour guides, she orchestrates much of the Friday Fish Fry (which are legendary in this area), and when you see Lakefront at a festival or event, chances are you see Chris.

Chris and I meet up from time to time and, eventually, our conversations always turn to beer or brewing. Chris usually brings a Lakefront sample and I bring a homebrew or two. Through Lakefront's "My Turn Series," the Klisch brothers (former homebrewers and owners of the brewery) allow every employee to brew a batch for one-time release. Chris was the most recent employee in the rotation for "My Turn." The only problem — Chris had never brewed before. We agreed it would be good for her to see what life is like for a 5-gallon (19-L) brewer and experiment with a recipe before making one on a large scale.

I planned a maibock recipe with all Wisconsin malts, noble hops with a special adjunct and flavoring. She was able to relate my small-batch process to the spiel her tour guides present on tours. We hit our target gravity and started transferring the wort to my fermenter. I was talking to my wife, Sandy, and Chris when it happened: I dumped four of the five gallons all over the garage floor. There were three pairs of eyes as big as ping pong balls. We were like Wisconsin deer in headlights. Criminny!

I was heartbroken but I still had one gallon — trub, hops and all. I followed through with the plan and lagered my micro-batch. I force-carbonated half the maibock in a two-liter plastic bottle to give me a point of reference, but I suggested we do something different with the other half to make it really special. I shared my idea with Chris and she was very enthusiastic. I soaked some medium-toast oak chips in water in one jar. In another I added lager yeast to maple syrup and lagered it beside the maibock. When it was ready, I blended the maple and oak to get a nice balance and then blended this mixture with the other two liters of maibock until balanced. Chris and other friends acted as a "sampling committee," and they all agreed they liked the traditional maibock, but unanimously said we should definitely make the second one.

Chris put me in touch with Matt Hofmann, who runs the lab at Lakefront. Matt and I made a 10-gallon (38-L) batch on their system. I changed the recipe to make it practical for the brewery, which called for the maple syrup addition late in the boil. The challenge was duplicating the toasted oak flavor. The primary taste from the toasted oak is vanilla, but it is sublimely more than just vanilla. On the day I washed the garage with wort I shared with Chris a bottle of Sam Adams Griffin's Bow, an oak-aged barleywine. After another taste I recognized what it was that made toasted oak more heavenly than simple vanilla. Bittersweet. I could get the vanilla flavor from vanilla beans. To set the flavor apart I needed to adjust the grain bill, so I added a few ounces of 120 °L crystal malt.

Matt and I made the test batch. It came out great. Chris received the green light. June 22 was release day. By the time you read this, "My Turn – Chris" may be sold out. No problem, you can brew your own. Store a few bottles away for the next few Chris-tmases. Prosit! BYO

A clone recipe for the "My Turn — Chris" can be found with this story online at http://byo.com/story2860.

Photo courtesy of Rick Schultz

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