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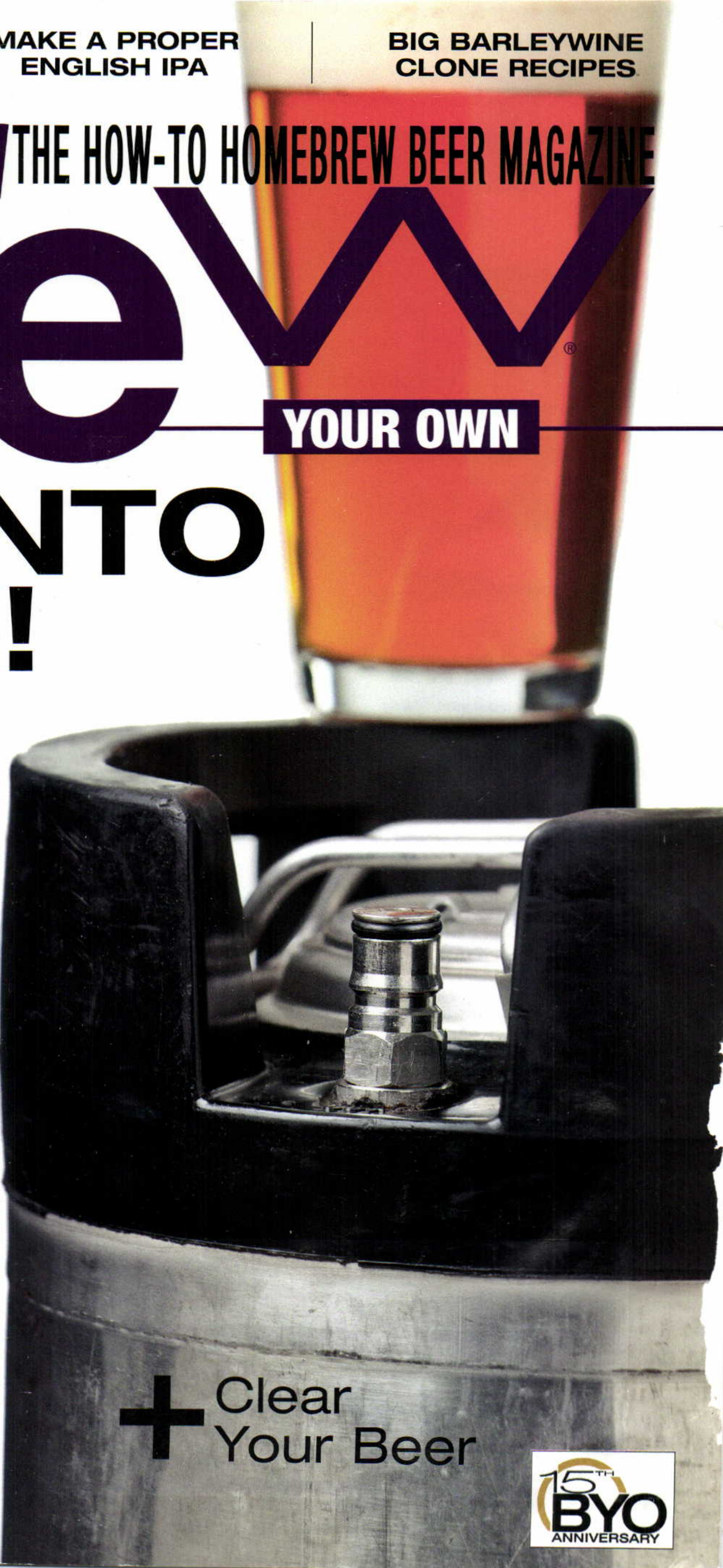
BIG BARLEYWINE CLONE RECIPES

Brew® YOUR OWN

THE HOW-TO HOMEBREW BEER MAGAZINE

NOVEMBER 2010, VOL.16, NO.7



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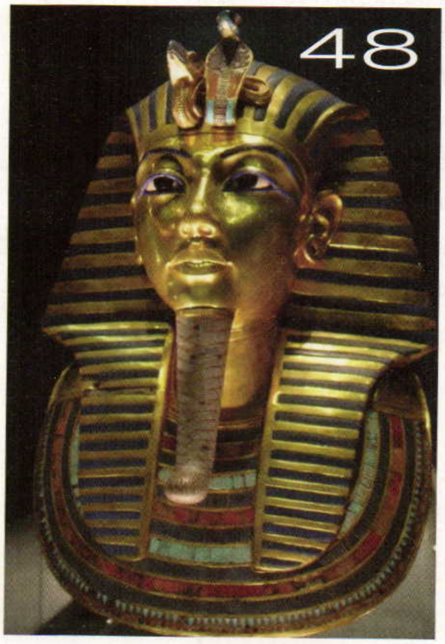
CONTENTS

November 2010 Volume 16 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.

what's happening at BYO.COM

Build a French-Press Style Hopback

In professional brewing applications, a hopback has traditionally been used to remove cone hops from the wort post-boil. Check out these plans to build your own. www.byo.com/component/resource/article/676

Tips From the Pros: Lautering

Get some pro advice for lautering from the Coeur d'Alene Brewing Co. in Coeur d'Alene, Idaho: www.byo.com/component/resource/article/594

Carbonation Priming Chart

Section A: Levels of Carbonation in Various Beer Styles

Style	Volume of CO_2
American ales	2.2–3.0
British ales	1.5–2.2
German weizens	2.8–5.1
Belgian ales	2.0–4.5
European lagers	2.4–2.6
American lagers	2.5–2.8

Don't use carbonation guesswork for your next homebrew. Use our handy chart for your own priming calculations. www.byo.com/resources/carbonation

Cover Photo: **Charles A. Parker**

Brew Your Own — THE HOW-TO HOMEBREW BEER MAGAZINE

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Volume 16, Number 7: November 2010.

Making Megalodon

I'm looking at the recent issue (October 2010) and was wondering if the recipe for the Megalodon Imperial IPA (p. 43) is in fact complete and correct. I'd like to take a shot at this one and want to be sure everything is right, just seems a little different than most with all the hop additions at 60 minutes.

Kenneth Jansky
Chicago, Illinois

The recipe is correct. There are four different hop varieties added 60 minutes before the end of the boil for bittering, then three different hops added as dry hops. Although most IPA and double IPA recipes call for hop additions late in the boil, this is not a requirement. Many commercial brews take the "bookend" approach — adding a big dose of bittering hops, then adding lots of hops either at knockout, in the whirlpool or as dry hops. A small amount of flavor, and even aroma, is retained from early hop additions and dry hops add a lot of hop oils to beer after fermentation.

There are number of ways an IPA or double IPA can achieve its bitterness, hop flavor and hop aroma. The "classic" way is to add bittering hops early in the boil, then hops for flavor and aroma late in the boil (often in the last 20 minutes). When this approach is used, the bittering hops are usually a high-alpha variety whereas the late-boil hops are low-alpha hops with pleasing flavor and aroma properties. (There are also "dual-purpose hops" that are used for both bittering as well as flavor and aroma.)

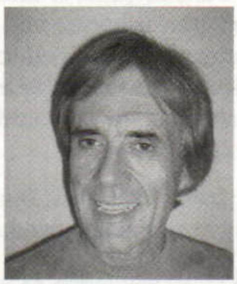
Adding hops in the middle of the boil — from 40 minutes to 20 minutes left in a 60-minute boil — also has proponents and this approach is carried to its logical extreme in Dogfish Head's "minute" series of beers (60-Minute IPA, 90-Minute IPA and 120-Minute IPA). In these beers, hops are added continually throughout the boil. Some proponents of adding hops in the mid-boil claim you get a character from the hops that isn't possible by adding them early or late. Detractors claim that you're just wasting hops because you extract less bitterness from mid-boil hops than bittering hops and you lose more flavor and aroma compared to hops

contributors

Andy Sparks has been a homebrewer for nearly twenty years. In 1993 he went pro with his passion and opened a homebrew shop called The Home Brewery in Fayetteville, Arkansas (visit the shop online at TheHomeBrewery.com). As an avid collector of great beers, Andy hasn't met a hop he didn't like. He appears regularly on Basic Brewing Radio and Basic Brewing Video.

In this issue, starting on page 40, Andy discusses the basics of kegging your beer at home in his second article for *Brew Your Own*. Read up on everything from the anatomy of a keg, to a simple kegging setup, to carbonating.

Christian Lavender is an Austin, Texas-area homebrewer and the founder of HomeBrewing.com, a website for finding the best prices on homebrewing kits and homebrew supplies as well as kegerators.com, a website devoted to finding the best prices on kegerators and draft beer supplies. Ask him a question about kegerators at www.kegerators.com/ask-an-expert.php.) In this issue, Christian's first article for *BYO*, he calls on his knowledge of kegging to build a hop filter that works with a home kegging setup. Go to page 67 to learn how to build your own version of his hop filter.



Bill Pierce started homebrewing in 1994, when he brewed a brown ale and was hooked. He was briefly a brewpub brewer and has completed the Craft Brewer's Certification Program from the Siebel Institute in Chicago, Illinois. On the homebrew side, Bill is a BJCP judge and longtime participant in the online brewing forum Home Brew Digest (hbd.org).

Bill is a longtime contributor to *BYO*, and former "Advanced Brewing" columnist, including a story in the May-June 2010 issue about Ballantine Brewing Company. On page 54 of this issue, Bill delivers the second installment of a two-part series of stories about calculating mash temperature.

added in the late boil. There are excellent beers brewed using either of the above methods.

On the other hand, some brewers add all (or at least the vast majority) of their hops late in the boil such that even most of the IBUs in their beer come from late additions (or from whirlpool hops in commercial breweries). Proponents of this method claim that you get a lot of hop flavor and aroma along with your bitterness. Detractors claim that you lose a lot of wort due to it being absorbed by hop material because your overall rate of hop utilization is low. Both of these statements are true, and it just goes to show that different brewers have different priorities.

Hops can also be added in the mash and to the first wort. Mash hopping is rare, but first wort hopping is something many brewers have tried. Supposedly, by adding hops to the first wort, you get a "finer" hop character than if you wait until the boil starts. The jury is still out on that idea, but the practice is fairly widespread. Beers that are mash hopped or first wort hopped usually also have a "regular" bittering hop addition.

Dry hopping, of course, can be used along with any of the different schedules for kettle hop additions. In addition, hop character can be added through a hop jack — a small vessel between the kettle and the chiller that filters wort through a bed of hops.

The bitterness or aroma of beer can also be adjusted with hop extracts. These aren't common in homebrewing, but many commercial brewers use iso-alpha extracts and/or hop oil extracts for some or all of their hop character. And finally, the hop character of a beer can be adjusted at serving time by pushing the beer through a filter (such as the Randall, popularized by Dogfish Head) or by floating hop cones in the finished beer.

In the near future, someone will probably find yet another method for introducing hops into beer — maybe they'll brew a very light, but very hoppy beer and use that for their brewing liquor and sparge water — but until then, just keep in mind that there are a lot of ways to add hop bitterness, flavor and aroma in your beers.

Aging Pliny the Elder

I purchased the special issue of your magazine devoted to "clone" beers, which included a recipe for Pliny the Elder. When I purchased that beer's ingredients at my local beer supply store, the owner told me that this recipe would need to be aged for six months. I'm writing in the hope of learning whether he is correct. How long would you recommend the beer remain in a carboy after being transferred from the primary? Once bottled, how long should the beer be aged in bottles at ambient temperature (roughly 65–75 °F/18–24 °C)? Would the recipe require additional aging in a refrigerator? Do you have a general "rule" to these questions for the other beers provided in your magazine?

Joseph Kolko
via email

Six months is excessive. Brewed properly, an ale of this strength could be ready in about three to five weeks. Given the amount of hops in this recipe, it would likely taste "young" at that point — in particular, the hop character would likely be aggressive — but it would be ready if it is brewed well. Pliny the Elder is a fairly big beer (around 8% ABV), though, and it will continue to age well for awhile (probably for at least 8 months). Over this time you will likely see the hop character soften and malt character mature a bit, too.

A lot depends on how the beer is brewed, though. Two homebrewers going by the same recipe can have wildly divergent results, depending on how well they brew the beer and guide it through the conditioning process.

The first step towards getting a beer to condition in a reasonable amount of time is to pitch enough yeast. If you pitch an adequate of amount of yeast, the fermentation will proceed at a reasonable pace, reach your target final gravity and the yeast will clean up unwanted fermentation characteristics (esp. diacetyl) quickly. If you underpitch, or separate the beer from your yeast too soon, the yeast will have to work harder (and longer) to clean the beer up.

To further get your beer to condition properly, monitor and control your fermentation and conditioning temperatures. Hold the fermenting beer in the proper range for the entire fermentation (and perhaps a day or two beyond). If you bottle condition, keep the bottles somewhere warm (75–80 °F/24–27 °C) for three to five days, then move to a cooler location. Cold conditioning a beer can be done by holding the beer anywhere from 60 °F (16 °C) all the way down to near freezing. (For ales, cold condition at the high end of this range for a week or two after primary. For lagers, hold the beer near the lower end of this range for at least a month. Lager recipes usually give an estimated lagering time.) Beer that has been conditioned and carbonated should be stored cold (in a refrigerator) if at all possible. If a beer is overly hazy, fining or filtering it will also help it condition more quickly.

Giving estimates of how long a beer will take to ferment, condition, carbonate or age will always involve making some educated guesses. As you learn more about brewing, you will get a better feel for when a beer needs more time at a certain stage. BYO

homebrew nation

BREWER PROFILE

Brewers: Dale Lutz and Phil Isaac

Hometown/State: Sagamore Hills, Ohio

Years brewing: Eight

Type of brewers: Partial Mash and All-grain

Homebrew setup: Brew garage with converted 15.5-gallon (~60 L) kegs; all gravity-fed system with a 12" (30 cm) sparge arm from Listermanns. In the mash tun is a 1½" stainless steel false bottom from Midwest Brewing.

Currently fermenting: Red Hook ESB Clone

What's on tap/in the fridge: A Dogfish Head 90 minute IPA clone and a Buckeye Brewing 76 IPA clone.

About the brewers: Dale Lutz and Phil Isaac are two neighbors who enjoy creating great homebrew and call themselves Two Buds Brewing. Dale has been brewing since 2002 and started out using Brewers Best kits. He later started partial mashing, which led to all-grain recipes around 2005. With two 10-gallon (38-L) converted Rubbermaid coolers from MoreBeer.com in hand, he soon met Phil, who quickly joined the brewing process.

They brew in the garage with converted 15.5-gallon (~60-L) kegs that were given to Dale over the years from some friends (much to his wife's delight, it got both the brewers out of her kitchen).

PROFILE RECIPE

2-Buds IPA

(5 gallons/19 L, partial mash)

OG = 1.075 to 1.090
FG = 1.012 to 1.020
IBU = 175 SRM = 5 ABV = 8.5

Ingredients

16 lbs. (7.3 kg) Briess Pilsen malt
1 lb. (0.45 kg) dark dried malt extract
12.75 AAU Amarillo pellet hops (1.5 oz./43 g at 8.5% alpha acids) (90 min.)
19.5 AAU Simcoe pellet hops (1.5 oz./43 g at 15% alpha acids) (90 min.)
24 AAU Warrior pellet hops (1.5 oz./43 g at 16% alpha acids) (90 min.)
1 oz. (28 g) Amarillo pellet hops (dry hop)
0.5 oz. (14 g) Simcoe pellet hops (dry hop)
0.5 oz. (14 g) Warrior pellet hops (dry hop)
2 vials of White Labs WLP007 (Dry English Ale) yeast. (1 half-gallon yeast starter)
2 tsp. Irish moss last 15 min. in boil
2 Tbsp. 5.2 pH stabilizer

Step by Step

Make the yeast starter two days before brew day. Add the pH stabilizer to strike water and mix 1.25 quarts/lb. grain. Heat to 160 °F (71 °C), where the target mash temperature should hit 149 °F (65 °C). Sparge with 4 gallons (15 L) of water for sparge. Heat to 180 °F (82 °C), mash for one hour. We use a single infusion mash and re-circulate the wort until clear. Sparge slowly at least 45 minutes and shoot for approximately 6 gallons (23 L) in the brewpot to allow for boil off.

Mix the bittering hops in a bowl and crush. We used a mortar and pestle to mix ours, which works well. Add the first 1 oz. (28 g) hops at beginning of boil, then at 10 minute intervals add the remaining hops. Cool the wort to 70 °F (21 °C) and pitch the yeast starters. At this point aerate or shake carboys well and ferment for two weeks. Add the dry hops to secondary fermenter before racking the beer. Age for two weeks or longer, with the knowledge that the longer it sits, the more mellow it becomes.

byo.com brew polls

Have you ever tried brewing a barleywine?

No, but I would like to	56%
Yes, a few times	20%
No, I'm not interested	20%
Yes, many times	4%

social homebrews

With thousands of fans, our *BYO* constituency is healthy and growing. Rant about beer and food pairings, trials and tribulations of your own, or just lurk for a while.
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Follow *BYO* along with thousands of fellow homebrewers and catch great recipe links and foamy musings about our favorite hobby. Follow us at: @BrewYourOwn.

what's new?

Greenbelt Liquid Yeast: New American Ale yeast strain

Wyeast Labs has partnered with Austin Homebrew Supply to release a previously unavailable yeast strain called Greenbelt. Greenbelt is an American ale strain that complements hop-driven beers with fruity and floral aromas. Good attenuation and flocculation characteristics make Greenbelt clean and versatile. Greenbelt is available exclusively through Austin Homebrew Supply and is scheduled for a mid-October release.
www.austinhomebrew.com

Blichmann HopRocket

The HopRocket™ is not only a hop-back with a 4oz capacity, it can be utilized as an in-line filter and also an in-line hop infuser for your dispensing system. This pressure-sealed unit will never overflow.
www.blichmannengineering.com

Briess Blackprinz® Malt

Briess Malt & Ingredients Co. has released the fourth malt in its new Maltster's Reserve Series. Blackprinz® Malt is a seasonal malt available now through the end of December for the next season's brews. Intensely roasted from hulless barley, Blackprinz® Malt is a smooth and mellow flavored black malt without bitter, astringent, dry flavors or aftertaste. Check out a recipe featuring this new malt on the recipe cards in this issue. The Maltster's Reserve Series is a series of four seasonal malts, one every season for the next season's brews. Though only available seasonally, they are all permanent additions to the Briess product line.
www.brewingwithbriess.com/Products/SeasonalMalts.htm

calendar

**November 9
Middleton, Wisconsin
The Madison Homebrewers and Tasters Guild's Badger Brew-Off**
Taking place at the Capital Brewery, this event replaces the Franco-Belgian Challenge Cup and the Big and Huge Homebrew Competition. Prizes and ribbons will be awarded to best in show winners.
Entry Fee: $5
Entry Deadline: October 31
Phone: (608) 882-4523
Email: mschnepper@yahoo.com
Web: www.mhtg.org/badger-brew-off

**November 13
Albany, New York
Knickerbocker Battle of the Brews**
The Saratoga Thoroughbrews will be celebrating their 15th annual competition this year. There will be a raffle and following awards ceremony, including a $250.00 certificate.
Entry Fee: $7
Entry Deadline: November 5
Phone : (518)-441-2637
Contact Email: knickerbockerbattle-ofthebrews@gmail.com
Web: www.thoroughbrews.org/kbotb/

**November 19-20
Tulsa, Oklahoma
FOAM Cup**
Entries for this year's competition can include anything for BJCP 2008 style guideline categories 1 through 28 (cider and perry will be included in this year's judging). Local entrants should collect their scores and awards at the FOAM Oktoberfest party.
Entry Fee: $7.00
Entry Deadline: November 13
Phone : (918) 645-5509
Email: desiree@highgravitybrew.com
Web: http://foamcup.us/

> "The stand itself is an old Craftsman workbench (found on Craigslist for $50)."

homebrew drool systems

My Modified Brutus

Don Barnum • North Tustin, California

In 2009, I decided to build my own brew stand to upgrade my all-grain brewing, a lofty endeavor to be sure. But thanks to BYO, my local brew club, and my membership to an online brewing forum, I was inspired to come up with my own design based on some of the same principles of building a system that I had read about. Many variations of the Brutus can be seen online, and I would like to thank Lonnie Mac and BYO for showing me the way.

The stand itself is an old Craftsman workbench (found on Craigslist for $50). I removed the old top and added a new top made from tube steel to hold the three kegs. Casters were then added to make it mobile. I went with regular steel instead of stainless because stainless is about four times the cost. Finally, I painted it all with heat-resistant paint and let it dry.

Old kegs (found on Craigslist) were used for the hot liquor tank (HLT), the mash tun, and the boil kettle. I cut the tops off using a standard Sawzall with the correct blades. Interestingly, as there were no videos on the Internet showing how to cut a keg this way, I took the liberty of making one and putting it on YouTube. I then reused the tops by installing stainless steel washers around the edges to keep them from falling in, and I installed copper filler tubes inside all of the tops. I posted another video showing how to install the washers and the filler tubes on YouTube, keyword "backhousebrew." A water filter was then mounted on the side and a Therminator plate chiller was mounted on the frame.

Another way I found to help keep down the cost was to eliminate the "Love" temperature switches in favor of manual controls. With that decided, the next objective was to install the burners. The idea of the first design was to develop an optional natural gas or propane heating system. Three propane burners (ordered on-line) were installed and two separate gas lines were run to the burners as well. You can see the knobs on the front plate. The red knobs are the propane control valves and the gray knobs are the natural gas valves. The propane gas burned pretty well but the natural gas didn't burn smoothly at all. I installed a bathroom exhaust fan with tubing to each burner to force more air into the burners, and it was like installing a turbo charger.

hop profile CHINOOK

The Chinook is a cross between Petham Golding and a USDA-selected male with high alpha acid and good storage properties. It was released to the public in 1985 and carries a mild to heavy, spicy, piney, grapfruity aroma. Its most notable use is in American pale and amber ales but can be used in porters and lagers as well due to its desirable aroma and bittering components.
Alpha-acid: 12–14%
Possible Substitutions: Nugget, Columbus, Northern Brewer, Target

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Share your tips, recipes, gadgets and stories with *Brew Your Own*. If we use it, we'll send you some *BYO* gear! Email our editors at **edit@byo.com**

beginner's block

COUNTER-PRESSURE BOTTLING

by betsy parks

Kegging your homebrew has lots of advantages — the most obvious is eliminating the whole bottling process. There are times, however, when you may want a few bottles to share, such as entering your homebrew into a competition, or even just bringing some beer along to a gathering. Thankfully you can counter-pressure bottle.

What you need

To counter-pressure bottle, you will of course need a kegging system, a counter-pressure filler and the tubing that is sold with it as well as a CO_2 tank. You will also need bottles, caps and a capper.

The goal is to bottle the beer while preventing as much loss of carbonation as possible, therefore the keg of beer should be cold (around 32 °F/0 °C) when you start to bottle, as CO_2 dissolves more readily in cold beer. It's also a good idea to chill your equipment and bottles down — but don't freeze them. You will also need to be sure that your filler, tubing, caps and bottles are all clean and sanitized.

The process

Your filler should come with detailed instructions, and most of them are a T-shaped design. Start by connecting the tubing to the filler with all of the valves closed and connect the tubing to the keg and the CO_2 tank. Make sure the CO_2 tank valve is off. The gas line connects to the "in" connector and the "out" connector attaches to the keg. The tube on the bottom is for adding gas and beer to the bottle.

The two main steps to counter-pressure bottling include purging the bottle of air and then transferring the beer from the keg to the bottle. The purging step displaces the air in the bottle with CO_2, which will minimize the beer's exposure to air. The less your beer is exposed to air, the longer it will taste fresh. This is done by placing the filler on the bottle, making sure the stopper is secure on the opening of the bottle. Next, open the gasket valve and slightly open the "bleeder" valve, which is the valve on the stem of the filler. You will hear the gas begin to escape from the bleeder valve. After about ten seconds or so, the bottle should be full and you can shut the gas valve.

The next step is to fill the bottle with beer. The filler's bottom should reach almost to the bottom of the bottle, so the bottle will fill under the blanket of CO_2, which will minimize the foaming and aeration. To fill, open the beer-in valve, and again, crack the bleeder valve. This valve is what causes the "counter-pressure" effect. When it is open, the pressure in the bottle decreases, which pulls the beer into the bottle. The wider the valve is opened, the faster the beer will flow. Fill the beer to where you would normally fill a bottle, or about an inch from the top, and cap it with a sanitized cap. Cap each bottle as soon as you fill it (it's good to have a helper), and try to cap on the foam, as this will further decrease levels of dissolved oxygen in the beer.

The first few times you counter-pressure bottle can be a little tricky. It is good to have a brewing buddy to lend some extra hands.

by marc martin

DEAR REPLICATOR,

A FRIEND THAT LIVES IN TACOMA, WASHINGTON TOLD US ABOUT THIS GUY THAT HAS A REALLY SMALL BREWERY, ALMOST LIKE A BIG HOMEBREW SETUP, THAT MAKES REALLY GOOD BEERS. IT IS CALLED M.T. HEAD BREWING IN GRAHAM, WASHINGTON. WE THOUGHT WE SHOULD CHECK IT OUT AND DROVE OVER THERE ONE SATURDAY AFTERNOON. I'M REALLY GLAD WE DID AS HIS BEERS ARE EXCELLENT. WE ESPECIALLY LIKED THE BROWN ALE. WE ARE HOPING YOU CAN GET HIM TO GIVE YOU SOME INFORMATION ON BREWING THIS BEER.

MIKE PETERSON
SEATTLE, WASHINGTON

Thanks for the request Mike. I always enjoy the ones that create an opportunity for the Replicator to hit the road and check out a new brewery. My 140-mile drive ended at a long driveway in the foothills of the Cascade mountains, about 35 miles south and east of Olympia, Washington. I was pleasantly surprised to find very friendly owners, a huge black dog, excellent beers and one of the funkiest breweries you could imagine. It is housed in an oversized garage along with a machine/ welding shop.

This brewery represents another of those all-too-common stories of a homebrewer gone wild. Owners Tim and Renee Rockey both recently retired from Sea Land Shipping and needed to find an outlet for their talents. Renee was a certified welder and Tim specialized in mechanical and refrigeration. Thus they made a perfect couple to build a brewing system from the ground up. That, coupled with the fact that Tim had been a homebrewer in the mid 90s, put them on the road to opening M.T. Head Brewing Company. They served their inaugural beer on July 1st of 2009.

The two-barrel brewing system that Tim assembled can best be described as "totally unique." He happened upon some used commercial soup kettles of various sizes locally. Figuring these could easily be adapted for brewing beer, he paid the bargain price of $1,800 and was on his way. The exterior of the 60-gallon (227-L) kettle was sprayed with foam insulation and became the mash tun. The largest kettle, at 80 gallons (303 L), was double walled and had been steam fired. The bottom of the outer jacket was cut away to accommodate a large natural gas burner to make the boil kettle. Two 50 gallon (189 L) kettles were fitted with air tight tops and became the fermenters. These are housed in a foam board box with a window A/C unit providing temperature control. The only commercially-made equipment he owns are two 79-gallon (~300-L) bright tanks and the heat exchanger. He estimates the total brewery investment to be between $10,000 and $15,000.

For the brown ale, Tim uses flaked barley creating a dense, light tan head that tops this dark mahogany colored ale. The combination of seven malts provides a nice complexity. Bitterness is just slightly above what is needed to offset the residual sweetness. The aroma displays rounded caramel with a very subdued hop presence. A perfect session beer to enjoy by an early winter fire. Mike, you and your buddy can fire up the kettle to make Bonehead Brown Ale because now, you can "Brew Your Own."

For further information about M.T. Head Brewing and their other fine beers visit the website http://mtheadbrewingco.com/ or call Tim at the brewery at 253-208-8999. BYO

M.T. Head Brewing Company Bonehead Brown Ale clone

(5 gallons/19 L, extract with grains)

OG = 1.050 FG = 1.012
IBUs = 36 SRM = 23
ABV = 4.9%

Ingredients

3.3 lbs. (1.5 kg) Muntons light, unhopped, liquid malt extract
1.3 lbs. (0.59 kg) dry malt extract
11 oz. (0.31 kg) CaraPils malt
8 oz. (0.22 kg) kiln amber malt (20(L)
6 oz. (0.17 g) crystal malt (60°L)
13 oz. (0.36 kg) crystal malt (120(L)
6 oz. (0.17 kg) chocolate malt (350°L)
8 oz. (0.22 kg) flaked barley malt
7.7 AAU Cluster hop pellets (1.1 oz./31 g of 7% alpha acid) (60 min.)
3.5 AAU Cluster hop pellets (0.5 oz /14 g of 7% alpha acid) (30 min.)
0.95 AAU East Kent Golding hop pellets (0.2 oz /5.7 g of 4.75% alpha acid) (5 min.)
½ tsp. yeast nutrient (last 15 minutes of the boil)
½ tsp. Irish moss (last 30 minutes of the boil)
White Labs WLP 001 (American Ale) or Wyeast 1056 (American Ale) yeast
0.75 cup (150 g) of corn sugar for priming (if bottling)

Step by step

Steep the crushed grain in 2 gallons (7.6 L) of water at 154° F (68 ° C) for 30 minutes. Remove grains from the wort and rinse with 2 quarts (1.8 L) of hot water. Add the liquid malt extract and boil for 60 minutes. While boiling, add the hops, Irish moss and yeast nutrient as per the schedule. Now 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). Hold at that temperature until fermentation is complete. Transfer to a carboy, avoiding any splashing to prevent aerating. Allow the beer to condition for 1 week and then bottle or keg. Age 2 weeks.

English-style IPA

Better bittering through balance

by Betsy Parks

THE BEER JUDGE CERTIFICATION PROGRAM (BJCP) HAS THREE SUB CATEGORIES TO CLASSIFY INDIA PALE ALE: ENGLISH, AMERICAN AND IMPERIAL. WHILE THEY ARE ALL HOPPY, THEY ARE DIFFERENT. IN THIS ISSUE, TWO BREWERS EXPLAIN WHAT MAKES ENGLISH-STYLE IPA UNIQUE, AND HOW TO ACHIEVE HOP AND MALT BALANCE WITH RESTRAINT.

One of the main differences between an English-style IPA as opposed to other styles of IPA is that an English-style IPA would normally feature English hop varieties, although there are a considerable number of examples of US hops and imported malts being incorporated into the IPAs of the late 19th and early 20th century from the brewing records.

The style was originally developed to withstand a long and hot sea voyage, which in the earlier days would have been in wood casks. Consequently high levels of hops for bittering were used, and in addition dry hopping appears in many recipes. These techniques would aid the keeping qualities of the beer and enhance the flavor profile.

Typical ABVs for examples from this period would have been 6.0%–8.0%, but there are also some that are lower, and those may have been for more domestic consumption as the style became one adopted in the domestic market.

The beer would also have been reasonably well attenuated to prevent over conditioning/pressurizing in cask, which would have led to cask, shive or keystone failures and loss of contents.

Many of today's American IPAs follow the same principles as outlined above but will tend to feature the US hop varieties.

In contrast, regular pale ales, depending on what time period you look at, would likely be slightly darker (the lighter colored IPAs really only became possible with advances in malting and particularly kilning enabling consistent paler malts to be produced). They would have had lower hop loadings during brewing and probably not as fully attenuated.

At Fuller's, we brew our English-style IPA using pale ale malt with a very small amount of crystal malt (about 2%) in the grist. We use Fuggles and Goldings hops as main kettle bittering hops, Goldings as a late kettle hop, Goldings and Target as dry hops.

We use proprietary strains of yeast in our brewery, but for brewers who want to emulate the style at home, I would recommend using ale strains, preferably those which attenuate well and do not produce very fruity/estery flavors in the beer.

Other than choosing ingredients, the best way to brew a good example of English-style IPA is to brew it well. We don't use any special techniques other than maintaining good brewing practices and we like to think that our unique yeast strain and experience combine to produce an enjoyable beer.

If you are interested in brewing your own English-style IPA, keep in mind that there is a tendency to over bitter IPAs, and that is not appropriate in this style. Remember, the original versions of this beer had a few months at sea to help soften the initial bitterness. Balancing your hop additions between initial, late and dry hopping should produce a pleasantly assertive bitterness matched with hop flavor, aroma and malt character. This approach is much more in tune to the English style, rather than a beer that leaves the drinker's palate coated with astringency.

"The style was originally developed to withstand a long and hot sea voyage . . ."

Derek Prentice, Brewing Manager at Fuller, Smith & Turner P.L.C. in London.

Ken Jones (right) is the Brewery Manager and a partner at Glenwood Canyon Brewing Co. in Glenwood Springs, Colorado. He has worked there since they opened in 1996 and previously worked at Carver Brewing in Durango, Colorado. He first learned homebrewing from his father, Don (left), in the mid 1970s.

I think the most important characteristic to brew this style of IPA is the use of English hops, though they can be augmented with other varieties. The second is the use of minerals to simulate water from Burton-on-Trent. Third is fermentation with British ale yeast for added flavor complexity.

At Glenwood Canyon, we brew IPA with domestic malts from Briess because we know they are fresh. Our grist consists of 91% 2-Row, 4% Bonlander®, 4% Caramel 40 and 1% Cara-Pils. We like to keep the color toward the light end of the scale in order to better showcase the hops and complexity from our yeast. We also strive to keep residual sweetness in check because a traditional IPA should be well-attenuated.

We use US Northern Brewer hops, Columbus and East Kent Goldings in our IPA. Northern Brewer is our primary bittering hop for several of our beers because it has a relatively clean, neutral flavor. We use Columbus hops in order to gain an appropriate level of bitterness that would be difficult to get from English-variety hops alone. Part of the art of an IPA is finding harmony with a combination of hops and Columbus works well with East Kent Goldings. Most of our late hops and all our dry hops are East Kent Goldings.

For yeast, we use Ringwood Ale yeast for our IPA, though there are many other British ale yeasts that would give similar results. An American ale yeast would do very nicely, but would probably lack some flavor complexity. We start our fermentation at 66 °F (19 °C) and ramp it up toward the finish. It's ok to have some esters in an IPA and it should definitely be well-attenuated.

We had our water analyzed and determined what was needed to Burtonize it. We lowered the pH with food-grade acid, then added Gypsum and a small amount of calcium chloride to our mash. We did several blind taste sessions with other brands of English-style IPAs and adjusted our mineral dosage accordingly. It took some time and effort to dial it in, but it was worth it. BYO

Carbonation Methods

The "bite" of yeast autolysis

by Ashton Lewis

Q I RECENTLY BOUGHT MY FIRST KEG FOR MY HOMEBREW SETUP. THE SALES REPRESENTATIVE RECOMMENDED THAT I USE THE OLD CRANK AND SHAKE METHOD OF 20 PSI AND SHAKE FOR 20 MINUTES. I HAVE HEARD THAT THIS IS NOT THE BEST METHOD FOR KEGGING AND WAS INQUIRING ON SOME RECOMMENDATIONS FOR FORCE CARBONATING MY KEG?

ROBERT G.
FREDONIA, ARIZONA

I RECENTLY KEGGED MY BEER (ALMOND BROWN ALE) FOR THE FIRST TIME. I TRIED THE "PRESSURIZE AND SHAKE" TECHNIQUE, SHAKING MY CORNY KEG VIGOROUSLY FOR FIVE MINUTES ALMOST EVERY HOUR FOR TWO DAYS AT ROOM TEMPERATURE BEFORE LOWERING THE CO_2 PRESSURE TO 5 PSI AND INSERTING THE KEG IN MY KEGERATOR. THE BEER COMES OUT FAIRLY QUICKLY EVEN WHEN I RELEASE SOME OF THE BUILT-UP PRESSURE AND HAS A MASSIVE HEAD TO IT (IT TAKES UP ABOUT HALF THE VOLUME OF THE GLASS); WHEN I DRINK IT, I DON'T GET ANY BUBBLES IN THE BEER ITSELF. WHAT AM I DOING WRONG HERE?

MATT CAMPO
STATEN ISLAND, NEW YORK

A I've been writing this column for 15 years now and often times I feel like Abby of "Dear Abby" fame. I hear about brewers making the same mistakes year after year and just sometimes wonder why advice givers don't seem to learn from solved problems. Since these two questions are similar, I felt it was best to address them both with one answer.

The "crank and shake" method to carbonate beer, which has a scrumptious name, is widely suggested and is probably the crudest method imaginable for carbonation. You have done nothing "wrong" since you were following the bad advice given to you by others who unfortunately are fairly large in number.

What you did do is to use a poorly planned method. Carbon dioxide solubility is affected by two variables you can control; beer temperature and carbon dioxide pressure. The goal of carbonation is usually to dissolve somewhere between 5 to 6 grams of carbon dioxide per liter of beer (in US terms this equates to 2.5 to 3.0 volumes). The units are not important; the important thing is that we have a tangible goal to carbonation.

When adding carbon dioxide to beer using a gas cylinder, as opposed to bottle conditioning, it is best to begin the process with cold beer since carbon dioxide solubility increases as the beer temperature decreases. If your goal is a normal level of carbonation you will be targeting about 5 g/l or 2.5 volumes of carbon dioxide. Consulting a gas solubility chart will tell you that if your beer is 38 °F (3 °C) the corresponding equilibrium carbon dioxide pressure for 5 g/l of carbon dioxide is 13 psig (the "g" indicates that this is gauge pressure instead of absolute). What this means is that if you supply 13 pounds of regulated carbon dioxide pressure to a keg of beer maintained at 38 °F (3 °C) that the beer will absorb carbon dioxide until equilibrium is reached.

The important thing about this method is the use of a properly functioning regulator and an accurate pressure gauge. That's an article unto itself, so I will let that thought linger. If you have a properly functioning regu-

"When adding carbon dioxide to beer using a gas cylinder, as opposed to bottle conditioning, it is best to begin the process with cold beer . . ."

lator gas will flow into the keg as your beer absorbs carbon dioxide. This continues until the headspace pressure ceases to drop over time and that is when the process ends.

In a small keg this takes about three to five days to complete if you simply hook the gas up and leave your beer alone. In larger batches the process takes longer since the headspace area is small compared to the beer volume. Commercial brewers' carbonation stones and in-line gas injection systems are used to create a much larger gas surface area and to reduce the time required for carbonation.

You can do this at home by shaking your keg as you did. The important thing, however, is to crank up the regulator to a pressure based on your carbonation goal. Otherwise, the whole endeavor is absolutely aimless. That's why this method has the lovely nickname, "crank-n-shake."

So why do people do this? One thing drives this method: speed. If you crank the pressure above the equilibrium target the gas drives into solution at a faster rate. The same is true with all types of equilibria. Take mashing as an example. If you put your mash pot into an oven maintained with a very good thermostat at, say, 152 °F (67 °C) the mash will eventually reach 152 °F (67 °C). This takes hours so we use a higher temperature for heating and then turn the heat down as the temperature approaches the set-point. This is pretty easy to control because we can easily measure temperature with a thermometer and we can respond to this information by reducing the heat and avoiding an over-shoot. But when carbonating we cannot measure the carbon dioxide content of the beer continuously and often end up with overly gassy beer.

There is one other thing that you need to investigate and that is your draft system. The easiest to use draft systems use enough beer line to provide pressure drop nearly equal to the keg pressure. Most beers are stored at 38 °F (3 °C) and contain about 2.5 volumes, so 13 psig is a common pressure seen in bars with draft beer. If you use 5½ feet of 3/16" beer line you will have restriction about equal to this pressure (3/16" beer line has 2.2 psig of pressure drop per foot of line). Why is this important? Well, if you match the pressure drop of your draft system to the keg pressure you don't have to drop the keg pressure every time you want to draw a beer. Not only does this practice waste carbon dioxide, granted not much, it also vents aromas from your beer.

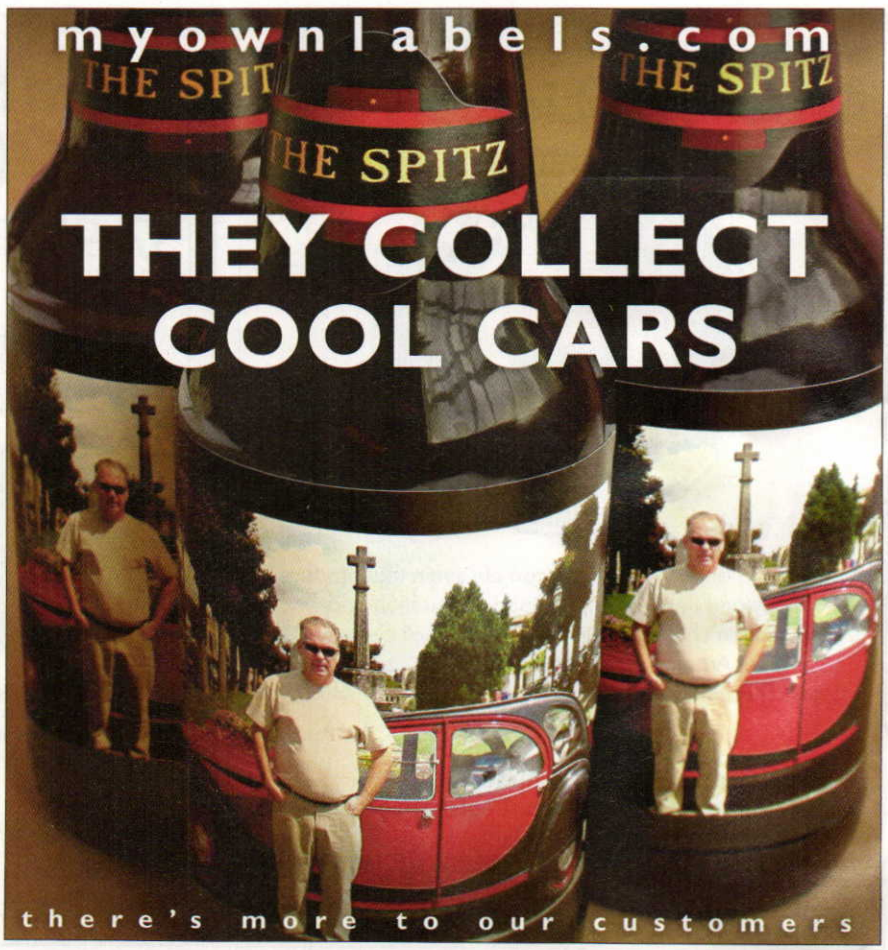
So the next time you brew a batch of Almond Brown Ale, finish off this great sounding brew by 1) chilling the beer before initiating carbonation, 2) using the proper equilibrium pressure for carbonating your brew, 3) exercising a little patience — a few shakes a day won't hurt if you cannot resist the urge and 4) use a longer hose to make pouring more controllable.

Q I HAVE A BATCH THAT HAS A DISTINCT YEAST BITE. AFTER READING SOME BACK ISSUES OF BYO, I THINK YEAST AUTOLYSIS MAY BE THE CULPRIT. HOWEVER, I REMEMBER READING THAT YEAST NEVER "DIE" THEY SIMPLY GO DORMANT UNTIL CONDITIONS ARE RIGHT TO REVIVE. I BELIEVE THIS BECAUSE OF THE YEAST THAT SITS IN THE REFRIGERATOR AND STILL IS FINE WHEN FINALLY USED. SO, IN THIS SECOND BATCH, YEAST IN SUSPENSION WOULD SEEM A MORE LIKELY EXPLANATION. WHAT IS THE CAUSE, OR MORE SPECIFICALLY, CURE? WOULD LONGER FERMENTATION EITHER IN THE PRIMARY OR SECONDARY HELP?

DAVID SCOTT
ELKHORN, WISCONSIN

A So much of what we as brewers know about beer comes from experience, the experience of others and, very importantly, the science of brewing that can be used to explain these observations. I think most professional brewers would agree that prolonged exposure to yeast does put beer at risk for developing yeast bite and that the cause of this flavor is yeast autolysis. Brewing science also supports this; there is no question that yeast cells do indeed die during storage and like other dead cells they lyse. The word "lysis" refers to the destruction or breakdown of cells. The word "autolysis" means that this destruction is self induced by enzymes normally contained within the membrane walls of lysosomes; these sacs are cell organelles and they lose their cell wall integrity when cells die, thereby releasing these digestive enzymes into the cell.

Yeast autolysis results in the release of the contents of the yeast



> "One way to minimize off flavors associated with yeast autolysis is to rack beer off of yeast sediment after primary fermentation is complete."

cell into the surrounding beer and the flavor change is described by various terms and your term of "yeast bite" is one. In some beers, for example in lighter styles, this flavor is very easy to pick out. In other beers there are so many other flavors present that the yeast bite aroma is not something that is normally detected. I have aged beer in wooden barrels with *Brettanomyces* for well over a year and not detected any "yeast bite," although I know for sure that the ale yeast that was in the beer when the barrels were filled is long dead.

I think with other beers you brewed, perhaps a stout or porter, that the flavor intensity of the beer merely masked any negative flavors associated with yeast death. One way to minimize off flavors associated with yeast autolysis is to rack beer off of yeast sediment after primary fermentation is complete. Also, keeping the aging beer cool or cold slows yeast death and autolysis. You are correct that yeast go dormant after fermentation is complete and that the population will maintain reasonable viability if kept cold.

Some brewers who age their beers in tanks with conical bottoms periodically "blow the cones" during aging. This is done to remove yeast sediment from cones. Since yeast is thick it acts as an insulating layer and the center of the yeast sediment can get quite warm if there is still some metabolic activity. This increase in temperature influences the rate of autolysis and can have consequences beyond yeast bite. When yeast lyse the concentration of amino acids around the decaying cells increases and this local condition can create ideal conditions for the growth of lactic acid bacteria, noted for their high nutrient requirements. BYO

Brew Your Own Technical Editor Ashton Lewis has been answering homebrew questions since 1995. A collection of his columns are available in his book, *The Homebrewer's Answer Book*, available online at www.byo.com/store. Do you have a question for the Wizard? Send it to wiz@byo.com.

English IPA

Big, British and balanced

by Jamil Zainasheff

India pale ale was first created when an enterprising brewer crafted a beer to better survive the long sea voyage from England to India in the late 18th century. It is said that the beer had more hop bitterness than other beers of its time to help preserve the beer against spoilage. Today, English commercial examples of the style have become weaker, in both hops and alcohol. Many beers labeled as IPA in England are much closer to bitters than the India pale ales of old.

Quite a few brewers still want to recreate an historic English IPA. Some brewers, such as Luke Nicholas of Epic Brewing Company of Auckland, New Zealand have even tried placing kegs of IPA on ships to simulate the effect of transit to India on the beer. While many do a brilliant job, there are still plenty of poorly fermented, out of balance examples. The worst thing about some of these misguided attempts is the brewer loading an English IPA up with heavy, sweet malt character. While English IPA should always have a noticeable, supporting malt character, it should not be sweet, heavy or overly full. It should be more about biscuit, toast and caramel than it should be about sweetness. You want a reasonably crisp finish, one that is drier rather than sweeter.

Start with British pale ale malt as the base. It provides that background biscuit-like malt character that is a key component in fine British beers. British pale ale malt is kilned a bit darker (2.5 to 3.5 °L) than the average American two-row or pale malt (1.5 to 2.5 °L) and this higher level of kilning brings out the malt's biscuity flavors.

Extract brewers should try to source an extract made from British pale ale malt. If you end up using domestic two-row malt extract, you will need to compensate with some additional specialty malts such as Munich, biscuit or Victory®, but use restraint. For a 5-gallon (19-L) batch, add about 5 to 10% of the total base malt.

All-grain brewers should use an infusion mash. A temperature in the range of 149 to 154 °F (65 to 68 °C) works well. Use a lower temperature when using lower attenuating yeasts or higher starting gravities. Use a higher mash temperature when using the higher attenuating yeasts or lower starting gravity beers. A great starting point is 152 °F (67 °C) if you are unsure.

I like the clean, light malt character of American-style IPAs brewed with pale malt only, but that does not work well for English IPA. English IPA requires a touch more malt complexity and a slight touch of caramel character. English IPA should not have as much caramel character as English bitters, but a small dose of crystal malt adds caramel notes, body and helps fill out the malt flavors. The type of crystal malt also makes a difference. Darker color crystal malts add richer colors, as well as some dark caramel, toasty, roasted and raisin flavors. Lighter color crystal malts add sweeter caramel notes. The maximum crystal malt this style can handle without getting heavy and cloying is in the range of 8 to 10% with a color range of 10 to 150 °L. However, the darker the crystal, the less you should use. An IPA with 10% 150 °L crystal malt may not be cloying, but it can be too intense a flavor for this style. On the flip side, an IPA with all light color crystal malt will tend to be sweet and lack depth of character.

If you are looking for more complexity or increased head retention, you can add other malts as well. Wheat malt, Victory®, biscuit and more are common additions in many recipes, but restraint is important so that the beer does not become saturated with non-fermentable dextrins and cloying flavors. In general, keep the total of all specialty grain additions

Continued on page 21

english IPA by the numbers

OG:	1.050–1.075 (12.4–18.2 °P)
FG:	1.010–1.018 (2.6–4.6 °P)
SRM:	8–14
IBU:	40–60
ABV:	5.0–7.5%

Bière de l'Inde
(5 gallons/19 L, all-grain)
OG = 1.062 (15.2 °P)
FG = 1.015 (4.0 °P)
IBU = 50 SRM = 12 ABV = 6.2%

Ingredients
11 lb. (5 kg) Crisp British pale ale malt (or similar English pale ale malt)
7.1 oz. (200 g) Great Western crystal malt 40 °L
7.1 oz. (200 g) Castle biscuit malt 25 °L
7.1 oz. (200 g) Great Western wheat malt 2 °L
5.3 oz. (150 g) Great Western crystal malt 120 °L
9.6 AAU Challenger hops (1.20 oz./34 g of 8% alpha acids) (60 min.)
6.15 AAU Fuggles hops (1.23 oz./35 g of 5% alpha acids) (10 min.)
6.15 AAU East Kent Goldings hops (1.23 oz./35 g of 5% alpha acids) (0 min.)
White Labs WLP013 London Ale or Wyeast 1028 London Ale yeast

Step by Step
The bulk of the flavor comes from the base grain, so try to get British pale ale malt. The crystal and wheat malt I use in this recipe is from Great Western Malting Co., though an even better choice for this style is British-type crystal malts.

Mill the grains and dough-in targeting a mash of around 1.5 quarts of water to 1 pound of grain (a liquor-to-grist ratio of about 3:1 by weight) and a temperature of 152 °F (67 °C). Hold the mash at 152 °F (67 °C) until enzymatic conversion is complete. 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 5.9 gallons (22.3 L) and the gravity is 1.053 (13 °P).

Once the wort is boiling, add the bittering hops. The total wort boil time is 1 hour after adding the bittering hops. During that time add the Irish moss or other kettle finings with 15 minutes left in the boil and add the last two hop additions at 10 minutes remaining and at flame out. Chill the wort to 68 °F (20 °C) and aerate thoroughly. The proper pitch rate is 11 grams of properly rehydrated dry yeast, 2 packages of liquid yeast, or 1 package of liquid yeast in a 2-liter starter.

Ferment around 68 °F (20 °C) until the yeast drops clear. With healthy yeast, fermentation should be complete in a week or less. 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.

Bière de l'Inde
(5 gallons/19 L, extract with grains)
OG = 1.062 (15.2 °P)
FG = 1.015 (4.0 °P)
IBU = 50 SRM = 12 ABV = 6.2%

Ingredients
7.34 lb. (3.33 kg) English pale liquid malt extract*
7.1 oz. (200 g) Great Western crystal malt 40 °L
7.1 oz. (200 g) Castle biscuit malt 25 °L
7.1 oz. (200 g) Great Western wheat malt 2 °L
5.3 oz. (150 g) Great Western crystal malt 120 °L
9.6 AAU Challenger hops (1.20 oz./34 g of 8% alpha acids) (60 min.)
6.15 AAU Fuggles hops (1.23 oz./35 g of 5% alpha acids) (10 min.)
6.15 AAU East Kent Goldings hops (1.23 oz./35 g of 5% alpha acids) (0 min.)
White Labs WLP013 London Ale or Wyeast 1028 London Ale yeast

Step by Step
*I use an English-type liquid malt extract custom made for my homebrew shop from a 100% Maris Otter malt. While I haven't used them myself, I've heard that Edme Maris Otter malt extract is a good substitute. If you can't get fresh liquid malt extract, it is better to use an appropriate amount of dried malt extract (DME) instead.

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 gallon (~4 liters) of water at roughly 170 °F (77 °C) for about 30 minutes. Lift the grain bag out of the steeping liquid and rinse with warm water. Allow the bags to drip into the kettle for a few minutes while you add the malt extract. Do not squeeze the bags. Add enough water to the steeping liquor and malt extract to make a pre-boil volume of 5.9 gallons (22.3 L) and a gravity of 1.053 (13 °P). Stir thoroughly to help dissolve the extract and bring to a boil.

Once the wort is boiling, add the bittering hops. The total wort boil time is one hour after adding the bittering hops. During that time add the Irish moss or other kettle finings with 15 minutes left in the boil and add the last two hop additions at 10 minutes remaining and at flame out. Chill the wort to 68 °F (20 °C) and aerate thoroughly. Follow the fermentation and packaging instructions for the all-grain version.

Web extra:
Visit BYO online for a directory of beer recipes, organized by style:
www.byo.com/stories/recipes/recipeindex

to less than 15% of an all-grain grist.

The Beer Judge Certification Program (BJCP) divides the India pale ale category into three sub-styles. You should think of all of them as "hoppy," but there is a vast difference in the level of hops between the IPA substyles. On the lower end is English IPA, which, while hoppy, does not have quite as bold a hop character as is found in American IPA. In an English IPA, the hops should never be overwhelming, resin-like, or shockingly bitter. English IPA should be firmly bitter, but the bittering and hop character should not completely overpower the fermentation and malt character. Bold, but not overdone is the key here. The trick is to get the right level of hop aroma and flavor, using traditional English hops, without going completely overboard.

English IPA is best brewed with English hops, such as East Kent Goldings, Fuggles, Target, Northdown or Challenger. The bittering level for English IPA is in the range of 40 to 60 IBU. Target a firm hop bitterness, without overwhelming the malt background. Keep in mind that there are many factors at play in the final impression of bitterness for the drinker. The starting and final gravities, water sulfate levels, the character malts selected, type of base malt, yeast strain, pitching rate, and even the yeast cell size have an impact on the perceived bittering. For most English IPAs, a bitterness-to-starting-gravity ratio (IBU divided by OG) between 0.7 and 1.0 gives the proper result. As a general rule of thumb in determining late hop amounts, include at least double the amount of bittering hops. Keep in mind this is just a generalization, since using very low or high alpha acid hops makes the equation faulty. For an English IPA include two or more late hop additions using two different hop varieties, totaling around 1 to 3 oz (28 to 85 g) for a 5 gallon (19 L) batch at 20 minutes or later. You can use more than two varieties, but do not go crazy. A couple of varieties creates an interesting complexity; ten different hop varieties creates an indistinct "hoppiness." Dry hopping and the use of a hop jack are also good ways to develop hop character for this style. If you do dry hop this beer, you should reduce the late hop additions to keep the hop flavor and aroma balanced with the malt character.

The sulfate content of brewing water affects the character of hop bitterness to a significant degree. When brewing with low sulfate water you are forced to add a large amount of hop alpha acids to develop enough bittering. However, adding large quantities of hops to get a stronger bittering can result in a resin-like character. Cutting back on the hops and adding a moderate amount of gypsum (or "Burtonizing" the water), results in a sharper, crisper hop bitterness without the resin character. While the BJCP style guide mentions high sulfur levels and sulfur character in examples of the style, an apparent sulfur character is a flaw. You shouldn't be trying to mimic the water of Burton-on-Trent. It is easy to overdo mineral additions, resulting in a chalky, metallic or harsh character. Most water only requires a small amount of gypsum. Start low, targeting half the amount of total sulfate typical of Burton water. If you do not know the sulfate content of your water, start with one gram of gypsum per gallon. Generally, you should need no more than three grams per gallon. It is usually better to add less than to add more and it only takes a small amount to accentuate hop bitterness. You can add gypsum to the mash or, if you are brewing with extract, you can add it directly to your boil kettle water before you heat it.

"English" yeast strains provide a variety of interesting esters and leave some residual sweetness to balance a bitter beer. Many English yeasts tend to attenuate on the lower side (< 70%), but for an English IPA you want to choose one of the more attenuative English yeasts. While you do want some balancing malt sweetness, using a low attenuating yeast in a bigger beer can result in a beer that is too heavy and sweet. My favorites for this style are White Labs WLP013 London Ale and Wyeast 1028 London Ale. They both provide a wonderful ester profile without being excessively fruity, and they attenuate a little more than most English yeasts. If you like to experiment, try to select English yeasts that attenuate in the mid 70s percent or higher. If you prefer dry yeast, Danstar Nottingham should produce good results.

At lower temperatures (<65 °F/18 °C), these yeasts produce a relatively low level of esters and at high temperatures (>70 °F/21 °C) they produce abundant fruity esters and fusel alcohol notes. I start fermentation in the middle of this range (68 °F/20 °C), letting the temperature rise a few degrees, slowly over a couple days. This creates the expected level of esters, helps the yeast attenuate fully, and keeps the amount of diacetyl in the finished beer to a minimum. If you must use less attenuative yeast, take steps to ensure enough attenuation. You can lower the starting gravity, lower the mash temperature, or replace a portion of the base malt with simple sugar to aid in drying out the final beer.

Serving English IPA at cellar temperature, around 52 to 55 °F (11 to 13 °C), allows the character of the beer to come out and can improve drinkability. Colder temperatures prevent the drinker from picking up the interesting fermentation and malt flavors and aromas of this style, so do not go below 50 °F (10 °C). Target a carbonation level around 2 to 2.5 volumes of CO_2 for bottled, 1.5 volumes for kegged, and 1 volume of CO_2 for cask conditioned beer. BYO

Jamil Zainasheff writes "Style Profile" in every issue of BYO. *He is the co-author of* Brewing Classic Styles *(Brewers Publications, 2007), as well as the host of "Can You Brew It" and "Brew Strong," both on The Brewing Network.*

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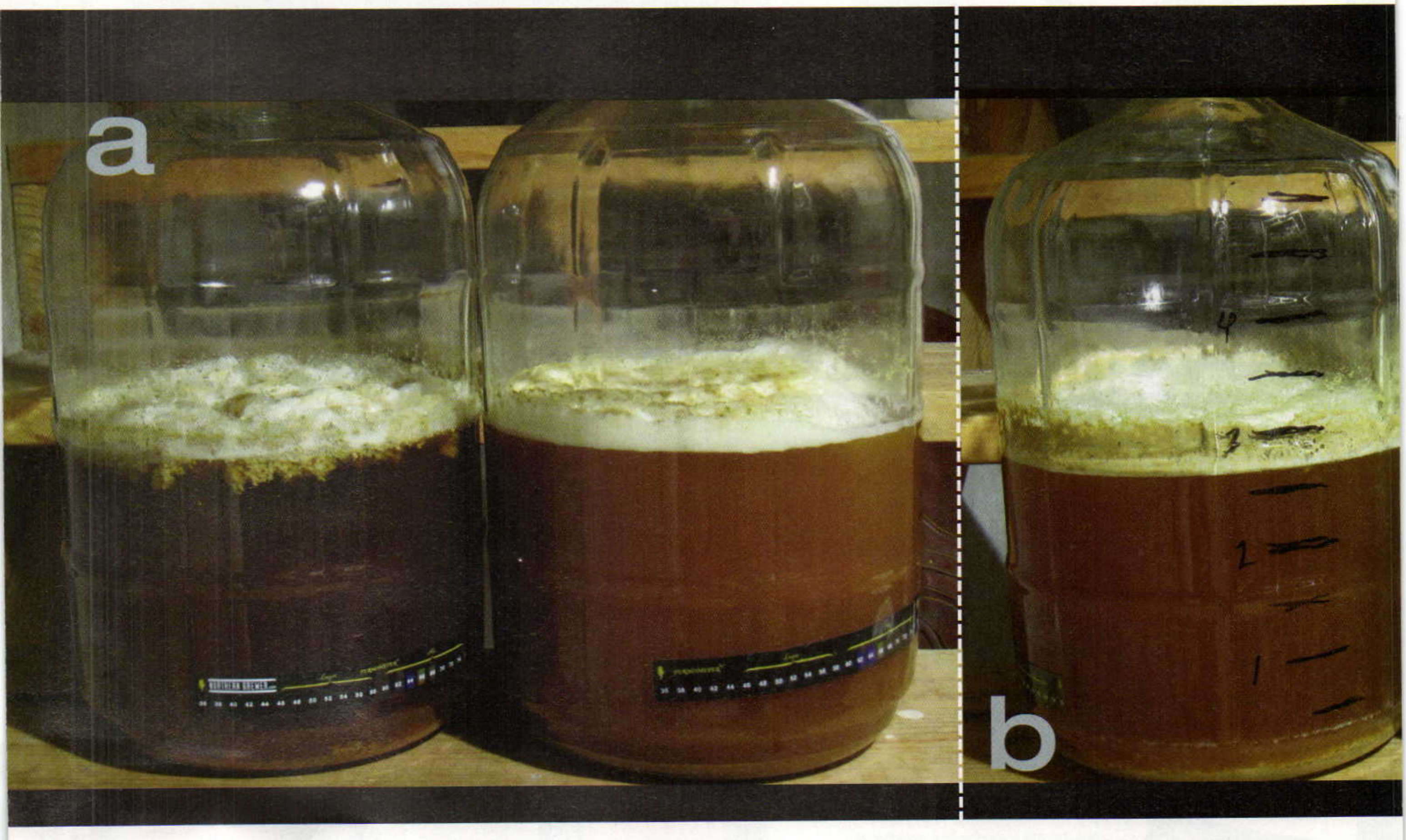
WHAT DOES IRISH MOSS DO?



Scientific experiments are designed to answer an experimental question. Many times, however, an experiment raises at least as many questions as it answers, and these new questions can lead researchers in new directions.

In this installment of the Brew Your Own/Basic Brewing Radio Collaborative Experiment series, we decided to test the effect of Irish moss (and similar fining agents, such as whirlfloc) on beer. In the BYO/BBR series of experiments, we test scientific questions about brewing at a home scale. Our goal is to design simple, but hopefully decisive, experiments, and encourage multiple homebrewers to perform them. The collective results will hopefully yield clear results that can guide homebrewers towards a better understanding of their craft. The BYO/BBR Collaborative Experiments series is ongoing. Watch Chris Colby's blog at byo.com and listen to James Spencer's Basic Brewing Radio podcasts for the announcement of new experiments.

The Background

Irish moss is a fining agent. Brewers add it to the boil to remove haze-causing proteins from their beer. Irish moss is rich in a class of molecules called carrageenans. Carrageenans are large, helical molecules that carry a negative charge when dissolved in a solution at typical wort pH levels. The carrageenans bind positively-charged haze-causing proteins, fall to the bottom of the kettle and are left behind when the beer is transferred to the fermenter.

The Questions

We designed a simple experiment to test the effects of Irish moss — or whirlfloc, a fining agent made from Irish moss —

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Story by **Chris Colby** and **James Spencer**

on homebrew. Irish moss is widely used, and our personal brewing experiences lead us to suspect it works as advertised. However, like most homebrewers, we have occasionally forgotten the Irish moss and still produced good beer. So it's at least fair to ask if Irish moss really does do what it is intended to do.

More interestingly, though, we also wondered if adding Irish moss could have other unintended — and previously unobserved — effects. For example, does the removal of the haze-causing proteins also have an effect on the beer's flavor? Could Irish moss be

a. James Spencer's two batches photographed one day after pitching. The Irish moss treated beer is on the left.

b. Three days after pitching. The untreated beer continues to be distinctly more cloudy.

c. Eleven days after pitching, the visible differences in the fermenter have almost completely disappeared.

Experimenters and their Results In Brief

Name	Beer	Comments
Matt Weide (Minneapolis, MN)	Belgian pale ale (extract) (Irish Moss)	Irish moss beer clearer; control has long-lasting foam
Tony Milner (Wallacy, UK)	hoppy pale ale (all-grain) (Irish moss, Protafloc)	Protafloc gave best results but was hardest to rack from
George Helfers (St. Louis, MO)	Duvel clone (all-grain) (whirlfloc)	slight difference in clarity; whirlfoc batch was clearer
Zot O'Connor (Seattle, WA)	Am. pale ale (extract) (Irish moss)	Irish moss beer is clearer no real flavor difference
Adam Ross (Davenport, IA)	best bitter (all-grain) (whirlfloc)	whirlfloc beer cleaner/crisper no difference in bitterness
John Greener (Nampa, ID)	pale ale (all-grain) (Irish moss)	control required blowoff tube Irish moss batch better foam
Jerry Marowski (Oak Creek, WI)	pale ale (all-grain) (Irish moss)	both beers clear in the glass less body in Irish moss beer
Doug Zobel (Oak Park, IL)	Am. wheat (all-grain) (Irish moss)	control batch had better foam control batch better flavor
Steve Wilkes (Fayetteville, AR)	pale ale (all-grain) (Irish moss)	Irish moss beer was clearer blowoff needed for control
James Spencer (Prairie Grove, AR)	pale ale (extract) (Irish moss)	small difference in initial clarity difference faded with time

removing other proteins that affect flavor or head retention? In addition, could it be removing other molecules besides proteins? If it removed iso-alpha acids, we should be able to detect this from a difference in bitterness. We also asked researchers to look for any differences between batches that proved interesting.

The Experiment

We asked homebrewers participating in the experiment to brew two batches of beer. Each beer was to be brewed from the same recipe, with the same ingredients and on the same brewing equipment. Every effort should have been made to brew, ferment and condition the beers in an identical fashion — with the exception of the experimental variable. In one batch, the homebrewer was instructed to add Irish moss, whirlfloc or other clarifying agent to the kettle. For the other batch (the control), no clarifying agent was to be added.

The idea of brewing two batches of beer in an identical fashion, except for the experimental variable, is simple. In reality, however, there are always complications. For extract brewers, there was one slight twist — they needed to account for the possibility of having different amounts of sediment (or trub) in their brewpots between batches. This could lead to collecting different amounts of "thick" wort, that would then be diluted to 5 gallons (19 L). If that happened, the batch with more trub — and correspondingly less "thick" wort transferred to the fermenter — would show a lower original gravity. In order to account for this, we asked extract brewers to brew the Irish moss beer — which we would expect to have more sediment — first. When the second batch was brewed, the brewers should only rack as much wort to the fermenter as the first batch yielded.

Data to Collect

The basic information we were looking for was how the finished beers compared in terms of clarity, but there were a number of additional pieces of information we asked our collaborators to keep track of.

We asked the brewers to observe their wort at the end of boiling and also to observe the fermenting beer.

We asked brewers to report all the usual measures that homebrewers keep track of, including original gravity (OG) and final gravity (FG). (We didn't expect to find any differences in these variables, but if you are taking the time to do an experiment, it doesn't hurt to collect every bit of data possible. You never know.)

The most important thing we asked for was, of course, comparisons of the final, conditioned beers, made by pouring each beer into an identical glass. We asked brewers to compare both the appearance as well as the flavor, aroma and mouthfeel.

There is no simple numerical scale to rank clarity in homebrew, but differences between two samples should not be too hard to spot. If the treatment actually works, we would expect a marked difference; otherwise, why would brewers bother to add it?

In beers with similar levels of clarity, brewers could use "the pencil test" to evaluate them. To do this, hold a pencil behind the beer and see if you can read the writing on it through the beer. The cloudier the beer, the harder the words are to read. (If you have a tapered glass, clearer beers will allow you to read the writing through more beer, in the wider part of the glass. This can help when comparing beers with similar levels of clarity.)

We also asked brewers to compare the color of the beers and to compare their levels of head retention. For example, does one beer have more foam than the other (when poured in the same manner)? Does one beer have longer-lasting foam? Are there color or other differences in the foam?

Viewing differences in clarity or the amount or quality of foam should be fairly easy and objective. Comparisons of aroma, flavor and body are a bit more subjective, but they are what are most important to most homebrewers.

We instructed the brewers to smell and taste the beers side by side. If they detected any difference in taste, we asked that they try to identify it. We asked particularly for brewers to look for differences in the levels of perceived bitterness.

The aroma should have likewise been compared. Did one beer smell more estery than the other? Additionally, we asked that participants compare the body and mouthfeel of the two beers.

Finally, as always, we asked that brewers be attentive and look for any interesting observations that crop up along the way. Sometimes it's the unexpected observation that leads to a big breakthrough.

In addition, we sent a set of beers that were brewed by James Spencer to Dr. Brad Sturgeon and his student Blake Lyon of Monmouth College for laboratory analysis.

The Results

We had eight brewers collaborating on the experiment. Most brewed two batches of beer and one brewed three (comparing Irish moss, Protafloc — a fining agent similar to whirlfloc — and no fining agent). Together with the batches brewed by James Spencer and Steve Wilkes, that makes a total of 21 batches of beer brewed. See the table on page 28 for a listing of participants and a brief summary of their results.

During The Boil

Irish moss acts during the boil, but at this stage it is hard to see if any effect has taken place. Most brewers made no comment on the appearance of the wort during the boil. Doug Zobel of Oak Park, Illinois, however, noted that the samples he took for measuring specific gravity were much clearer in the case of the Irish moss treated beer — which is exactly what would be expected and is consistent with the authors' experiences in brewing.

During Fermentation

Large differences between the batches were seen in early fermentation. When Irish moss was not added, the fermenting wort looked cloudy. In contrast, when Irish moss was added, the fermenting wort looked clear, with large, fluffy clumps of yeast floating in it. See the pictures on pages 26 and 27 for an illustration of this from the batch brewed by James Spencer.

In addition, the appearance of the kräusen was different between batches, with the untreated batches producing more kräusen. Batches with Irish moss showed a smaller volume of more "tightly knit" kräusen. John Greener of Nampa, Idaho pointed out that the kräusen in his Irish moss batch had "brown chunkies" in it, an observation confirmed by Steve Wilkes of Fayetteville, Arkansas. Two of the participants found the need to install a blowoff tube to their untreated batches, whereas the Irish moss treated batches did not require one.

Tony Milner of Wallacy, United Kingdom, noted that not only the appearance of the wort, but also the amount of sediment thrown in the fermenter, differed between treatments. He brewed three beers — one with Irish moss, one with Protafloc and the control.

Milner noted that the Protafloc beer showed the most sediment, followed by Irish moss and then the control. The amount of sediment corresponded to clearer beer, so the cost of clarity was losing a small volume of beer compared to the control — about a pint from a one-gallon (3.8 L) batch, he estimated.

Color and Clarity

Of course, the appearance of the fermenting wort is of little importance compared to the appearance of the finished beer. And, in most cases, differences in color and clarity were noted between the two batches. The appearance of the treated beer was usually described as clearer and darker than the untreated beer. The darker look is likely due to fewer haze particles, which reflect light, being present.

Six of the outside collaborators reported that the Irish moss treated beers were more clear, whereas two did not see a difference. Steve Wilkes' batch also showed a clear difference in clarity, while the beers brewed by James Spencer showed less of a difference. As mentioned before, one brewer (Tony Milner) compared Irish moss, Protofloc and no fining agent and found that the Protofloc treatment resulted in the clearest batch, followed by the Irish moss, followed by the control beer.

Most of the brewers reported that the difference in clarity was small and that this difference faded over time. This is most likely due to the beers warming up and the chill haze in the untreated beers going away.

It should be noted that Irish moss was added at the rate recommended in the respective homebrew recipes, usually the equivalent of ¾ tsp. to 1 tsp. per 5 gallons (19 L). Adding Irish moss at a higher rate would likely result in greater clarity; however, its negative effects (see the foam section) would likely be enhanced as well.

Two of James Spencer's beers were analysed in a lab. Blake Lyons, who did the analysis, reported that, although the two beers looked to be the same color, measuring the colors in a spectrophotometer (at 430 nm) revealed that the Irish moss treated beer had a color of 12.9 SRM compared to a 16.4 SRM for the control beer. This is interesting, but would need to be repeated a few times before we could say that Irish moss removes (a visually imperceptible amount of) color from treated beers.

“Six of the outside collaborators reported that the Irish moss treated beers were more clear, whereas two did not see a difference.”

Foam

A comparison of the volume of foam and head retention times proved interesting. Of the seven brewers who commented on foam, four claimed that the untreated batch showed the largest volume of foam. Matt Weide of Minneapolis, for example, said his untreated beer showed a fluffy, long-lasting, off-white head. One of the brewers did not see a difference and two claimed that the Irish moss treated batch exhibited more foam. It is interesting to note that the two brewers whose Irish moss treated beer showed the best foam were also the same brewers who had to install a blowoff tube during fermentation on their control carboys.

The obvious interpretation is that, while the Irish moss is removing haze-causing proteins, it is also dropping out some proteins that contribute to foam. Our experiment alone doesn't prove this, but it is consistent with this explanation. (And other homebrew authors, including George Fix, have concluded that Irish moss reduces foam positive proteins.) The anomalous two results can potentially be explained due to the loss of proteins from the kräusen during the blowoff.

Flavor and Aroma

We expected clearer beer in the Irish moss treated batches, but what about flavor and aroma? If the fining agent was demonstrably reducing haze, was it reducing anything else? In general, brewers reported that the treatment had little or no effect on flavor and aroma. In a few instances, small differences were reported, but the brewers always claimed that the differences would have been hard to spot had the beers not been tasted side by side.

Seattle brewer Zot O'Connor's response was typical when he wrote there was "no real difference" between batches with respect to flavor and aroma. Adam Ross, however, felt his whirlfloc treated beer was "cleaner and crisper," compared to the control.

One brewer (Doug Zobel), who made an American wheat beer, felt the Irish moss treated beer showed a slight lessening of some of the subtler aspects of the beer. He concluded that he would likely avoid using Irish moss on very subtle beers, but that the difference was so small that he would continue using it on bolder beers.

Bitterness

If Irish moss removes haze-causing proteins, might it also remove some compounds that contribute to bitterness? The brewers who participated in this experiment, several of whom brewed hoppy beers, found no evidence for this. Only one brewer (Doug Zobel) found the untreated beer to be more bitter, and his perception was that the difference from the control batch was slight.

Our lab analysis backs this up. The bitterness of the beer treated with Irish moss was measured to have 64.8 IBUs while the control beer showed 64.2 IBUs. This difference is likely due to the ordinary variation that occurs in laboratory measurements. However, even if it was real, a difference of less than one IBU is not going to be detectable on the human palate.

Body and Mouthfeel

Mouthfeel in beer is something that could possibly be altered by a fining agent. And one brewer — Jerry Marowski of Oak, Creek, Michigan — felt that his Irish moss treated beer was thin and watery, compared to the untreated beer. Jerry was one of the few brewers who indicated that he was rethinking his use of Irish moss due to his participation in the experiment; most claimed that they would continue using it.

By the Numbers

We asked brewers to record their original gravity (OG) and final gravity (FG), simply because these are easily measured statistics. Irish moss (or other fining agents) is not claimed to interact with sugars. As such, we would expect the OGs and FGs to be unaffected by the treatment — and this is exactly what we saw.

Although the OGs of both batches were not always equal, they were always within a "gravity point" or two and the higher gravities were sometimes found in the treated beer and sometimes in the control.

Conclusion

Our results indicate that Irish moss shows visible effects as early as fermentation, and does indeed produce clearer beer, although the degree of difference between treated and untreated beers was not very large. For homebrewers that prize clarity in their beers, adding Irish moss is recommended. Irish moss did not appear to strip large amounts of flavors or aromas, but some small differences were noted in some cases. If you routinely brew a very delicately-flavored beer, it may be worth your while to repeat this experiment at home and see if you can detect any differences. Head retention may be diminished by the use of Irish moss, although the fining agent did not reduce the volume of foam greatly. It is interesting to note that adding a fining agent in the kettle led to different appearances of the wort during fermentation and, in some cases, different amounts of sediment.

Keep an eye out for new *BYO/BBR* Collaborative Experiments in the future (find out by following Chris Colby's blog at www.byo.com/blogs/blogger/Chris Colby/) and consider joining us in future investigations. BYO

Chris Colby is Editor of Brew Your Own *magazine. James Spencer is the host of* Basic Brewing Radio.

BARLEYWINE CLONES

Story by **Glenn BurnSilver**

Barleywine is, as the name implies, a beer with an alcoholic content similar to that of many wines — typically 9 to 14 percent alcohol by volume (ABV). But barleywine is more than just a boozy, high-alcohol beverage. Indeed, barleywine holds a special place in the minds of many beer drinkers.

"The inclusion of the word 'wine' elevates this beer style to the realm of elegance previously reserved for the wine spectrum," says Peter Zien, owner and head brewer at AleSmith in San Diego, where Old Numbskull is produced. "It is beer's initial attempt to move up in the world and separate itself from the working man's beverage to the elixir of the elite."

"It should be something to savor," adds Matt Phillips of Phillips Brewing in Victoria, British Columbia, where Burley Wine is made.

With flavor profiles that can include malty caramel, toffee, tobacco, sherry, marshmallow, vanilla, biscuit and roast — and the best examples showing an ever-increasing complexity over time — barleywine was long considered a special drink. Though the style was estimated to have been brewed for more than a century prior, Bass is credited with the first commercial beer using the term barleywine when it released No. 1 barleywine in 1903.

The style has two variations — English and American. The most notable difference between them is in the hops. Both styles are thick, rich and malty, warming to the palate and belly (with the English style typically showing more caramel or biscuit-like notes). The American style is typified by beers that are heavier on

The Bass Brewery in England is credited with releasing the first commercial barleywine in 1903.

the hops, especially citrusy American hops. Sierra Nevada's Bigfoot is a prime example of a highly hopped barleywine. Sierra Nevada head brewer Steve Dresler explains that even after the brew has been made with a huge dose of hops, they go the extra step of using additional dry hopping.

"We wanted to do something more hop fronted," he says. "As barleywines go, particularly at the time (the beer was created in 1981), it was a radical departure from what was available. We wanted something that was richer and maltier, and very pronounced on the hop end."

"To find out how the pros do it, *Brew Your Own* turned to five commercial barleywine brewers of both English and American styles — Steve Dresler (Sierra Nevada), Peter Zien (AleSmith), Matt Phillips (Phillips Brewery), Ben Johnson (of Midnight Sun in Anchorage, Alaska) and Darron Welch (at Pelican Pub & Brewery in Pacific City, Oregon) to get their tips, secrets and high points for brewing barleywine at home."

Try This at Home

Concocting a barleywine involves some challenges, but is far from impossible. To find out how the pros do it, *Brew Your Own* turned to five barleywine manufacturers of both English and American styles — Dresler, Zien, Phillips, Ben Johnson (of Midnight Sun in Anchorage, Alaska) and Darron Welch (at Pelican Pub & Brewery in Pacific City, Oregon) to get their tips, secrets and high points for brewing barleywine at home.

Where To Start

"The grain bill for most barleywine is huge, while the amount of wort you collect is relatively small. A large mash tun is definitely a plus," says Johnson who brews Arctic Devil Barleywine. "In the brewing process, oversized equipment is a big bonus."

Johnson's sentiments are echoed by all the brewers. It takes a lot of grain to get the original gravity high enough so the proper alcohol levels — 8 to 12% ABV is suggested by the BJCP style guidelines — can be obtained. However, that's not to say a sufficient runoff for a 5-gallon (19-L) batch can't be obtained by mashing two distinct grain bills. Or, if this is impractical, do a smaller batch.

"Homebrewers with limited mashing capacity should reduce the batch size if they can't fit their grain bill into their mash/lauter tuns," Zien says. Homebrewers can also supplement their wort with malt extract.

Target mash temperatures run the gamut from relatively high to below the usual saccharification range.

"We mash Stormwatcher at a very low temperature (138 °F/59 °C) to maximize fermentability," Welch said of his barleywine creation, Stormwatcher's. "This not only improves the balance and drinkability of the beer, but helps increase the alcohol content. With a big malty beer, there is a danger of the flavor profile becoming unbalanced. Too much residual sugar can be a culprit. (Our) target apparent attenuation for Stormwatcher is 80 percent."

A long boil is also needed to get the original gravity up. While Welch boils for four hours, Johnson for three and a half, and Dresler for three, the other brewers target a 90 minute boil, which should work well enough at home to concentrate the wort, increase malt caramelization and develop a good environment for the yeast.

"If they are doing a standard 75–90 minute boil and can achieve an OG that high, there is no need to do (a 3 hour boil)," Dresler said. "The only reason for the long boil is for wort concentration."

Hitting Your Target OG

If that wort concentration's original gravity doesn't seem high enough already, it can always be stepped up slightly by adding some fermentables to the boil. Both Zien and Johnson do this, adding brown sugar to their worts. Not all brewers subscribe to this line of thought, however.

"I would be very cautious and skeptical of chaptalizing with sugars of any kind for a traditional American or English style barleywine," Welch says. "For making strong Belgian style ales, absolutely, but for barleywine, I wouldn't think so. Part of the allure of barleywine is the rich viscosity of the liquid itself. Chaptalizing will create more alcohol and thin out the body, which is opposite of what I want in barleywine." ("Chaptalizing," in winemaking, is the adding of sugar to boost alcoholic content.)

The Right Yeast

Each of the five brewers in this article uses a different yeast strain for their barleywine, but all agree on one thing: the strain must be able to ferment to high alcohol levels, but also be tolerant of high alcohol environments. The environment that will be created quickly becomes toxic for yeast, and not all strains are up to the task.

"The type of yeast chosen for a barleywine is critically important," Zien says. "It must be able to handle a high alcohol environment and not poop out before final gravity is reached."

Dresler uses Sierra Nevada's house strain, of course, and homebrewers can use Wyeast 1056, White Labs WLP001 or Fermentis Safale US-05. Zien uses White Labs WLP001, California Ale yeast, while others recommend London Ale (WLP013 or Wyeast 1028), English Ale (WLP002 or Wyeast 1968) or Scottish Ale (WLP028 or Wyeast 1728) strains for the ability to properly attenuate in a high alcohol environment.

Pitch It High and Inside

With any beer, the proper pitch rate is essential. This is doubly true when creating a barleywine.

"Another thing absolutely crucial to making good barleywine is having lots of healthy yeast," Welch says.

All the brewers recommended creating a yeast starter with the highest cell count possible.

A 3–4 qt. (~3–4 L) yeast starter with a low OG — you're raising yeast at this point, so SG 1.020–1.030 is a good range to target — will help you raise the required amount of yeast and pitch them on brewing day. Aerate well and ferment on the warm end of ale temperatures (70–72 °F/21–22 °C). You can get by with a smaller starter if it is continually stirred.

"You really want to get that yeast up and running," Dresler adds. "It can make a big difference."

Welch agrees: "Part of the reason for having a very large initial pitch rate is so that the yeast can ferment the bulk of the fermentable sugar very quickly and efficiently. By doing so, you can prevent extended, lengthy fermentations that are likely to cause off-flavors from poor yeast health," he explains. "At the same time, you need to have enough active healthy yeast in the beer to actually finish the fermentation, and then reduce all of your diacetyl and alpha acetolactate (the precursor to diacetyl) to flavorless compounds. So as the beer is finishing, it is important to really pay attention to the fermentation on a daily basis, to assess the attenuation of the beer and ensure that it does not sit on dormant or dead yeast for any length of time. It would be very disappointing to put in all the work to brew a barleywine only to have it ruined by forgetful yeast management."

Dresler adds that a yeast nutrient can be a helpful addition.

"In a beer like this, it is not a bad idea," he says. "It puts the yeast on a more even playing field with the fermentation you're going to put it with."

Aeration

Aeration is also extremely important for yeast, and more so on a high alcohol playing field. There are several ways to get proper aeration, from shaking the carboy vigorously (only more than you might with a lower alcohol beer) to oxygenating with an oxygen cylinder and air stone. Either way, plenty of O_2, combined with a healthy pitching rate, will create a robust setting for the yeast to go to work and do the job properly.

"Just to get it going and that initial vigor, we aerate and saturate to the fullest," Dresler says. "The critical thing is that initial aeration to get that yeast going. Adding aeration is critical with a beer like this."

Time and Temperature

The general sentiment is that barleywine should be fermented at slightly cooler temperatures, between 65–68 °F (18–20 °C) to prevent the fermentation from running too fast and hot and potentially creating the off-flavors Welch mentions above and leaving the finished product with an alcoholic bite. Additionally, this will prevent the yeast from expiring too fast and allowing the beer to fully ferment out and get to the proper gravity.

"An uncontrolled, hot and fast fermentation is the wrong way to make a barleywine," Zien says. "The fusel alcohols need to be held in check to make the presence of alcohol smooth, enhancing and warming. You're going to want to choose a cool fermentation temperature, like mid-60s Fahrenheit (around 18 °C), in order to slow the yeast down."

Because the original gravity is so high, most barleywines finish out in about 6-7 days at the initial temperature, followed by a couple days at cooler temperatures. Dresler, for example, takes Bigfoot down to 60 °F (16 °C). Finally, some cold conditioning will help to clear the beer.

Secondary Fermentation

A secondary fermentation can make a big difference in a big beer. Some critical factors are achieving the desired attenuation, reducing unwanted off-flavors and avoiding yeast autolysis.

Most of the brewers concurred that 10 to 14 days in the secondary should be plenty. Taking the temperature down to 60 °F (16 °C) allows the surviving yeast to finish the job slowly, while avoiding the creation of off-flavors. You can also dry hop in secondary.

"I would say that as long as the secondary is at a low temperature, and the yeast doesn't autolyse, a nice long secondary would be great," Phillips says. "Every yeast is different, and if yours is prone to autolysis, I would keep it short."

"I recommend a two week secondary fermentation for an American-style barleywine," Zien adds. "This will give it time to soak up the hoppy goodness of the dry hops, as well as clean the beer of any remaining diacetyl produced during the primary fermentation."

Aging

Unlike a pale ale, barleywine is not drinkable in four to six weeks. Carbonation takes longer to develop, as do the complex flavors that make this beer so pleasurable. The alcoholic heat also subsides.

Simply put, this is a brew that gets better with age.

"As a young beer, the alcoholic warmth is more of a heat, and as the beer ages, the hotness dissipates into a pleasantly rounded warmth," Welch says.

Even the commercial products noted here are aged for several months at the very least. Arctic Devil is aged for one year in an oak barrel before being bottled.

"Age only seems to benefit this style of beer," Zien says concisely, noting his barleywines stored for a dozen years are "quite different than when originally released, but every bit as enjoyable!"

"Cool and dark is the way to go," Phillips says of storage techniques.

Of course, the best way to proceed at home is to wait as long as possible (at least three months), then open one. Decide what flavor profile you're after, and then decide if the beer is ready, or more time is warranted. If more time is needed, repeat process as necessary.

Johnson sums it up, "Great barleywines need time to age and develop. They also take time to brew. Anyone who thinks they can make a great barleywine in the same time it takes to make an IPA or hefeweizen is fooling themselves. Settle in for the long brew day and enjoy the experience. Then wait another several months to drink it. The wait is well worth it."

Turn the page for barleywine clone recipes from Sierra Nevada, Pelican Brewery, Phillips Brewery, AleSmith and Midnight Sun.

Sierra Nevada Bigfoot clone
(5 gallons/19 L, all-grain)
OG = 1.092 (23 °P) FG =1.023
IBU = 94 SRM = 19 ABV = 8.9%

Ingredients
17.25 lbs. (7.8 kg) pale malt
2.0 lbs. (0.91 kg) caramel malt (60 °L)
29 AAU Chinook hops (FWH)
 (2.4 oz./68 g of 12% alpha acids)
25 AAU Chinook hops (60 mins)
 (2.1 oz./60 g of 12% alpha acids)
9.5 AAU Cascade hops (0 mins)
 (1.9 oz./54 g of 5% alpha acids)
1.0 oz. (28 g) Cascade hops (whirlpool)
0.8 oz. (23 g) Centennial hops (whirlpool)
Wyeast 1056 (American Ale),
 White Labs WLP001 (California Ale)
 or Fermentis Safale US-05 yeast

Step by Step
Mash at 155 °F (68 °C). Collect enough wort for a 3-hour boil — likely between 6.5 gallons (25 L) and 8.0 gallons (30 L), depending on your evaporation rate. Boil for 3 hours, adding hops at times indicated. ("FWH" means first wort hops, hops added while the wort is running off.) Remove the previously added hops from the wort after adding the 0-minute addition. Add whirlpool hops 10 minutes after knockout and let wort sit for 45 minutes in the whirlpool before cooling. (Note: 5 gallons/19 L of wort will cool off much faster than a multi-barrel batch at Sierra Nevada. You may want to consider providing a tiny amount of heat during the whirlpool, just enough so the wort stays above 170 °F (77 °C) during the whirlpool. Alternatively, you can add the whirlpool hops at knockout instead.) Ferment at 68 °F (20 °C).

Sierra Nevada Bigfoot clone
(5 gallons/19 L, extract with grains)
OG = 1.093 (23 °P) FG = 1.023
IBU = 94 SRM = 20 ABV = 9.0%

Ingredients
2.0 lbs. (0.91 kg) pale malt
2.0 lbs. (0.91 kg) caramel malt (60 °L)
3.5 lbs. (1.6 kg) Briess Light dried
 malt extract
6.6 lbs. (3.0 kg) Briess Light liquid malt
 extract (late addition)
29 AAU Chinook hops (FWH)
 (2.4 oz./68 g of 12% alpha acids)
25 AAU Chinook hops (60 mins)
 (2.1 oz./60 g of 12% alpha acids)
9.5 AAU Cascade hops (0 mins)
 (1.9 oz./54 g of 5% alpha acids)
1.0 oz. (28 g) Cascade hops (whirlpool)
0.8 oz. (23 g) Centennial hops (whirlpool)
Wyeast 1056 (American Ale), White Labs
 WLP001 (California Ale) or
 Fermentis Safale US-05 yeast

Step by Step
Place crushed grains in a large steeping bag (or partial mash mash tun) and steep them at 155 °F (68 °C) for 45 minutes in 5.5 qts. (5.2 L) of liquid. Rinse grains with 5.5 qts. (5.2 L) of water at 170 °F (77 °C). Add water to make at least 4.0 gallons (15 L), add first wort hops (FWH), stir in dried malt extract and bring wort to a boil. Once boiling, add bittering hops and boil for 60 minutes. Stir in liquid malt extract for final 5 minutes of the boil. Add remaining hops at 0 minutes (or see all-grain recipe for whirlpool instructions). Cool wort and transfer to fermenter. Top wort up to 5.0 gallons (19 L), if needed, and aerate. Pitch yeast and ferment at 68 °F (20 °C).

Pelican Brewery Stormwatcher's Winterfest clone
(5 gallons/19 L, all-grain)
OG = 1.129 (32 °P)
FG =1.026 (6.5 °P)
IBU = 31 SRM = 40 ABV = 13%

Ingredients
15 lb. 9 oz. (7.1 kg) Golden Promise
 pale malt
7 lb. 7 oz. (3.4 kg) Munich malt
1 lb. 11 oz. (0.75 kg) melanoidin
 malt
1 lb. 15 oz. (0.88 kg) caramel
 malt blend
 (Pelican uses a blend of four different caramel malts, ranging from 15 to 120 °L — pick four that cover this range and add roughly 0.5 lb. (0.23 kg) of each)
1.0 lbs. (0.45 kg) torrefied wheat
6.0 AAU Magnum hops (60 mins)
 (0.50 oz./14 g of 12% alpha acids)
5.6 AAU Goldings hops (30 mins)
 (1.4 oz./40 g of 4% alpha acids)
2.6 oz. (75 g) Hersbrucker hops
 (whirlpool)
0.88 oz. (25 g) Goldings hops
 (whirlpool)
Wyeast 1968 (London ESB) or White
 Labs WLP002 (English Ale) yeast

Step by Step
Mash at 138 °F (59 °C) for 90 minutes with a liquor-to-grist ratio of 2.4 to 1. Collect sweet wort until run-off extract is about 10 °Plato (SG 1.040). Below that and you are adding too much water (which you are going to have to boil away). Typical boil times for Stormwatcher's are 4 hours, with an overall evaporation rate of about 35%.

Bittering hops (Magnum) are added 60 minutes before boil stop. Flavoring hops (Golding) are added 30 minutes before boil stop. Whirlpool hops (Hersbrucker and Goldings) are added at boil stop. (Fuggles and Mt. Hoods also will work nicely for this beer.)

Oxygenate as much as possible after chilling wort, and pitch yeast at a rate of about 50–60 million cells per milliliter. Ferment at 65–66 °F (18–19 °C) until complete (at 80% apparent attenuation). Remove finishing beer from yeast after first week to ward off autolysis. When finished, carbonate to 2.5 volumes of CO_2.

This beer should continue to mature and evolve for months and years.

Pelican Brewery Stormwatcher's Winterfest clone
(5 gallons/19 L, extract with grains)
OG = 1.126 (32 °P)
FG =1.025 (6.5 °P)
IBU = 31 SRM = 40+ ABV = 13%

Ingredients
1 lb. 11 oz. (0.75 kg) melanoidin
 malt
1 lb. 15 oz. (0.88 kg) caramel
 malt blend
 (See note in all-grain ingredients)
8.5 lbs. (3.9 kg) Coopers Light dried
 malt extract
5.0 lbs. (2.3 kg) Briess liquid Munich
 malt extract (late addition)
6.0 AAU Magnum hops (60 mins)
 (0.50 oz./14 g of 12% alpha acids)
5.6 AAU Goldings hops (30 mins)
 (1.4 oz./40 g of 4% alpha acids)
2.6 oz. (74 g) Hersbrucker hops
 (whirlpool)
0.88 oz. (25 g) Goldings hops
 (whirlpool)
Wyeast 1968 (London ESB) or White
 Labs WLP002 (English Ale) yeast

Step by Step
Place crushed grains in a large steeping bag (or partial mash mash tun) and

CLONE RECIPES

steep them at 148 °F (64 °C) for 45 minutes in 5.0 qts. (4.7 L) of liquid. Rinse grains with 5.0 qts. (4.7 L) of water at 170 °F (77 °C). Add water to the "grain tea" to make at least 4.0 gallons (15 L). Stir in dried malt extract and bring wort to a boil. Once boiling, add bittering hops and boil for 60 minutes. Add remaining hops at times indicated. Stir Munich malt extract into wort during the final 5 minutes of the boil. Cool wort and transfer to fermenter. Top wort up to 5.0 gallons (19 L), if needed, and aerate well. Pitch yeast and ferment at 65–66 °F (18–19 °C).

Phillips Brewery Burley Wine clone
(5 gallons/19 L, all-grain)

OG = 1.085 (21 °P)
FG = 1.013 (3.2 °P)
IBU = 18 SRM = 25 ABV = 9.2%

Ingredients

16.5 lbs. (7.5 kg) pale malt
1 lb. 3 oz. (538 g) crystal malt
3.5 oz. (100 g) chocolate malt
3.5 AAU Cascade hops (90 mis)
(0.71 oz./20 g of 5% alpha acids)
4.4 AAU Cascade hops (10 mins)
(0.88 oz./25 g of 5% alpha acids)
Wyeast 1028 (London Ale) or White Labs WLP013 (London Ale) yeast

Step by Step

Mash at 156 °F (69 °C) for 1 hour, and collect enough wort for a 90-minute boil. Boil wort for 90 minutes, adding hops at times indicated. Phillips instructs brewers to "Oxygenate the hell out of it." (Indeed, to get the high degree of attenuation the brewery gets, a second shot of oxygen right before high kräusen might be a good thing. Adding yeast nutrients might not be a bad idea, either.) Ferment at 70 °F (21 °C).

Phillips Brewery Burley Wine clone
(5 gallons/19 L, extract with grains)

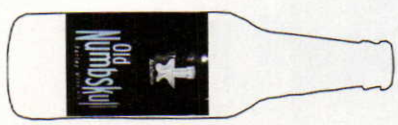
OG = 1.085 (21 °P) FG =1.013 (3.2 °P)
IBU = 18 SRM = 26 ABV = 9.3%

Ingredients

1 lb. 3 oz. (538 g) crystal malt
3.5 oz. (100 g) chocolate malt
3.5 lbs. (1.6 kg) Muntons Light dried malt extract
6.6 lbs. (2.3 kg) Muntons Light liquid malt extract (late addition)
3.5 AAU Cascade hops (90 mis)
(0.71 oz./20 g of 5% alpha acids)
4.4 AAU Cascade hops (10 mins)
(0.88 oz./25 g of 5% alpha acids)
Wyeast 1028 (London Ale) or White Labs WLP013 (London Ale) yeast

Step by Step

Steep crushed grains at 156 °F (69 °C) for 45 minutes in 3.3 qts. (3.2 L) of liquid. Rinse grains with 3.3 qts. (3.2 L) of water at 170 °F (77 °C). Add water to the "grain tea" to make at least 4.0 gallons (15 L). Stir in dried malt extract and bring wort to a boil. Once boiling, add bittering hops and boil for 90 minutes. Add remaining hops at times indicated. Stir liquid malt extract into wort during the final 5 minutes of the boil. Cool wort and transfer to fermenter. Top wort up to 5.0 gallons (19 L), if needed, and aerate well. Pitch yeast and ferment at 70 °F (21 °C).



AleSmith Old Numbskull clone
(5 gallons/19 L, all-grain)

OG = 1.102 FG =1.017
IBU = 90 SRM = 15 ABV = 11%

Ingredients

16 lb. 13 oz. (7.6 kg) Gambrinus pale 2-row malt
16.3 oz. (0.46 kg) C & H medium brown sugar
9.8 oz. (0.28 kg) Munich dark malt
6.5 oz. (0.19 kg) Crisp crystal malt (45 °L)
4.9 oz. (0.14 kg) Crisp CaraMalt malt
4.9 oz. (0.14 kg) Gambrinus Honey malt
4.9 oz. (0.14 kg) Simpsons CaraMalt malt
4.9 oz. (0.14 kg) CaraMalt Light malt
4.9 oz. (0.14 kg) flaked barley
16 AAU Chinook hops (FWH)
(1.5 oz./42 g of 11% alpha acids)
15 AAU Columbus hops (FWH)
(1.1 oz./31 g of 14% alpha acids)
9.8 AAU Warrior hops (FWH)
(0.65 oz./18 g of 15% alpha acids)
2.3 AAU Simcoe hops (30 min)
(0.19 oz./5.4 g of 12% alpha acids)
1.1 AAU Chinook hops (15 min)
(0.1 oz./2.8 g of 11% alpha acids)
0.6 AAU Cascade hops (5 min)
(0.1 oz./2.8 g of 6% alpha acids)
1.7 AAU Palisade hops (2 min)
(0.28 oz./7.8 g of 6% alpha acids)
1.0 oz. (28 g) Amarillo hops (dry hop)
1.0 oz. (28 g) Columbus hops (dry hop)
1.0 oz. (28 g) Chinook hops (dry hop)
1.0 oz. (28 g) Simcoe hops (dry hop)
1.0 oz. (28 g) Palisade hops (dry hop)
1.0 oz. (28 g) Warrior hops (dry hop)
White Labs WLP001 (California Ale), Wyeast 1056 (American Ale), or Fermentis Safale US-05 yeast

Step by Step

Mash at 150 °F (66 °C). Boil for 90 minutes. Chill wort, aerate very well and pitch a lot of healthy yeast. Ferment at 65–68 °F (18–20 °C).

Extract with grains options:

Omit flaked maize. Reduce pale malt to 1.0 lb. (0.45 kg). Add 8.66 lbs. (3.9 kg) of light dried malt extract. Steep grains at 150 °F (66 °C). Boil at least 4.0 gallons (15 L) of wort. Reserve roughly half of the malt extract until 5 minutes before the end of the boil.

Midnight Sun Arctic Devil Barleywine clone
(5 gallons/19 L, all-grain)

OG = 1.124 FG =1.032
IBU = 40 SRM = 51 ABV = 12%

Ingredients

22 lbs. (10 kg) Maris Otter pale malt
1 lb. 1 oz. (0.48 kg) crystal malt (120 °L)
6.1 oz. (0.17 kg) Cara-munich
15 oz. (0.43 kg) brown sugar
8.5 AAU Fuggles hops (60 mins)
(1.7 oz./48 g of 5% alpha acids)
6.9 AAU Challenger hops (30 mins)
(0.92 oz./26 g of 7.5% alpha acids)
0.92 oz. (26 g) Fuggles hops (0 mins)
0.15 oz. (4.3 g) Challenger hops (0 mins)
10 oz. (0.28 kg) Fuggles hops (dry hops)
Wyeast 1728 (Scottish Ale) or White Labs WLP028 (Edinburgh Scottish Ale) yeast

Step by Step

Mash at 148 °F (64 °C) for 60 minutes. Collect enough wort for a 3.5-hour boil. Ferment at 68 °F (20 °C) until finished, then transfer the beer onto dry hops for ten days. Age in barrels for 10–12 months. Carbonate to 2.4 volumes CO_2. BYO

Photo by Charles A. Parker/Images Plus

Stepping up to kegging greatly reduces the amount of work it takes to package your homebrew. Kegs are also a near perfect vessel for beer storage — they shield your beer from light and can be pressurized to achieve exactly the level of carbonation you desire.

KEG IT!

The Convenience and Coolness of Kegging

Story by **Andy Sparks**

I DON'T THINK I had finished bottling my first batch of homebrew when I realized that my least favorite part of my new passion was messing with all those bottles. As with most new homebrewers, I was eager to pinch pennies any place I could. I went to the local pool hall where they only sold beer in long neck returnable bottles. The cool thing was that they only charged me $0.05 per bottle for the deposit. Wow, a case of bottles in a nice box for only $1.20, it seemed like a great way to save money. Well after washing out the cigarette butts and removing the labels from the bottles, I started thinking I just might not be saving so much after all.

Pros and Cons of Kegging

I think I had only bottled about three batches before I decided that I really liked the idea of having only one bottle to wash for each batch of beer, one really big stainless bottle. The pros of kegging seemed obvious to me. The ease of cleanup was great, but the ability to artificially carbonate my beers virtually overnight was the clincher for me. Another benefit is the ability to use a counter-pressure bottle filler to fill a few bottles (for homebrew contests or to give to friends) from the keg. Counter-pressure bottling results in sediment-free bottles of homebrew. (You can read more about counter-pressure bottling in the December 2008 issue of *BYO*. A 2002 story on this technique can be found at: http://www.byo.com/component/resource/article/509-counter-pressure-bottling-techniques).

I really didn't stop to consider the cons of jumping into kegging my home-

MINI-KEGS
The space-saving alternative

The Party Pig (top) holds half a normal 5-gallon (19-L) batch, and the Tap-A-Draft (bottom) holds 6 liters, so you will need mulitiple units if you want to keg a full batch of homebrew.

A 5.0-gallon (19-L) kegging setup is great if you have the space. Five gallons (19 L) is the volume of most homebrew recipes and carboys and other pieces of homebrewing equipment are often scaled to this size batch.

However, not everyone has the luxury of enough space to use a "full" kegging system. If you need your fridge space for food and don't have the space for a dedicated beer fridge, you need a different kegging solution.

Mini-kegs are an option for homebrewers looking to avoid bottling, but who don't have the space for a full kegging system. There are a few different types of mini-kegs on the market today with the most popular being the Party Pig from Quoin and the Tap-A-Draft from Sturman BG. Both systems use large PET plastic bottles to hold their contents and hold a smaller amount of beer than a full-sized 5-gallon (19-L) batch, but that is about all they have in common with each other.

The Party Pig uses priming sugar to achieve natural carbonation in the pig along with a single use plastic pressurization pouch. After giving the pig a week or so to carbonate you activate the pouch inside to create pressure in the pig and force the beer out.

To activate the disposable pressure pouch you insert a hose into the beer faucet and using a small hand pump force air into the pig increasing the pressure inside until the pressure pouch activates. As the pouch inside expands it takes up the extra space as beer is consumed keeping the beer from going flat and forcing it out of the faucet. As far as I can tell there is no way to force carbonate in a Party Pig but if you have carbonated beer in a keg you could use that to fill a Pig which would be a great way to take a couple gallons of homebrew to a party.

I have also found that if you let the beer in the pig sit for too long without drinking it, the pressure can build up inside the Pig to the point at which it can be difficult to depress the button on the faucet. If this ever happens to you, don't keep pushing on the button and take it outside. When the button does depress the beer will be coming out in a hurry and can cause a mess.

The Tap-A-Draft, or as its fans call it TAD, is a more recent entrant into the mini-keg market. The Tap-A-Draft now comes with a 6-liter PET plastic bottle so it also will not handle a full size batch. Tap-A-Draft does allow the homebrewer the choice of natural carbonation or forced carbonation through the use of small, disposable, CO_2 cartridges.

The manufacturer claims that it only takes two of these cartridges to dispense a whole bottle, if you plan on force carbonation you will probably need more. It also makes a great way to take beer you have in a Corny keg to a party, just fill it up and grab a couple CO_2 cartridges and go.

brew. As far as I was concerned "there were no stinkin' cons." The cons turned out to be manageable, but really should be considered before buying your system. The main negative, besides the total expense of getting set up, would be the size of the kegs and the requirement that you refrigerate and serve from them standing upright. The most common 5.0-gallon (19-L) keg will fit in most refrigerators only after most of the shelves have been removed. Also, having draft beer on hand will require a certain amount of maintenance and cleaning of your draft equipment to keep everything operating smoothly. As far as I'm concerned, this is by far the most common problem with draft systems, homebrew or commercial — the lack of regular and thorough cleaning of the system. Luckily, draft line cleaning is easily mastered (and I will cover it later).

The reason that I love having homebrew on tap is because you can pour as much or as little as you like. Unlike with bottles, with a keg you are not committed to finishing another 12 or 22 ounces (354 or 650 mL) — and who doesn't have time for another half glass of homebrewed goodness? Also, showing up at a party with a 5.0-gallon (19-L) keg of killer homebrew is a great way to make new friends!

Basic Kegging Setup

After a little deliberation, I placed my order for a homebrew kegging setup from my local homebrew shop. My setup was pretty typical. It came with one used, but reconditioned, "Corny" soda syrup keg, a 10 lb. (4.5 kg) CO_2 tank, a dual gauge CO_2 regulator, quick disconnects for both gas and liquid, a plastic spigot and all the needed hoses and clamps. I thought it was strange that they called these soda syrup kegs Cornies, but it turns out that the Cornelius Company was one of the main manufacturers of these and so they have picked up this nickname over time. (The kegs are also manufactured by a couple other companies, namely Firestone and Spartanburg.)

This is important because not all the parts from the different manufacturers are interchangeable. As such, whenever you disassemble more than one keg, be sure you know which parts belong to which keg.

Five-gallon (19-L) kegs are by far the most common size, but 3.0-gallon (11-L) and 10-gallon (38-L) versions can sometimes be found. (Even rarer are the 2.0-gallon (7.6-L), 2.5-gallon (9.5-L) and 15-gallon (57- L) varieties.)

I chose to go with the dual gauge regulator mainly because I figured two gauges must be better than one. With a dual gauge regulator, you have a gauge to display both the CO_2 tank's pressure and the pressure being applied to the keg. The pressure on the keg side is what we are most concerned with and is very low compared with the pressure in the tank. The high pressure gauge holds steady at around 800 PSI (at room temperature) as long as there is gas in the tank. Once this gauge starts dropping, you are out of gas.

Your gauge set should come with a special washer that fits between the gauge and the CO_2 tank. You should not use any type of thread tape on this connection and use the washer provided to ensure a proper seal. Most regulators today come with a ball valve for attaching the hose that will run to the gas side of your keg. This is convenient because you will want to occasionally shut off the gas to a keg without disconnecting it from your system. Most systems also include something called a check valve or a back flow preventer. These devices prevent beer from flowing back up the gas line and into your gauge. This may not seem like much of an issue, but when we talk about force carbonating later, you will see that it can be surprisingly easy to do.

The quick disconnects you get will depend on what style of keg you have or the kind that come with your setup. They basically come in two different styles, ball lock and pin lock. The difference has to do with the type of connection posts at the top of the keg. These connection posts are used to connect the gas and the beer line to the keg. Because these kegs were originally made to hold soda syrup, the soda companies did not want their customers to be able to switch between the two brands so they made the connections incompatible with each other. It should also be noted that because the soda companies no longer use these kegs for syrup, the supply of these "used" kegs is unpredictable. Because homebrewers tend to prefer the ball lock style, those are becoming increasingly more expensive.

The type of quick disconnects I received with my setup was the ball lock style, but both types work just fine. Recently I have seen new universal ball lock replacement posts for pin lock kegs that might be useful if you really want to avoid the pin lock style. These look interesting with the only issue being that they are made of aluminum and might be harmed by the caustic nature of draft cleaning chemicals. As long as they are not soaked in caustic, I'm guessing they would be fine. Both ball lock and pin lock quick disconnects are easily disassembled by unscrewing the top of the valve with a large screwdriver. They should be disassembled and cleaned regularly to keep them fresh and clean.

The faucet I received is sometimes referred to as a picnic or cobra tap. It is usually made of black plastic and has a small lever on top. As inexpensive as these simple faucets are, they are surprisingly good for serving draft beer. They are super easy to clean and use. To take them apart, you only need to unscrew the top and pull it apart. To use them just press the lever with your thumb. As with all beer faucets, you should always open it fully to keep the beer from spraying into the glass and creating a bunch of foam. These faucets can also be locked in the open position by rocking the lever forward which is nice for cleaning and flushing.

The CO_2 tank I received was a 10 lb. (4.5 kg) tank and that is a nice size to have. It is a nice balance between portability and volume of gas. You can find tanks that are smaller, such as 2.5 lb. (1.1 kg) and 5.0 lb. (2.3 kg) tanks — and these are nice and portable — but are top heavy when you get your gauges attached and they don't hold much gas.

The posts on these kegs, here covered with white and blue caps, are where the gas enters and beer leaves the kegs. You can see the pressure relief valves in the middle of the lids.

You can also get larger CO_2 tanks like 20 lbs. (9.1 kg) and above, but these can be very heavy and hard to move, but they last a long time. I get my CO_2 refilled at a local welding supply company. They let me trade my empty for a full tank instead of refilling my tank. That is pretty normal, so don't get too attached to the shiny new tank that came with your setup.

The kegging system described here will allow you to dispense beer pushed with CO_2. If you would like to serve beers, such as dry stouts, pushed by "beer gas" — a mixture of nitrogen and CO_2 — you will need an entirely separate set of equipment. Beer gas, sometimes called Guinness gas, comes in a different cylinder and requires a different regulator (because the pressure in the cylinder is different). In addition, most nitrogen systems use special faucets to enhance the pour. (To set up a nitrogen pour kegging system, see the December 2008 issue of *BYO*.)

Anatomy of a Keg

The basic anatomy of a Corny keg is pretty much the same for both styles of kegs. There will be the keg body, made of stainless steel. Most kegs come with rubber handles on the top, but some have metal handles. On top of the keg will be the two connection posts and an oval shaped lid that is held on with a clamping mechanism. The lid usually has a pressure relief valve in the middle and uses a large rubber O-ring to seal. Look for lids that don't have any bends or dents in them.

A small dent on the edge of the lid can make it difficult to get it to seal well. The two posts on top of the keg will be where you connect the gas and beer lines. While these posts look identical, they are not and are not interchangeable. The post for the gas is usually marked with the word "IN" near it, and at least for ball lock style kegs, its quick disconnect is usually colored gray. The post for liquid, in our case beer, is usually marked with the word "OUT" and often the quick disconnect for this side is black. "Grey is for gas, black is for beer" is an easy way to remember this, but this does not work as well for pin lock style kegs. For pin lock style kegs it is a bit easier because they use small pins protruding out from the post to latch onto. The gas post has two pins and the liquid side has three pins so it is obvious that they are different and cannot be connected incorrectly.

Used Kegs and Cleaning

My experience has been that the folks that wholesale reconditioned kegs to homebrew shops have wildly different ideas of what "reconditioned" means. For some, "reconditioned" means checking, testing and replacing all the rubber parts. For others it means they just dumped out the contents and pressure tested the keg. (For step by step instructions on how to refurbish a used keg, see page 63 of this issue.)

Once a keg is refurbished, or if you buy a new keg, it will still need to be taken apart and cleaned before each use. (The article on page 63 explains keg disassembly.) One helpful hint to ensure that the keg holds pressure when you reassemble it is to use keg lube. Keg lube is basically food grade grease used to lubricate the rubber parts of your draft system. Rub a tiny amount on the O-rings — especially the big ring on the lid — and this will seal off any microscopic links. It does not affect the flavor or head retention of your beer. This stuff goes a long way and one tube will last most homebrewers a lifetime.

Carbonating Beer

When it comes time to carbonate your beer, you can do that a few different ways. It is possible to naturally carbonate your beer in kegs just like you did when bottling beer. Some folks do prefer this method of carbonation but many prefer to force carbonate their beer as soon as it is good and clear. If you do want to naturally carbonate your beer, you might consider cutting off the last half inch (1.3 cm) of your liquid dip tub. This will help reduce how much yeast sediment is drawn into the tube and after the first glass or so you should not see much yeast being drawn up the draft line.

If you choose to force carbonate your beer, you can go about that a couple basic ways. I have also seen people use hybrid versions that combine both ways. For lack of an official name, I will call the first the "Crank-N-Shake" method and the second the "Set-N-Wait" method. Before we jump into the differences between the two methods, we need to talk a little about how CO_2 and water react together.

Carbon Dioxide is interesting stuff in that it can be dissolved into liquid. This gives us the delightful sparkle we all know and love. The thing is that the amount of CO_2 that can be dissolved into liquid is related to the temperature of the liquid (beer in our case). The key thing to remember is that the colder the solution, the more CO_2 it can hold. For this reason, the first step to force carbonating your beer is to get it good and cold. You can do this by placing your carboy in the refrigerator the night before or you can transfer your clear beer to a clean and sanitized keg and refrigerate that overnight. It is a good practice to squirt a little CO_2 into your empty keg before starting to transfer your beer into it to help reduce any oxidation in the final product.

To make this and the process of carbonation go as smoothly as possible, I like to add a small plastic "T" at end of my tubing. Off of each side of this "T" I attach two quick disconnects, one gas disconnect and also a beer disconnect. This way, when I want to direct CO_2 to the very bottom of the keg as in flushing or force carbonating I can attach the gas line onto the normal liquid post and force CO_2 down the liquid dip tube.

Once your beer is chilled to serving temperature and is transferred to your keg, you are ready to get started.

Crank-N-Shake Method

The "Crank-N-Shake" method is named because you basically crank up the pressure and shake the CO_2 into solution. If you choose to use the "Crank-N-Shake" method, attach your keg to the gas and turn the pressure on your regulator up to about 20 PSI. Some use higher pressure, but I really don't think that is necessary. Before you start, make sure your CO_2 tank is secure and will not get pulled over as you start to rock your keg back and forth. As you start to rock the keg you will hear the CO_2 rush into the keg. As more and more CO_2 is dissolved into your beer, less CO_2 will rush in to take its place. If you keep shaking the keg, it will soon reach equilibrium and this sound of hissing gas will stop. Rock the keg for awhile, I find that about the time I'm getting sick of rocking it is about right, but shoot for about 10 minutes of gentle rocking. Now you have a big can of shaken beer, so now is not the time to pour a sample. Place the keg back into the refrigerator and let it settle down. I usually let it sit overnight before giving it a try. If it needs a little more carbonation, you can take it out and shake it some more, but be careful because it is easy to overdo it. If you do over carbonate, you can reduce the level by unhooking it from the gas and repeatedly venting the pressure using the pressure relief value in the lid.

One valid criticism of the Crank-N-Shake method is that you have no idea how much CO_2 you are dissolving into the beer, and for most beer styles you want a specific amount. With trial and error, you can learn to get close to your carbonation goals; but if you want to hit a specific goal, the Set-N-Wait method is much better.

The Set-N-Wait Method

The "Set-N-Wait" method involves hooking the keg up to the gas at normal serving pressure, for me about 12 PSI, and letting it sit. It will reach the correct level of carbonation in two or three days. This is basically what the "Set-N-Wait" method is, because we know how much CO_2 can be held in solution at a given temperature, we can simply set the pressure to the correct level and just wait for the CO_2 to dissolve. Depending on how much fizz you want in your beer, and how much is appropriate for the style, you can adjust the total volumes of CO_2 you dissolve into your beer. There are several sources on the internet for looking up the correct pressure to set your regulator to, based on what temperature your beer will be while it sits under pressure. However, because most homebrew is stored at refrigerator temperature (38–40 °F/3.3–4.4 °C) and most "regular" beers are served at between 2.0 and 2.5 volumes of CO_2, a simple rule of thumb can be given — set your regulator to between 8 and 12 PSI, let the beer carbonate and adjust the pressure later if you want more or less fizz. (If you want to serve British-style ales at cellar temperature (around 52 °F/11 °C) with 1.8 to 2.0 volumes of CO_2, you will need to use an external thermostat on your beer fridge to set the temperature. At this temperature, set the gauge pressure to 8 to 12 PSI and you will get this lower level of carbonation.

This is by far the easiest carbonation method and I find that, for most of my beers, simply getting them chilled to serving temperature and putting them on gas at serving pressure will result in a nearly perfectly carbonated beer in about a week.

It is important to remember that if you accidentally have your gas line hooked up to your liquid post (an easy mistake to make), you set up a situation where beer can flow up the gas line and potentially into the gauge if not protected by a check valve. Even if you have a check valve, you still don't want beer up in your gas line that you will need to clean out. So be careful.

I have both a kegerator and a large three door commercial refrigerator that I use to hold my kegs. The kegerator is nice and has two chrome faucets on a stainless tower that sticks up from the middle. Faucets on a kegerator like this are exposed to room temperature and allow some beer to dry in them between uses. This means they require regular cleanings to keep them fresh. A sour faucet will ruin every beer poured from it. Contamination from a faucet can make its way back down the draft line and into the keg if allowed to go on long enough. The entire bottom of the three door refrigerator is dedicated to kegs. In there I use the picnic taps exclusively and they work great. Because they stay inside the refrigerator with the keg, they stay just as cold as the beer. They seem to stay fresher longer and are easy and quick to clean out if needed.

Cleaning Your Lines

Cleaning your draft equipment is vitally important to serving fresh tasting beer. I personally use a product called Beer Line Cleaner that is made specifically to clean draft lines. This stuff is pretty strong, so you should be extra careful when using it. A little common sense goes a long way here; always follow the manufacturer's mixing and usage instructions. I have heard of others using other products to clean draft lines, but I really like using the stuff that is made to professionally clean draft lines.

My process is pretty simple; I mix up about a gallon (~ 4 L) of beer line cleaner and place it in the bottom of my dirty keg. I put the top back on, shake and roll the keg around for a minute or two, working it around good in the keg. After that I hook up the gas to the "IN" post and hook up a faucet to the "OUT" side. Turn the pressure up enough to push the cleaning solution out of the faucet.

I like to collect this in another keg or bucket for reuse if I have more than one keg to clean at a time. I usually don't rush this process; I let out about a cup and then let it sit for a few minutes before draining some more. I really like to have the cleaner stand in the lines for awhile to allow it to break down any gunk or beer stone in the line. As I mentioned, the cleaner is really strong so letting it stand in the lines for a long time or even overnight is not recommended. I repeat this process until the entire gallon (4 L) has been pushed through the system.

Pushing this volume of cleaner through the lines does a great job of cleaning the lines, but leaves them full of beer line cleaner. The next step is to flush this from the lines. For this you can use plain water, but I prefer to use a mild acid-based sanitizer, like Star-San or Sani-Clean to neutralize and rinse the residual cleaner from the lines and leave them packed with sanitizer. Once again, put the sanitizer in the keg, close it and shake the solution around to coat the inside of the keg. Then push the sanitizer out with CO_2 pressure — when the pressure blows, it will leave sanitizer foam in the lines.

Dispensing Beer

Now that your beer is all carbonated in your kegs, there is only one thing left to do — pour some beer! Don't be discouraged if the first glass you pour is all foam. Foaming can be caused by several factors, one of which is dirty draft lines, but we will assume that since you just rebuilt your kegs and taps that will not be the problem. To completely understand the relationships between gas pressure, temperature, tap height and the diameter and resistance of the draft line can be quite complicated. (You can read about all these details and how to balance your draft system in the January-February 2006 issue of *BYO*).

However, because most homebrew is stored at the roughly the same pressure and dispensed at roughly the same height, most homebrewers find that beer pushed through 3.5 to 4.5 feet (1.1 to 1.4 m) of 3/16 ID tubing yields a good pour.

For the most part, if problems with foaming do arise, they can be resolved with the following technique. First, turn the pressure on the regulator down to around 2 or 3 PSI, then shut off the gas to the keg in question at the ball valve. Then, using the pressure relief valve, vent almost all the pressure from the keg. At this point, try to dispense a beer. Almost no beer should be coming out, maybe just a trickle. Then open the ball valve and check the pour again. The idea here is to gently sneak up on the proper serving pressure for your setup. Keep turning up the pressure until you get a nice foam-free pour. For my system, I find that about 12 PSI works great. Occasionally I find, especially on new full kegs, that I can't push with that much force and must turn it down to get it to pour nicely.

Bottles still have their place in my brewery, but for most beers I can't even imagine having to wash all those bottles, let alone having to hunch over the bottles and slowly fill every single one, yuck! I know for me I will be kegging my next batch! BYO

Andy Sparks described how to build a hop trellis in the March-April 2009 issue of Brew Your Own.

AN EARLY EGYPTIAN RECREATION

TUTANKHAMUN ALE

Back in 1996, the London department store Harrods sold 1,000 bottles of a special reconstruction of an ancient Egyptian beer for £50. This is approximately $75 at today's exchange rate — and remember this was before Sam Adams released Utopias. The story of this beer starts with some archaeologists and an electron microscope, and ends up at Scottish Newcastle Brewery, but there's some brewing history to consider first.

It is widely accepted that beer was first produced by the Sumerians somewhere around 6,000 to 8,000 years ago. Evidence from the "Hymn to Ninkasi," written around 3,800 years ago, suggests that a twice-baked bread — or "bappir," made from barley, roasted barley, malted barley and honey — was used as a source of fermentables. This was mashed along with pale malt, and dates were also used. (In 1989, Anchor Brewing produced a version of this beer that they called Ninkasi. See also the *BYO* story, "Archaeobeers," in the September 2007 issue.)

There is some evidence that beer was brewed in Egypt in the "Pre-Dynastic Era" (5500–3100 B.C.), that is before the Pharaohs. The exact timing of this is not clear, so it is probable that brewing technology came to Egypt from Mesopotamia. In any case, at least by the time of the Pharaohs (3050 – 330 B.C.) beer-drinking had become an integral part of life for everyone, including the Pharaohs, who often had their own royal breweries. Until the 1990's Egyptologists were generally of the opinion that it was brewed in a similar manner to the previously mentioned Sumerian beer. An often quoted additional source of fermentables was honey, because, like dates, it was known to be widely available in Egypt.

This all raises some questions, including what was the strength of the beer or beers produced in this way? How much of the grain starch would have been hydrolyzed to fermentable sugars, especially if it had not been malted? Was it drunk as a sort of mildly alcoholic porridge? Could the mash have been left long enough for the starch to have degraded to sugars? Or were most of the fermentables supplied by adding a large proportion of honey or dates?

Barry Kemp of Cambridge University came up with some of the answers. He was field director of a dig at the ancient Worker's Village of Amarna, built by Akhen-aten in 1350 B.C. and destroyed by Tutankhamun just seventeen years later. What Barry Kemp's team found was several breweries, including the royal brewery, and he got in touch with Jim Merrington of Scottish and Newcastle Breweries in Britain, who was no stranger to Egypt. It is often difficult, even impossible, in archaeological digs to find food residues because of the rot and decay which occurs over such a long time period. But, in this case the Egyptian atmosphere was so dry that traces of bread, grain and beer residues were found in the breweries at Amarna. Dr. Delwen Samuel, also of Cambridge University, and an archaeobotanist was responsible for attempts to identify these residues.

Dr. Samuel used both optical and scanning electron microscopy for this purpose, and came up with some very interesting results. First, the grain could be either barley, or emmer, an early form of wheat; these grains were usually used separately and not as a mixture. Second, there was evi-

Story by **Terry Foster**

dence that the grain in both bread and beer residues had been malted, and may have been heated while still wet, bringing about some gelatinization of the starch. Third, dates were not used at Amarna. Dr. Samuel believes that the assumption that dates were widely used in ancient Egypt was because a hieroglyphic seen in recipes was translated as "dates," when all it meant was "sweetness" derived from the malt. She found no evidence that other kinds of flavorings were used in the beer. Fourth, the wet malt was sieved to remove the grain hulls, and not for filtering crumbled bread as had been previously assumed.

Dr. Samuel proposed a brewing scheme where one part of grain was malted and ground then mixed with cold water. A further part of grain, which could be either malted or unmalted, was ground and mixed with hot water, and well heated. The hot and cold mashes were then mixed and let stand for an unspecified time, after which the mixture was sieved, and fermentation was carried out. Obviously, questions still remain about the extent of starch conversion, and the source of yeast, but this is somewhat closer to modern brewing procedures than the traditional view.

That might have been the end of it, except that this archaeological team wanted to go one step further and actually brew a beer along these lines. And that is where Scottish and Newcastle came in. Their team went to Egypt, studied the dig and Dr. Samuel's findings and set to work. They analyzed water from the wells around Amarna and decided only a little gypsum addition would be needed for brewing. It was also decided that they would use emmer, which raised a problem because that's a very scarce grain these days. It is still grown in Turkey, so they imported enough seeds for the National Institute of Agriculture and Botany in Cambridge to grow 770 lb. (350 kg). This was then malted at Moray Firth Maltings in Scotland, and all was set, except for the details of the recipe.

It was decided that they would shoot for a 6% ABV beer, which would be flavored with coriander and juniper. Coriander grew widely in ancient Egypt and was known to have been used there in baking; the reasoning behind adding juniper appears less sound. Mashing and boiling would be along more modern lines in the pilot plant brewery at Scottish and Newcastles at its Fountain Brewery in Edinburgh. A fast-fermenting "modern" yeast strain, selected from the National Yeast Collection was to be used. According to one source (which I have not been able to verify) the grain was moistened and ground in a pestle and mortar, which took 14 hours! The same source stated fermentation was carried out in one-gallon jars. Another source stated that the emmer was ground in the pilot plant, which could be run only at one-tenth of its normal speed because the grain was so hard.

> **"This beer was specially brewed in conjunction with Tutankhamun and the Great Pharaohs, an exhibition running at Denver Art Museum"**

Whichever was true, a batch of Tutankhamun Ale was successfully brewed and 1,000 bottles filled, labeled and sent off to Harrods. At 0.9 pint (0.5 L), a bottle that would have taken around 130 gallon jars if we can believe that source! It was described as having a hazy, gold color, and tasting fruity, grainy, with caramel/toffee, sweet, spicy/astringent and with a dry finish.

What about a recipe for homebrewers? Well, for a start you're going to find it difficult to get hold of emmer, but it shouldn't be much of a departure from authenticity to simply use regular wheat malt. You can use a grist consisting of 100% wheat malt, but that can often cause severely set mashes. Therefore, I recommend a 40:60 mixture of wheat malt to barley malt. For extract brewers, you can buy either an American wheat beer extract, or a Weizenmalt extract, both of which should be suitable. The choice of yeast is problematic; we could go for a neutral yeast, or a wheat beer strain. I took another route, and opted for an abbey strain, on the basis that this would be a sweet beer, so the estery fruitiness such yeast should impart would give the beer a little more balance. I did go for "normal" fermentation temperatures, but the Ancient Egyptians may well have fermented their beer at higher temperatures, and you may want to try it at 70–80 °F (21–27 °F) if you favor authenticity over drinkability!

A New Royal Brew

Scottish and Newcastle never made another batch of this beer, and closed their Edinburgh brewery in 2002. And then they themselves disappeared and their brewing empire was carved up by Heineken and Carlsberg between them. So that's the end of the story of Tutankhamun Ale.

Or is it? The very day I sat down to write this article, I got a press release telling me that Wynkoop Brewing Company in Denver had brought out Tut's Royal Gold. This beer was specially brewed in conjunction with Tutankhamun and the Great Pharaohs, an exhibition running at the Denver Art Museum from June this year up to January 2011.

Wynkoop's beer is about 6% ABV and uses pale malt, honey, wheat and teff — a grain native to north-east Africa — as sources of fermentables. It is flavored with tamarind, coriander, grains of paradise, orange peel and rose petals. Head Brewer Andy Brown stated that, "We wanted to create a beer that echoed what ancient Egyptian royalty might have consumed back in Tut's day. It's a hybrid beer inspired by Egyptian ingredients, but brewed with the benefit of 3,000 additional years of brewing science."

Andy also says he was inspired by a brewer from Belgium talking about how wit beers might have tasted like 1,000 or so years ago.

"Things like spontaneous fermentation, sour, cloudy, spiced and consumed within days of being brewed all apply to both ancient Egyptian and old school Belgian beers, so I made a hybrid recipe," said Andy.

Andy was kind enough to give me his recipe (for 20 barrels), and I have adapted it for a 5-gallon (19-L) brew. For the grain bill I have used the *BYO* standard of 65% extract efficiency, and made the assumption that the teff grain will give a yield about the same as for the unmalted wheat. Andy says teff is grown in Idaho by the Maskal Teff Company; if you cannot get it simply substitute it with the same amount of malted wheat.

Converting the figures for the spices presents a problem, since the numbers are small enough that they can only be given in grams. If you don't have a gram scale, you will have to resort to around a teaspoonful of each, except for the coriander which should be only the proverbial "pinch." The spices were added in a grain bag during whirlpool, and the bag then suspended in the fermenter. You might find it simpler not to add the bag in the boiler but directly to the fermenter before running in the wort.

Marty Jones from Wynkoop Brewing Company was kind enough to send me some Tut's Royal Gold, and I tasted it with a few other beer-lovers. The consensus was that it did taste very much like a Belgian witbier, with a lot of flavor coming from the yeast. The notes from the spices and "sweeteners" were subdued, but added a subtle layer of complexity beneath the almost smoky wheat flavor.

Tut's Liquid Legacy

So, if you'd like a taste of what Tutankhamun may have been drinking, give these recipes a try.

Terry Foster is Brew Your Own's *"Techniques" columnist.*

RECIPES

Tutankhamun Ale
(5 gallons/19 L, all-grain)

OG = 1.060 (14.7 °P)
FG = 1.014 (3.6 °P)
SRM = 4–5 ABV = 6.0%

Ingredients

5.0 lbs. (2.3 kg) white wheat malt
7.5 lbs. (3.4 kg) pale 2-row malt
0.35 oz. (10 g) coriander seeds
0.35 oz. (10 g) juniper berries
White Labs WLP500 (Trappist Ale) or Wyeast 1214 (Belgian Abbey) yeast

Step by Step

Mash the ground grain at 150–152 °F (66–67 °C) for 90 mins. Sparge so as to collect 5.0 gallons (19 L) of wort; bring to boiling and keep it there for 15 minutes, or until hot break is clearly visible. Crush the coriander and juniper and boil a further 10 mins, then switch off heat, cool to fermentation temperature and pitch yeast. Ferment at 65–70 °F (18–21 °C) for 5–7 days before racking to secondary for a further 1–2 weeks. Keg or bottle and shoot for 2–2.5 volumes CO_2.

Tutankhamun Ale
(5 gallons/19 L, extract with grains)

OG = 1.059 (14.7 °P)
FG = 1.013 (3.6 °P)
SRM = 4–5 ABV = 6.0%

Ingredients

8.0 lbs. (3.6 kg) liquid wheat malt extract
0.35 oz. (10 g) coriander seeds
0.35 oz. (10 g) juniper berries
White Labs WLP500 (Trappist Ale) or Wyeast 1214 (Belgian Abbey) yeast

Step by Step

Thoroughly mix extract with enough hot water to give a final volume of 5.0 gallons (19 L); bring to boiling and keep it there for 15 minutes, or until hot break is clearly visible. Crush coriander and juniper and boil a further 10 minutes, then switch off heat, cool to fermentation temperature and pitch yeast. Ferment at 65–70 °F (18–21 °C) for 5–7 days before racking to secondary for a further 1–2 weeks. Keg or bottle and shoot for 2–2.5 volumes CO_2.

Wynkoop Brewing Co. Tut's Royal Gold clone
(5 gallons, 19 L, all-grain)

OG = 1.057 (14.0 °P)
FG = 1.009 (2.3 °P)
SRM = 5 ABV = 6.3%

Ingredients

6 lb. 4 oz. (2.8 kg) Rahr Premium 2-row pale malt
1.0 lb. (0.45 kg) coarse ground ivory teff flour
1 lb. 8 oz. (0.68 kg) Simpson's Golden Naked Oats
1 lb. 12 oz. (0.8 kg) unmalted wheat
1.0 lb (0.45 kg) malted wheat
5.0 oz. (0.14 kg) rice or oat hulls
5.5 g grains of paradise
4.0 g Pakistani rose
7.0 g bitter orange peel
5.5 g tamarind paste
2.3 g ground coriander
1.0 oz. (28 g) pitted dates
10 oz. (0.28 kg) wildflower honey
White Labs WLP400 (Belgian Wit Ale), or Wyeast 3522 (Belgian Witbier) yeast.

Step by Step

Mash all the grains at 138 °F (59 °C) for 30 minutes. (The rice or oat hulls are to assist run-off which can be problematic with wheat beers; you should add them to the mash along with the other grains.) Add sufficient boiling water to raise temperature to 155 °F (68 °C) for a further 30 minutes. Run off and sparge to collect 5.5–6.0 gallons (20–23 L) of wort, and boil it for 60 minutes. Cool, run into fermenter, adding spices in a hop or muslin bag and pitch yeast. Mix the honey and dates with enough boiling water (about 0.5–1 pint) to give a pourable slurry and add to the fermenter after the high kräusen has fallen. Rack to secondary after 5–7 days, leave 1–2 weeks to clarify and reach finishing gravity, then bottle or keg as per normal procedures.

Malt Extract Version

You can't substitute the pale malt with pale extract and do a partial mash with the other grains, because the presence of so much unmalted wheat will likely give just a sticky mess. I suggest a different route, namely start with a witbier kit. These are available from suppliers, and you should follow their directions up to the end of the boil. Then as above, cool, run into fermenter, adding spices in a hop or muslin bag and pitch yeast. Mix the honey and dates with enough boiling water (about 0.5–1 pint) to give a pourable slurry and add to the fermenter after the high kräusen has fallen. Rack to secondary after 5–7 days, leave 1–2 weeks to clarify and reach finishing gravity, then bottle or keg as per normal procedures.

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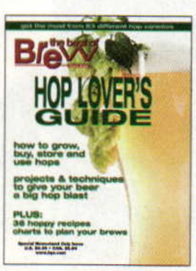

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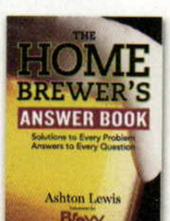

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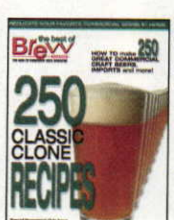

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mash TEMPERATURES

MASTERING MASH MIXTURES

Story by **Bill Pierce**

The first installment of this article (in the October '10 issue of *BYO*) explored the concepts of thermal mass and slaking heat, and their effect on temperature. In this installment we will extend the discussion to the formulas for the temperatures, masses and volumes used in multi-step infusion, decoction and cereal mashing.

Some all-grain brewers perform step mashing, which involves multiple temperature rests in order to emphasize the effects of specific malt enzymes. Another somewhat common practice is to employ a mashout, that is, raising the temperature of the mash to 168–170 °F (76–77 °C) after the starches are converted and before beginning to sparge the grain to rinse the sugars. Beyond multi-step mashing, some cereal adjunct grains have a higher gelatinization temperature than malted barley. In order for the starches to be accessible to the malt enzymes so that they can be converted to sugars, these grains must first be gelatinized in a separate cereal mash, usually along with a small fraction of malted barley. Once gelatinized, the cereal mash is added to the main portion of the mash for conversion. And finally, from the early days of lager brewing comes the decoction mash, in which a portion of the mash is removed and boiled separately before being returned to the main mash. In all these cases, the temperature of the resulting mixture of water, grains, mashes or decoctions can be calculated.

All of the formulas for doing so are based on the so-called "mixing formula" that was presented in the first installation of this article:

$$Aa + Bb = Cc$$

Here, the upper case values represent the first quantity and the lower case values the second quantity, while the A and B values represent the properties being measured. And the C values are the result when the two quantities are combined.

Infusing Without Confusing

The first infusion formula solves the mixing formula for the volume of the water infusion to raise the mash temperature to a desired value:

$$V_i = [(T_d*(ThM+(0.4*W_g)+(2.08635*V_w)))-(T_m*(ThM+(0.4*W_g)+(2.08635*V_w)))]/(2.08635*(T_i-T_d))$$

Where:
V_i = Volume of water infusion to raise the mash temperature to the desired value (quarts)
T_d = Desired mash temperature after addition of infusion (°F)
ThM = Thermal mass of mash tun (pounds)
W_g = Weight of grain (pounds)
V_w = Volume of water in mash (quarts)
T_m = Temperature of mash prior to infusion (°F)
T_i = Temperature of water infusion (°F)

The 0.4 coefficients are the heat capacity of malt relative to that of water. The 2.08635 coefficients are the weight of one quart of water in pounds (use 8.3545 if your volume units are in US gallons). As discussed in the first installment, metric brewers can use the same formula with degrees C and kilograms, omitting the 2.08635 coefficients. The result will be in liters.

If you examine the formula closely, it sums the thermal masses of the mash tun, the grain and the water in the mash, multiplying them by the desired temperature to calculate the "thermal points" (the heat energy, which is expressed in BTUs or kilogram-calories) needed. Subtracted from this are the thermal points already contributed by the mash at its current temperature. The result is the total thermal points that must be supplied by the water infusion.

According to the mixing formula, thermal points divided by temperature equals thermal mass. In this case the temperature is the difference between the current and desired temperature. And finally, the water mass must be converted to volume.

Going Universal

With only two more variables, the previous equation can be extended into a universal formula that involves all combinations of grain and water, so that it also can be used for returned decoctions and cereal mashes:

$$T_d = [T_m*(ThM+(0.4*W_g)+(2.08635*V_w))+(T_i*((0.4*W_i)+(2.08635*V_i)))]/[ThM+(0.4*W_g)+(2.08635*V_w)+(0.4*W_i)+(2.08635*V_i)]$$

The additional variables are:

W_i = Weight of grain in returned decoction/cereal mash (pounds)

V_i = Volume of water in infusion, returned decoction or cereal mash (quarts)

If you are calculating for a water infusion only, enter 0 for the grain weight of the returned decoction or cereal mash. Or by entering 0 for all grain values, the formula can be applied to mixing two volumes of water, wort or beer at different temperatures.

Examining the formula, it calculates and sums the thermal points contributed by the mash and the infusion, returned decoction or cereal mash. It also sums the total thermal mass. According to the mixing formula, thermal points divided by thermal mass equals temperature, so the result is the final temperature achieved. Note that the concept of slaking heat when the malt starches are hydrated, as discussed in the first installment, is not a factor in further infusions and/or decoctions. It only affects the initial strike water temperature calculations.

As was also mentioned in the first installment, the influence of the vessel's thermal mass is not so pronounced in multi-step mashing, decoction or cereal mashing. This is because the difference in temperature between steps is typically much less than that of the initial mash when the vessel must be heated from its ambient temperature to that of the first rest. For example, if you are mashing in on a cold day (40 °F /4.4 °C), and you do not preheat the mash tun or factor its thermal mass into the formula — in other words, you use 0 as the thermal mass value — the error in the calculated temperature of the strike water can be as great as 7 °F (4 °C). On the other hand, if you omit the vessel's thermal mass from the calculations for the infusion water necessary to raise the mash temperature from 150–168 °F (66–76 °C) for mashing out, the error is only 0.7 °F (0.4 °C). The additional volume of hot water to make up for the error is 0.4 quarts (0.38 L) for a typical 5.0-gallon (19-L) batch.

Doctoring Decoction

The most difficult calculations involve decoction, determining how much of the mash to remove in order to achieve a desired temperature after it is returned. This is not the same as removing a portion of the mash liquid only. Remember that water and malt have different heat capacities (1.0 and 0.4, respectively). Therefore the relative heat contributions of the water and malt also vary with the water/grain ratio of the portion that is removed. Additionally, remember that heat capacity is directly related to mass rather than volume, so the mass of the decocted portion also must be converted to volume.

One formula computes the volume of the decocted portion to remove:

$$V_d = [(T_d-T_m)*(ThM+(0.4*W_g)+(2.08635*V_w))*(D_{Th}+0.32)]/[(T_i-T_m)*((2.08635*D_{Th})+0.4)]$$

The additional variables are:

V_d = Volume of decoction to remove (quarts)

D_{Th} = Water/grain ratio (thickness) of decoction to remove (quarts/pound)

The 0.32 factor is the generally accepted value for the volume in quarts of 1 pound of malt (in metric terms it's 0.668 liters for 1 kilogram).

Looking closely at the equation, it calculates and sums the thermal points necessary to raise the mash temperature to the desired value and multiplies this by the volume of decoction (based on the thickness) that includes one pound or kilogram of grain. This is divided by the difference between the mash temperature and that of the returned decoction multiplied by the thermal mass of the grain in the decoction. The result is the total volume of the decoction to remove.

Approximating the Percentage

Most decoction brewers do not measure the decocted portion quite so accurately. They merely approximate by removing a portion based on the decoction thickness as a percentage of the total mass volume. Should you wish to calculate the decocted portion in percent, the formula is:

$$D_p = (100*V_d)/[V_w+(0.32*W_g)]$$

Where:
D_p = Percentage by volume of mash to remove for decoction

If you wish to measure the decoction by weight, use the following:

$$W_d = [V_d*((2.08635*D_{Th})+1)]/(D_{Th}+0.32)$$

Where:
W_d = Weight of decoction to remove (pounds)

As in any of the other decoction formulas, metric brewers should use liters and kilograms, omit the 2.08635 coefficient for the water weight in pounds and substitute 0.668 as the volume in liters of 1 kilogram of malt.

The formula is based on the fact that 1 pound (0.45 kg) of malt and 1 quart (0.95 liter) of water together has a volume of 1.32 quarts (1.25 liters). The volume of 1 kilogram (2.20 lbs.) of malt and 1 liter (0.95 quart) of water is 1.67 liters (1.76 quarts).

The Final Mixture

All of this technical discussion may seem like a lot of math and bother for what many brewers do by instinct as much as science. Most of us have learned from experience that it's a good idea to keep both cold and nearly boiling water on hand in case we miss our target temperature during mashing. The hot sparge water in a brewery's hot liquor tank is a source of the latter, and almost everyone has a cold water tap near his or her brewing area.

At least for some of us, coming to an understanding of the science behind the instinct is satisfying because it provides a logical basis for what occurs during the brewing process. If knowledge is power, an insight into these concepts should help increase our confidence, reduce stress, simplify the brew day and allow us to predict and hit our target mash temperatures more easily and regularly. And if consistency is one of the goals, then achieving more accurate temperatures is certainly an important component. In the end, it's all about better beer. BYO

Bill Pierce is a frequent contributor to Brew Your Own *magazine.*

Brewing Sugars

To use or not use them?

by Terry Foster

My first brew was awful! I had inadequate equipment, poor quality ingredients, and since there was, at the time, then very little information easily available, not much idea of what I was doing. I came to brewing via country wine-making with fruits and vegetables, which required considerable quantities of added sugar. So when I looked at the few beer recipes I could find, I thought they would brew a very weak beer and ended up adding as much sugar as malt extract. The resulting beer was strong; in fact, all you could taste was alcohol, for it had little body, and my poor boiling technique had not extracted much hop bitterness.

As I delved further into brewing I realized that part of the problem had been my profligate use of cane sugar, which was fully fermentable so that it was a source of alcohol but added no flavor. So I turned away from sugar and brewed only from malt for some while. But, many British brewers insisted on using sugars. So, since I am an experimental scientist, I decided to revisit using sugar in my own brews. I made two beers whose recipe and ingredients (malt extract, crystal malt, hops and yeast) were identical, except that in one I replaced 20% of the extract with an equivalent amount of cane sugar. The result was unequivocal, for to my palate the one brewed with sugar was thinner than the all-malt brew.

I swallowed the arguments of CAMRA, the great proponent of cask ale, that brewers used sugar only as a cheap substitute for malt. Indeed, apart from a few years of bad grain harvests, sugar was not permitted for use in brewing in Britain until 1880. When I graduated to all-grain brewing I was happy enough to use only malt and to eschew sugar, as well as other adjuncts such as maize, rice, and so on. My prejudice against sugar was further confirmed when I found out that in 1900 in the Northwest of England an outbreak of arsenic poisoning resulted in 70 deaths, with some 3,000 people also becoming severely ill. The immediate source of the poison was beer, but the real source was found to be the invert sugar used by the brewers. The sugar was made by the standard procedure of hydrolysis of cane sugar with sulfuric acid. But the sulfuric acid had been made from iron pyrites, which contained arsenopyrite, and the arsenic carried through into the beer and into the unsuspecting consumers!

Then in 1977 I came to the USA, where homebrewing was very soon to be legalized and to become popular. Strangely enough one of the mantras of homebrewers at that time was that cane sugar, or sucrose, would give beer a cidery flavor, to such an extent that it could not be used even in small amounts, such as for priming. Dextrose or corn sugar was much preferable, as it did not give this odd flavor. But sucrose itself was not the cause of this off flavor, being fully fermentable to CO_2 and ethanol. The problem was that if too high a proportion of sugar was used, and consequently too little malt, there was a lack of yeast nutrients and the fermentation would struggle. I knew this, and seeing this unwarranted prejudice against sugar I began questioning my own reservations about its use.

> "British brewers liked to use 5–15% of sugar in the grist as a 'nitrogen diluent.'"

Pros and cons of sugar

The obvious thing was to look into the reasons why commercial brewers might want to use sugar of any kind. First of all, British brewers liked to use 5–15% of sugar in the grist, as a "nitrogen diluent." In other words, it would reduce the proportion of protein fragments in the beer, so that it would not throw a chill haze when cooled. For the same reason, American brewers who were using the higher nitrogen 6-row barley malts employed high proportions of non-proteinaceous adjuncts such as rice.

But the Brits used sugar in cask-conditioned beer, which was not normally cooled low enough to give chill hazes, so they had to have another reason for using sugar, which turned out to be that it served as a brew length extender. You could make a normal brew length, then add, say, 10% sugar in the kettle, do the boil, then dilute down to the normal finishing gravity, and produce up to 15% more volume of beer, depending upon the type of sugar added. It may not sound like a lot, but that extra volume cost only the price of the sugar, since all other costs were going to be spent anyway, no capital costs for extra vessels was required, so it was a very cheap way to push production when demand was high. This procedure also gave great flexibility as demand changed throughout the seasons.

Invert sugar

But British brewers especially did not generally use sucrose, for they preferred invert sugar. This is a mixture of fructose and glucose and is produced by hydrolysis of sucrose, and can be added to the wort as syrup or as blocks containing about 17% water. Either form is more readily soluble than solid cane sugar. But invert sugar is often produced from raw, rather than refined sugars and comes in several grades. The impurities in the raw sugar give the invert color, and during the inversion process are converted to various by-products, especially condensation products similar to melanoidins. Consequently different grades of invert sugar have different flavors and colors and are not as fully fermentable as sucrose. In other words they can add flavor and color to the beer, rather than just alcohol and carbon dioxide.

Invert sugars are often used in commercial brewing as a component of priming mixtures. These would be added to dark mild ales, which were drunk quickly, so that residual flavors from the invert could add perceived sweetness and "lushness" to the ale. That style is relatively rare in Britain today, but such priming mixtures are often favored by brewers for other beers, even for the paler bitter ales.

One final point on the use of sucrose versus invert sugar is that both of them, when pure are just as readily fermentable as each other. Sucrose must first be hydrolyzed to fructose and glucose, which occurs outside the yeast cell. These sugars must then be absorbed by the cell before fermentation can occur; this implies that sucrose may be fermented more slowly than these other sugars. In fact, it seems that this hydrolysis occurs very rapidly with the result that yeast utilization of sucrose is just as rapid as for glucose and fructose.

Other forms of sugar

But there was a more obvious use of sugar in brewing which I had overlooked. That was the use of lactose in sweet stouts, first called "milk stouts" because of the source of the sugar. The most famous of these was Whitbread Mackeson Stout, which was brewed conventionally with pale, crystal, and chocolate malt, but with a little under 10% lactose added. The OG is around 1040, but alcohol level is only about 3–3.2% ABV, because lactose is not fermented by yeast. The result is a low alcohol beer with a surprisingly full flavor, but not cloyingly sweet since lactose is less sweet to the palate than sucrose.

So I came around to the idea that Brits used sugars in brewing for other than economic reasons. But why limit my search to Britain? Well, no point in looking at Germany, that other great brewing nation where use of sugar was prohibited by the Reinheitsgebot. So what about Belgium? Well, of course they use sugar, notably in their abbey ales. Mostly they use candi sugar, which is slowly crystallized onto strings suspended in a sugar solution. It's a very pure form of sugar, and contains 99% sucrose; it can be produced in a translucent white form, or in darker colors. Candi sugar is supposed to have all sorts of positive effects in beer, such as improving head retention. It is most commonly used in the stronger dubbel and trippel abbey ales (6-10% abv), at about 10% of the total grist. Since it is fully fermentable, candi sugar yields a drier beer than one of the same alcoholic strength obtained from all-malt grist. There is still enough malt used in brewing these beers to provide plenty of body. I think candi sugar doesn't add much flavor directly, but that the dryness it confers allows the fruity flavors from the Belgian yeasts to come through more clearly.

And then of course there is the good old USA. The early European settlers used a very crude form of sugar, namely molasses, as the sole source of fermentables in brewing beer. That was an economic approach, for barley malt was either not available to the settlers at all, or was imported from England, and therefore expensive. Modern commercial molasses are not as crude as those used by the settlers, but they do have a strong flavor, and are not really suitable for brewing applications, except perhaps to add a little extra something to a robust porter or stout. For that, you probably only need about a half-pound of molasses to a malt bill of 10 lb. (4.5 kg) or more for 5 gallons (19 L) of beer.

There are two other notable forms of sugar which are sometimes used by craft brewers, namely maple syrup and honey. The former is mainly sucrose, while the latter consists mainly of dextrose and fructose, so it can be regarded as a form of invert sugar. However, both are used in beer for their flavoring properties rather than as process aids. But their flavors are of a delicate nature and they are probably used best in beers that are low in hop bitterness and character and are relatively neutral in flavor, such as pale lager or mild ale. Honey of course has been considered to be a source of flavor and fermentables in the early forms of beer produced in Mesopotamia and Ancient Egypt. Then there are the darker sugars, which come in various shades of brown and are simply sucrose containing various levels of impurities, and can be used to add subtle flavor notes to beer. The problem with all these is that they do not have intense characters, and are so high in fermentable sugars that you are limited in how much you can add, and therefore in how much of their flavor you can impart, without drying out the beer and increasing its alcohol content to the point of unbalancing it entirely.

There are no guidelines for using "flavor" sugars, other than that the amount used should be a maximum of 10-15% of the malt bill, with the higher proportion used only for beers of OG 1.060 or more. Exactly how much you use and what the other constituents of the beer should be is something you have to work out yourself. Use a grist that gives a neutral flavored beer (say pale or Pilsner malt only), add 10% maple syrup or honey, see how the beer tastes, and tinker around with this in the next brew. Once you get a feel for it, you can then decide to add it in stronger-flavored beer, in order to get the complexity you are after.

Making invert sugar at home

Invert sugars designed for brewers are not widely available here, apart from Tate & Lyle's Golden Syrup, which some homebrew suppliers carry. But it is easy enough to make it yourself without needing to handle any dangerous chemicals like sulfuric acid:

Mix 1 lb. (0.45 kg) cane sugar with ½ pt (0.24 L) hot water and stir thoroughly until the sugar is fully dissolved. Add 2 g (½ tsp.) of citric acid, and bring to a boil. Keep boiling until the liquid is pale gold in color, usually about 20–30 minutes. You can use this directly in a brew, adding it to the kettle at the start of the boil. However, the citric acid flavor may be noticeable if it is a mild-flavored beer. In that case it is preferable to add precipitated chalk (calcium carbonate) to the syrup with vigorous stirring; about 1–2 g should suffice, (or add to give pH 7.0). For best results, while the syrup is still hot, filter out the precipitate through a fine muslin gauze before adding to the kettle. In order to make darker, more flavorful versions, try adding a little molasses at the start. Limit this to about ½ tsp at first, and only add larger amounts according to taste.

Summary

Using sugar in brewing is a little controversial, but hopefully I have shown what benefits various brewing sugars can bring. While it may not be for all, it can be another color in the palette of the homebrew artist. BYO

Terry Foster writes "Techniques" in every issue of BYO.

Refurbishing Kegs

Save money by fixing up used kegs

by Chris Bible

The components of a basic kegging system include a carbon dioxide (CO_2) tank, a regulator for the carbon dioxide tank, the keg itself and various hoses, fittings and disconnects. (See page 40 for an introduction to kegs and homebrew kegging techniques.)

CO_2 tank

The CO_2 tanks most commonly used by homebrewers hold 5, 10 or 20 pounds (2.3, 4.5 or 9.1 kg) of CO_2. These tanks are made of either steel or aluminum and must be certified as pressure vessels and need to be recertified every five years.

CO_2 tank regulator

A CO_2 tank must have a pressure regulator to reduce the pressure of the gas exiting the tank from approximately 800 PSI to about 10–30 PSI, the pressure required to force carbonate and dispense beer. Regulators may have one or two gauges. On two gauge models, one of the gauges displays the tank pressure, and the other gauge displays the pressure of the gas exiting the regulator (i.e. the dispensing pressure). Many regulators are also equipped with a check valve to ensure that nothing can flow back into the regulator.

The homebrewer's keg

Homebrewers typically use 5-gallon (19-L) kegs that were originally designed for soda pop dispensing machines. Three- and 10-gallon (11 and 38 L) sizes are also available, though harder to find. The two basic types of kegs are ball lock and pin lock. "Ball lock" and "pin lock" refers to the type of connectors on the gas and liquid posts. Either type is acceptable for use by homebrewers, but their parts are not interchangeable.

In order to reduce the cost of a kegging system, homebrewers can purchase used soda kegs and refurbish them for holding and dispensing beer.

Refurbishing kegs

Because most kegs have been used to store soda syrups, it is important to clean and refurbish a used keg. Refurbishing a keg involves inspecting the keg, taking it apart, thoroughly cleaning it and replacing the old rubber gasket components with new.

Initial inspection

First, visually inspect the keg to make sure there are no obvious holes or large dents in it. If all looks OK, then hook it up to your CO_2 tank in order to pressure test it. When the CO_2 tank is connected and the keg is sealed, raise the pressure to 30 PSI. The CO_2 tank will hiss as CO_2 enters the keg. This hissing sound should stop within less than a minute. If the hissing stops, the keg probably doesn't have any leaks. In order to be more confident about this, disconnect the gas and see if the keg holds pressure for 24 hours.

Disassembly

After you ensure that the keg is pressure tight, the next step is to release the pressure, remove the lid and completely disassemble the keg.

The lid Remove the lid and inspect the rim and the open lip of the keg. Large dents on either of these sealing surfaces increases the potential for leaks. If the dents are very large, consider replacing the lid or at least attempt to hammer out the dents.

Next, inspect the large rubber gasket attached to the lid. It should be in good repair with no cracks or missing chunks. This gasket has the potential to have absorbed soda flavor or aroma compounds that might potentially impact your kegged beer. If the gasket exhibits any soda-like odors, it should be discarded and replaced (a complete set of replacement gaskets for a keg will include a lid gasket, two dip tube gaskets and two post O-rings). Even if the gasket does not

"Refurbishing a keg involves inspecting the keg, taking it apart, thoroughly cleaning it and replacing the old rubber gasket components with new."

With a little work, used soda kegs can be refurbished for dispensing beer.

have any noticeable odors, it should, as a minimum precaution, be removed, soaked in hot, soapy water for 1–2 hours and then rinsed.

Different lids will have different hardware on top. This hardware might include a pressure-relief valve. Check to ensure that the pressure relief valve operates freely and does not bind. Corny kegs that are designed for use in soda applications are rated for much higher pressures than they would encounter in a homebrewing application, so it is very unlikely that the pressure relief valve would be required to safely vent the keg in an over-pressure situation. It can, however, be extremely handy to be able to quickly vent a keg or lower the pressure with the quick push or pull of a valve. For these reasons, pressure relief valves are more of a convenience item than a safety feature for homebrewers.

Fittings Before disassembly of the fittings, it is a good idea to use a black permanent marker to label which connectors go to which part of the keg. Label the side of the keg near each connector as "gas" or "beer" as appropriate. If the keg is a ball-lock type, you may want to also label the fittings prior to removal. If you choose to do this, be sure that the marker is applied on the fittings on the hex part, where the beer can not come into contact with the marker. For ball-lock type kegs, use a deep-well socket wrench to remove the fittings. For pin-lock type kegs, use a crescent wrench or box-end wrench to remove the fittings. Most ball lock kegs require a ⅞" wrench to remove the fittings, while most pin locks require $^{13}/_{16}$".

Poppits After the fittings have been removed, next remove and examine the poppits. Poppits are little metal posts with a spring around them. There will be three little feet on each poppit. Make sure that all three of the feet look identical, and that they are not bent, twisted or otherwise damaged. If they are damaged in any way, they should be replaced. Next examine the springs. The spring on the poppits will eventually become worn and will be unable to exert enough force to properly keep the poppit tightly in the hole in the fitting casing which surrounds it while in use. There are several ways to possibly fix this situation, but the easiest thing to do is to replace the defective spring, or replace the whole poppit.

Dip tubes After removing the fittings and the poppits, next remove and inspect the dip tubes. They should be relatively straight with no severe kinks or bends. Check that the flanged edge is flat and smooth and that there are no dents present on the flanged surface. Dents on this surface can result in a poor seal and this creates the potential for gas leakage. Dents on the flanged surface can sometimes be fixed by carefully hammering them out. To do this, remove the dip tube from keg and the gasket from underneath the flange. Carefully tap out any dents using a hammer, then reassemble the parts and insert in the keg. The dip tube gasket should be removed and replaced with a new one.

Cleaning the keg and components

Before concerning yourself with the keg interior and components, it is a good idea to clean up the outside of the keg and remove any labels that may be adhered to the outer surface of the keg. If there are labels on the outer surface of the keg, it is likely that they were originally intended to be permanent. They will likely not come off using a simple soak technique.

WD40 and Goo Gone are both effective at dissolving the adhesive on permanent stickers. Other organic-based solvents can also be effective. Use of a solvent in combination with a razor blade should allow you to remove any stubborn labels. A scrub pad will help to remove any residual glue. If you wish to really shine up the exterior of the keg, as well as remove discoloration and small rust spots, Bar Keeper's Friend (or other acid-based metal cleaners) works well.

After the exterior of the keg has been cleaned, the next thing to do is to address the keg interior and components. The keg should be completely filled with a cleaning solution of TSP or PBW. Do not to use bleach to clean or sanitize your keg. Bleach will chemically react with stainless steel and aluminum and can cause pitting and holes to form in your keg if left in contact too long. Star San or iodophor are suitable sanitizers for kegs.

All of the disassembled parts — including the posts, poppets, dip tubes, etc. — should be immersed in the cleaning solution, either by placing them into the keg or in a separate container. Use a dip tube brush to ensure you get any potential buildup out of the tubing. Allow everything to soak in the cleaning solution for several hours. After a thorough rinsing, the keg is ready to be reassembled and sanitized for use.

Summary and conclusions

Kegging beer can be a great alternative to bottling, even though it has a higher initial cost. Purchasing and refurbishing a used keg can reduce the higher initial cost. To refurbish a used keg:

- Completely inspect, disassemble, and clean the keg.
- Replace any damaged components and gaskets that are worn or cracked.
- Re-assemble the keg using new replacement components.
- Sanitize the keg and fill with delicious homebrew.
- Force carbonate your beer, then enjoy! BYO

Chris Bible is BYO's "Advanced Brewing" columnist.

Build A Kegerator Hop Filter

Add more flavor to your homebrew

by Christian Lavender

Most of the homebrewers I know that own kegerators rarely bottle their homebrew anymore. But some of the most hopped homebrews I've tasted lately seem to come in bottle form. As a kegerator homebrewer, I asked myself, "How can I make my draft homebrew hoppier?"

I use kegs as my secondary and tertiary fermenting vessels when brewing, and with the right timing, this allows my brew to self-carbonate with the malt sugars left over from the main fermentation. With this process of fermenting, conditioning and dispensing within a closed keg system there never seems to be a good opportunity to introduce any additional bittering/flavoring/hop aroma to my draft homebrew. Filtering hops within the system seemed like an answer.

I had read about the original Randall the Enamel Animal, a Dogfish Head invention, and many other different types of hop filter builds online and from friends, but I wanted to build a hop filter that was going to be kegerator-friendly, easy to detach and clean and cost effective. So, I decided to introduce a hop filter to my home kegerator system.

To build this project, I chose a water filter with ¾" female pipe threads and a 3-position bypass valve so the hop filter could be changed without detaching from the keg. I had a plethora of fittings, bushings and couplers lying around my garage as well as tubing and O-rings, so I headed to the homebrew shop.

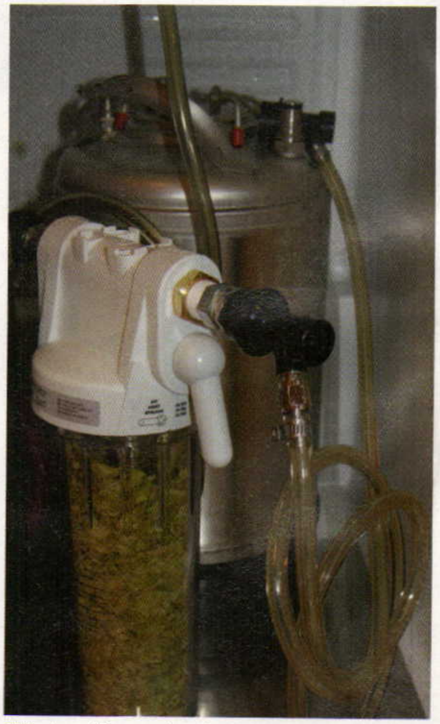
After talking with a few of the veteran homebrewers at the shop I quickly realized that there was going to be a million different ways to build this hop filter, so I had to determine what the key functionality needed to be. Hop flavor injection capability was obviously important and bypassing and ease of cleaning came to mind. Quick disconnects on the filter housing would let me detach the entire filter unit from the kegerator dispensing system for easy cleaning. The kettle screen, usually an accessory that turns your brewpot into a mash tun, would be easier to modify into a filter than buying a stainless steel rod and drilling holes.

After assembling the hop filter, getting it installed and pouring my first homebrew, I have to say I could really taste a difference in the hop profile of the beer. One small addition to the kegerator has made an already smooth operator into a smooth hoperator!

"One small addition to the kegerator has made an already smooth operator into a smooth hoperator!"

Parts and equipment list

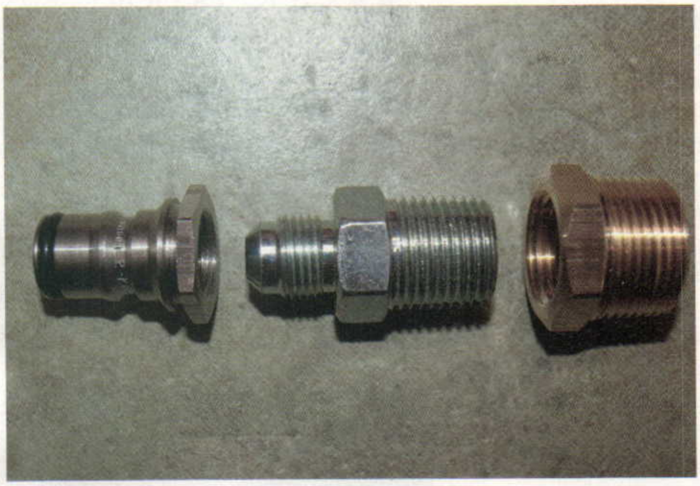
- GE Household Pre-Filtration System. Model # GXWH20S
- Brewer's Edge® KettleScreen(tm) with ½" thread and 12" long
- ½" Male pipe thread to ⅜" Male barb connector
- 4 small ⅜" O-rings
- 3 clamps
- ½" female pipe thread to ½" female pipe thread coupling
- 2 Firestone liquid posts with ⅜" female pipe thread
- 2 ⅜" Male pipe thread to ½" male pipe thread reducers
- 2 ¾" Male pipe thread to ½" female pipe thread bushings
- 2 Quick disconnect fittings for ball lock kegs with ¼" MFL (threaded)
- 2 ¼" swivel nut to ¼" barbed end sets
- 4 ft. of 3⁄16" inner dimension PVC tubing
- Teflon tape
- Filter wrench
- Adjustable wrench
- Flat head screwdriver
- Metal snips
- Measuring tape
- Bolt cutters



This hop filter project is an easy way to make your kegged homebrew much hoppier.

1. GATHER YOUR SUPPLIES

I have a mountain of spare homebrew parts scattered around my home, as most homebrewers I know do, and was able to track down most of the fittings including the clamp, coupler, reducers and bushings. Before I got started on the assembly, I needed to take inventory of my tools and supplies to make sure I could finish what I started and, low and behold, I was missing a vital piece that sent me back to the homebrew shop. I had overlooked getting a second quick disconnect fitting to connect the "out" on the hop filter to the "in" on my tap tower. It's always a good rule of thumb to lay down the game plan before you get started with any project. When I returned home my good buddy Brew (my Golden Retriever) had taken it upon himself to play tug-o-war with the beer line I had purchased to connect the hop filter and tap tower together. So yep, you guessed it, back in the car and back to the homebrew shop. This time I bought a bushel of beer line.



2. ASSEMBLE THE FITTINGS

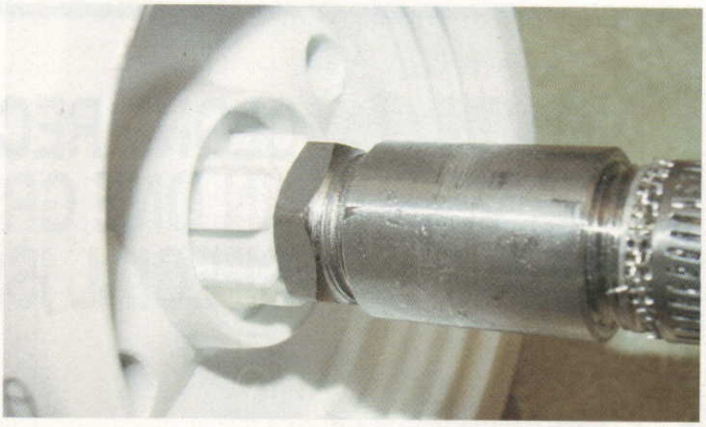
Before you get started assembling the fittings for the quick disconnects, make sure to clean and sanitize all the parts. You will need to lay out the three parts (¾" male pipe thread to ½" female pipe thread bushings, ⅜" male pipe thread to ½" male pipe thread reducers, Firestone liquid posts with ⅜" female pipe thread) for each side and wrap the male threads of each fitting with the Teflon tape. (I used a mixture of brass and stainless steel fittings, but I suggest using all stainless steel fittings when possible.) After you get all of the fittings tightly screwed together you can insert the ¾" male pipe thread of the bushing into the ¾" female pipe thread on the filter housing. Repeat this on the other side of the filter housing to finish assembling the quick disconnect liquid posts for use with the quick disconnect fittings for ball lock kegs.

3. KETTLE SCREEN MODIFICATION

Measure 7" up from the crimped end of the Brewer's Edge® KettleScreen™ and cut with your metal snips. Make sure to reshape the snipped tube back to its original shape with a pair of pliers. On the half with the threaded fitting use your bolt cutters to cut off the permanent clamp and remove the fitting. Remove the ½" threaded fitting and insert it into the end of your newly cut 7" screen. Slip on a stainless steel adjustable clamp and tighten. Next, screw on your ½" x ½" female pipe thread coupling and then screw in the ½" x ⅜" male barb connector into that. Slip on the 4 small ⅜" O-rings until they are about midway down the barb. When you have completed these steps you should have something that looks like the modified screen in the picture.

4. INSTALLING THE SCREEN

Slowly twist the screen assembly into the opening on the inside of the filter assembly cap. The O-rings you used on your barb fitting should twist in and be quite snug. The purpose of this design is for making cleaning of the hop filter as easy as possible. When ready to clean the filter you will just slowly twist out the filter assembly from the filter cap. During dispensing, the PSI in the filter housing will force the screen up and create a natural pressure seal. These filters are designed to withstand up to 125 PSI, so you do not have to worry about its pressure capability because most beers are dispensed between 5 and 12 PSI. Tightly secure the clear filter closure to the filter cap with the included filter wrench.



5. COMPLETE THE ASSEMBLY

Once the filter is assembled we will now be ready to attach it to the rest of the kegerator dispensing system right? Wrong. Make sure you clean, clean, clean this filter. The last thing needed at this point is for your beer to be contaminated by an unclean "filter." Use regular brewing sanitizer and baptize your new hop filter. After you have cleaned you are ready to add the filter to the system. The beer should flow from your keg like this: KEG ->HOP FILTER ->TAP TOWER. Assemble your beer line jumper out of the two quick disconnect fittings, ¼" swivel nut x ¼" barbs, clamps and the PVC beer line. Connect the beer line jumper from the keg's beer line "out" to the hop filter's line "in" liquid post. Then connect the tap tower quick disconnect to the hop filter's line "out" liquid post. You now have completed the connection and have another important step at this point. What kind of hops to use?

6. TEST DRIVE

I used Centennial whole leaf hops for the first run through the filter. My homebrew on tap at the time was a Black Rye brewed with Columbus and Centennial and then dry hopped with Amarillo and Centennial. I turned on the CO_2, set it to around 8 PSI and watched the hop filter fill with beer. As the beer traveled down and then back up through the screen I watched for leaks around all of my fittings. Success! No leaks and the beer made it all the way out and up to the tap tower dispenser. I closed the kegerator door and let the temperature come back down to 38 °F (3 °C) before dispensing to minimize foaming. The first beer was foamy, but quickly settled and I could see some particulate had made its way through the filter. After a few beers the particulate matter cleared and I was left with a noticeably hoppier brew. BYO

Christian Lavender is a homebrewer in Austin, Texas and founder of Kegerators.com and HomeBrewing.com. This is his first article for Brew Your Own.

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I Homebrew Because

BYO fans weigh in on Facebook

Attend any homebrewing gathering and you will find that homebrewers have much to debate, and a whole lot of opinions. We all agree on one thing, however — we all love to homebrew! *BYO* recently asked our Facebook fans to finish a simple phrase, "I homebrew because..."

We heard from the ardent:
"I like 'living under the influence!' The influence of limitless creativity that homebrewing affords me. Homebrewers are always pushing the envelope in terms of recipes and techniques. Without homebrewers there would be no craft revolution! We ROCK!"

"To refine my craft and someday quit my day job to create liquid happiness. Oh, and nobody brews the beers that I make and I like it that way."

"Because I can truly call it MINE!"

There were the scientists and logisticians:
"It lets my artistic side come out, while still satisfying my scientific side."

"Because I'm married to a mad scientist and enjoy conducting experiments as much as he does."

"Because studying beer actually makes beer more enjoyable."

There were budget and ingredient-conscious brewers:
"It's cheaper, it's better tasting, I enjoy it, and when the world's economies collapse I will have something to barter with."

"I know exactly what's in it, how it was treated, how much effort was put into creating it, enjoy drinking it, and love the response, 'you make your own what!?!?'"

"Because I've worked in a lot of big commercial keg breweries and I know how they make it. So I don't want to drink it . . . I'll make my own thank you very much."

Mostly, though, homebrewers find satisfaction in the brewing process:
"I enjoy the sense of accomplishment when making something that tastes as good or better than microbrews I've had other places."

"I homebrew because creating something by hand is much more satisfying than drinking something made in a factory."

"I homebrew because I work in a job where I cannot point to something I have created, and through homebrewing I can."

"I can do it for the rest of my life and not even make the same one twice if I so choose."

Of course, some folks are just plain pragmatic:
"I can brew whatever I want and it is better than most of the stuff at the liquor store."

"Nobody else makes what I want to drink."

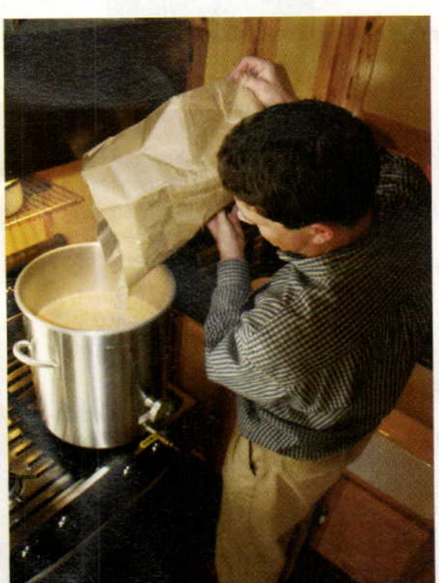
"Because I am German. I can't help it. I am biologically incapable of NOT brewing."

"It's more fun than working on my 'honey do' list"

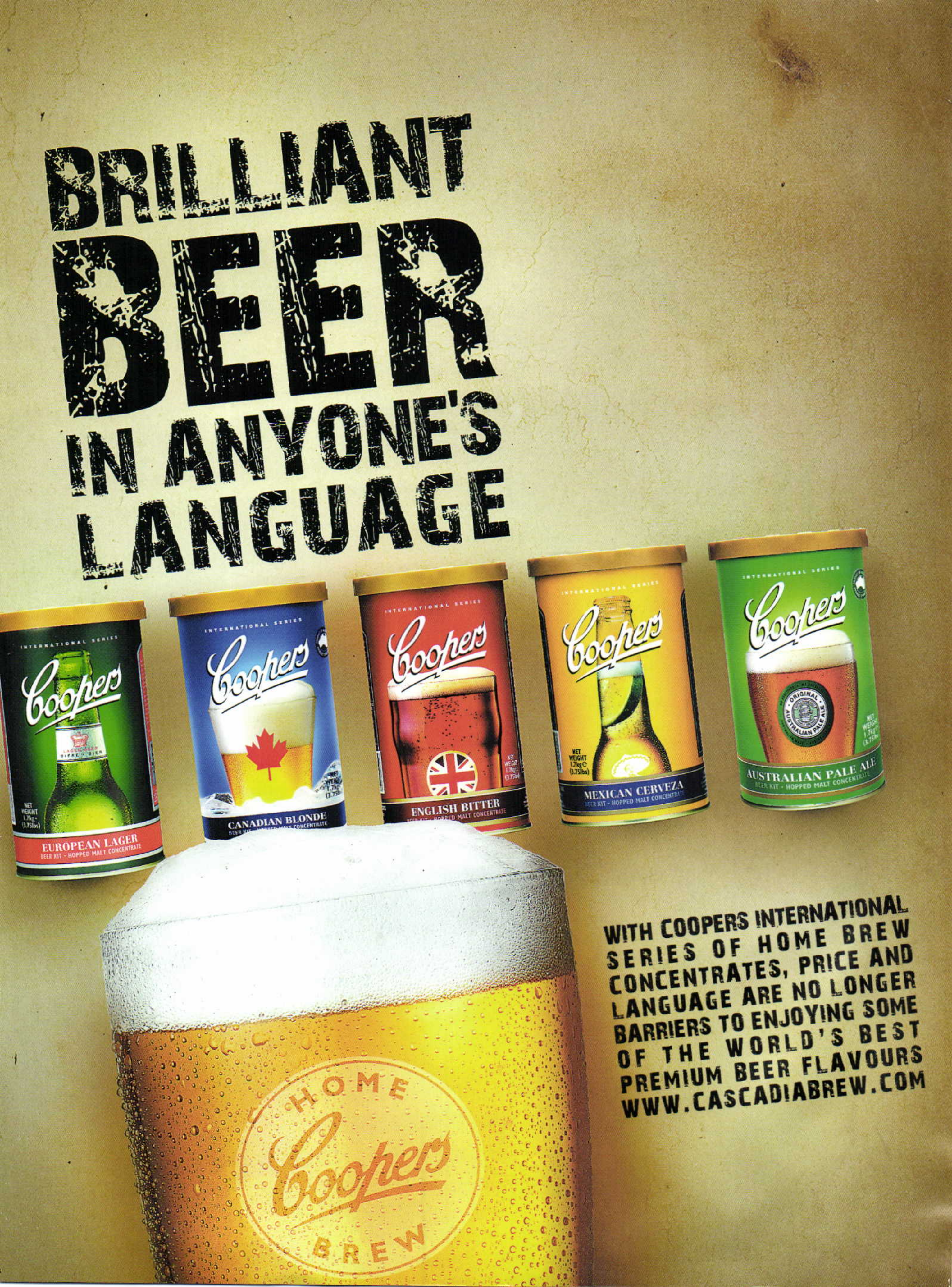
And then there's our favorite reply:
"You can buy beer?"

Thank you to all of our Facebook friends for having some fun with us. Join us next time by becoming a fan of *BYO*! Go to www.facebook.com/BrewYourOwn

"I can do it for the rest of my life and not even make the same one twice if I so choose."



Homebrewers make their own beer for love, money and just the fun of brewing!



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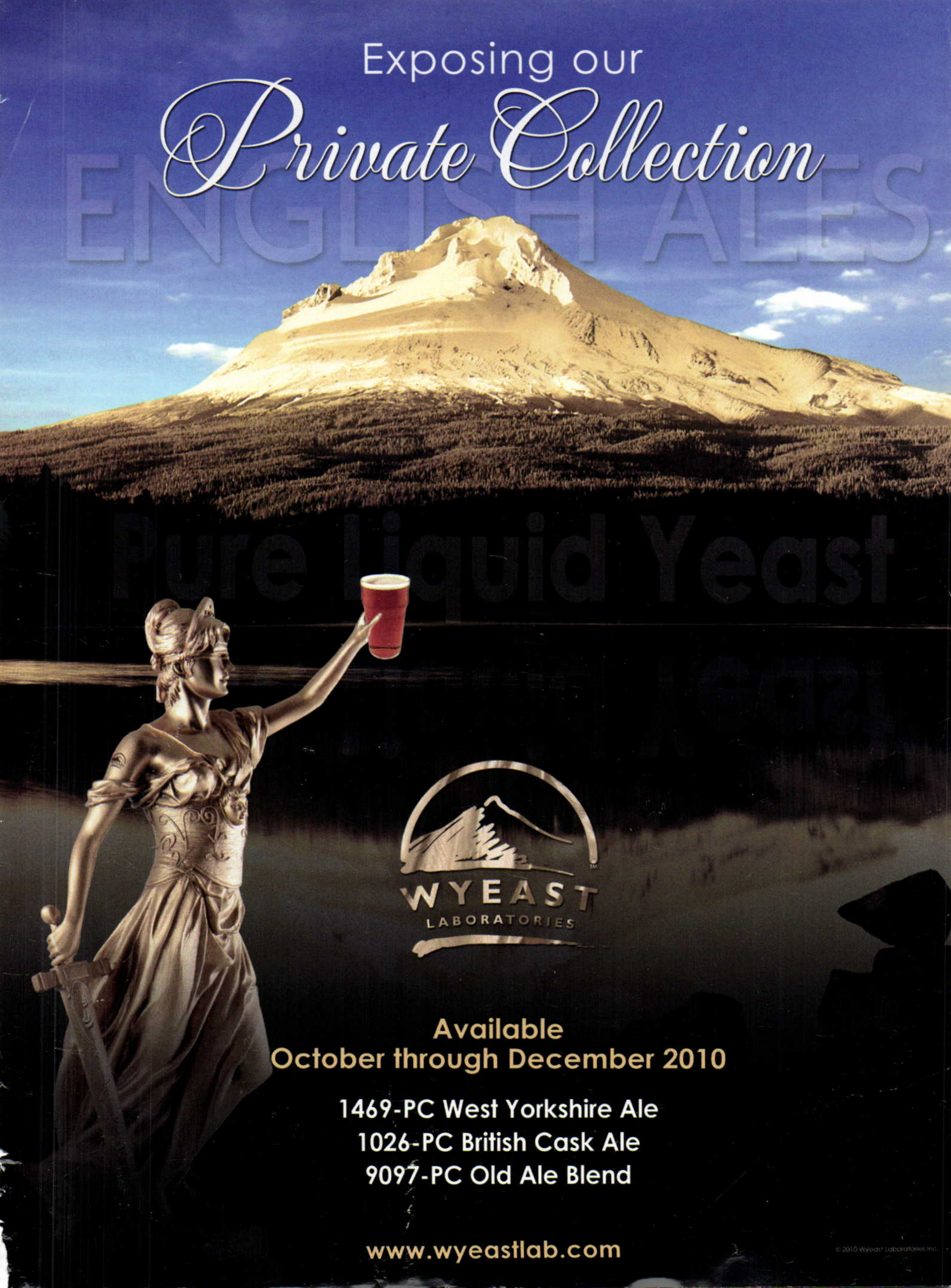

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