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SEPTEMBER 2012, VOL.18, NO.5

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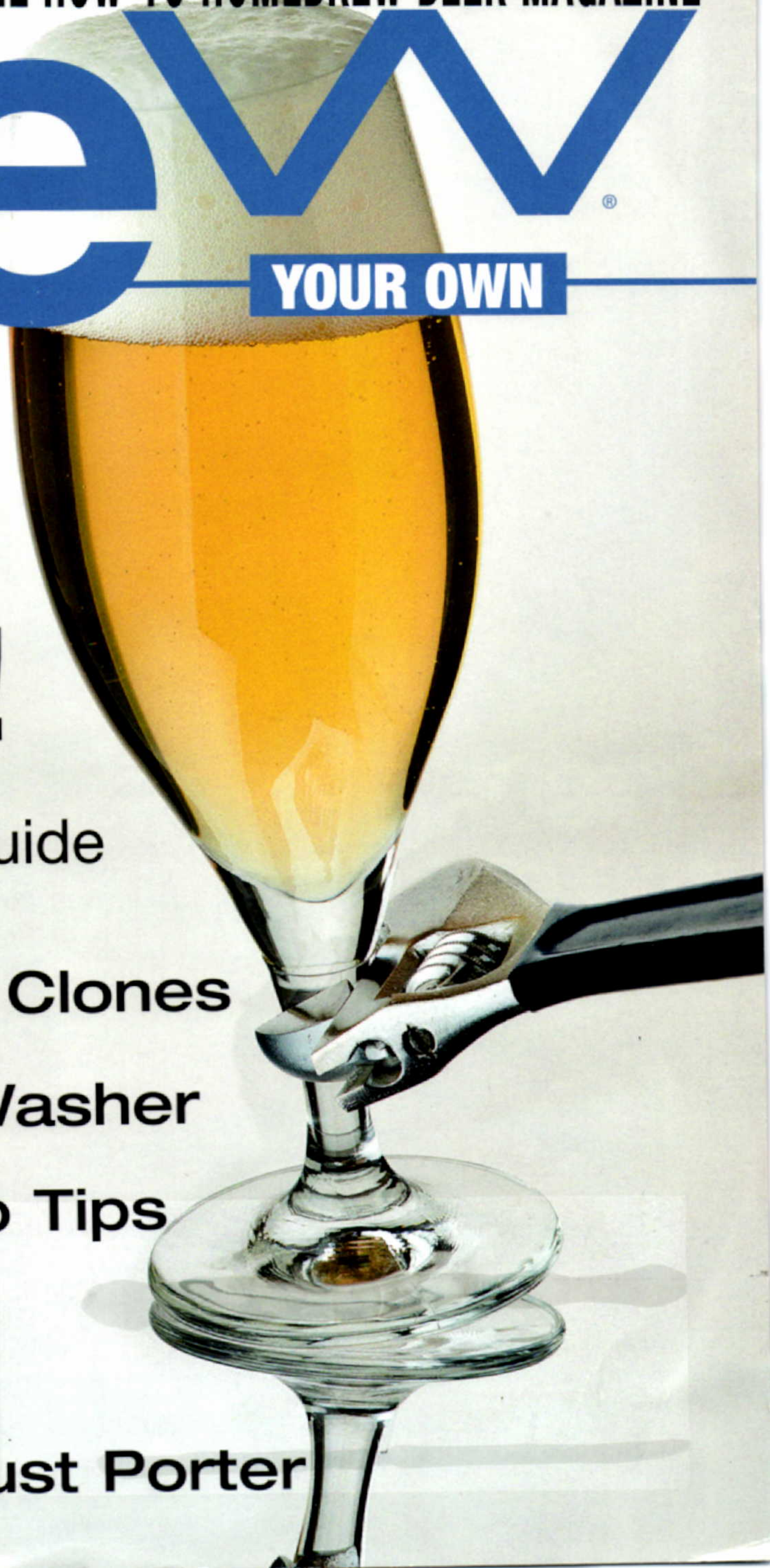

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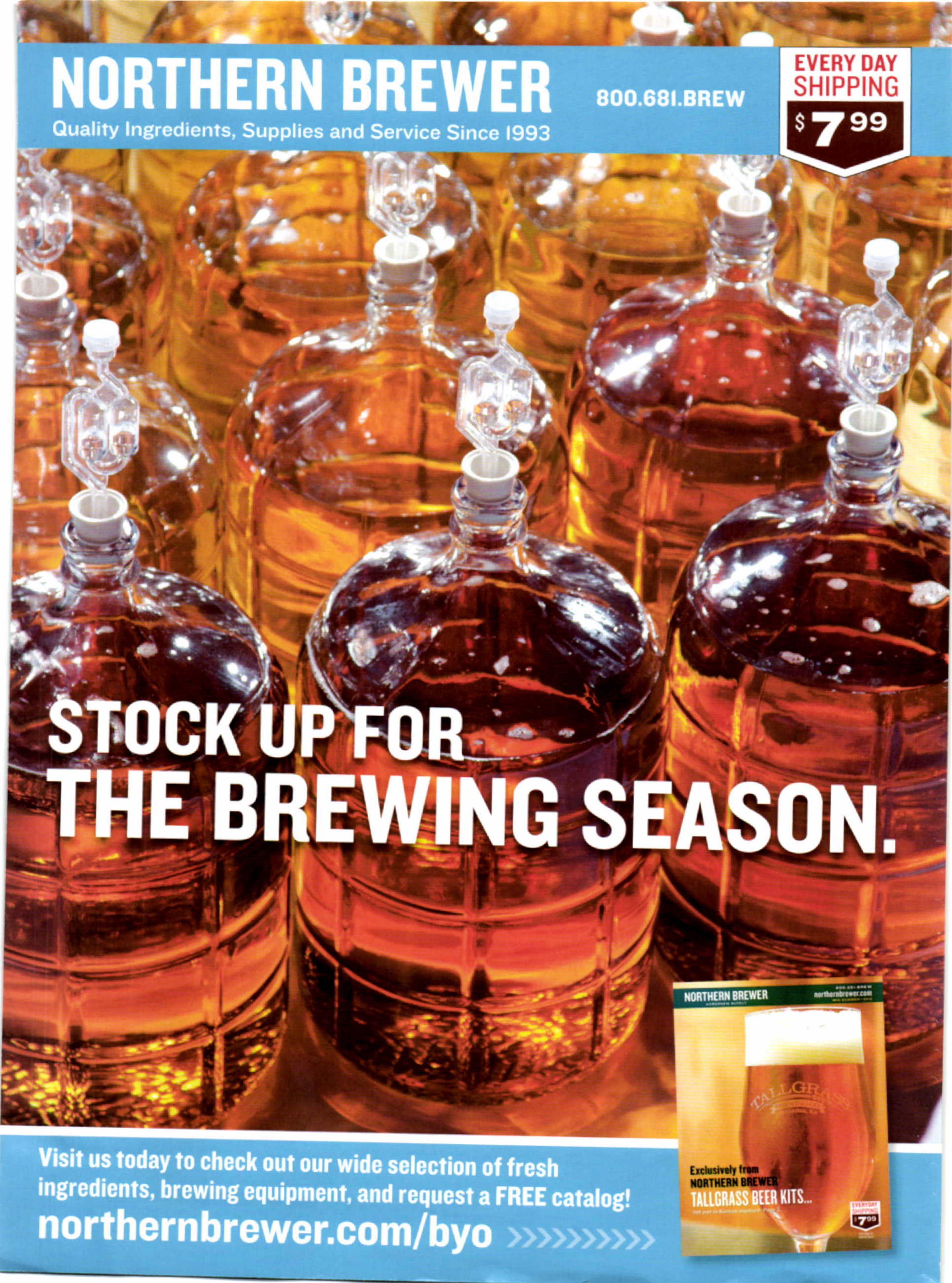

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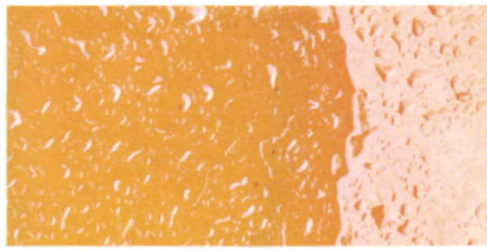

BYO RECIPE STANDARDIZATION

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

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

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

Hops:
We calculate IBUs based on 25% hop utilization for a one hour boil of hop pellets at specific gravities less than 1.050.


GREAT
BRITISH
MALT

what's happening at BYO.COM

20 Tips for New Brewers

Looking for some expert advice to get your first homebrews off the ground and into the fermenter? Check out some tips from homebrew suppliers around the US to make those first few batches as good as they can be.

www.byo.com/component/resource/article/1777

Open Fermentation Advice

Many commercial sour beer brewers also employ open fermentations with their wild brews. If you've considered trying an open fermentation at home, read about building your own open fermenter, as well as some expert advice from open fermentation pro Ron Jeffries of Jolly Pumpkin Artisan Ales.

www.byo.com/component/resource/article/390

Brew a Prohibition-Era Pilsner

A Colorado brewer recreated the recipe for a lager originally brewed during Prohibition in an illegal Chicago distillery owned by Al Capone. Don't forget the soy beans!

www.byo.com/component/resource/article/1280

Follow Jamil Zainasheff's Pro Brewing Career

BYO's longtime "Style Profile" columnist (and award-winning homebrewer) is now in his second year as owner and brewmaster for Heretic Brewing Company in Pittsburg, California. Follow along as he experiences the ins and outs of the world of commercial brewing in his *BYO* blog.

www.byo.com/blogs/blogger/Jamil/

Cover Photo: **Charles A. Parker**

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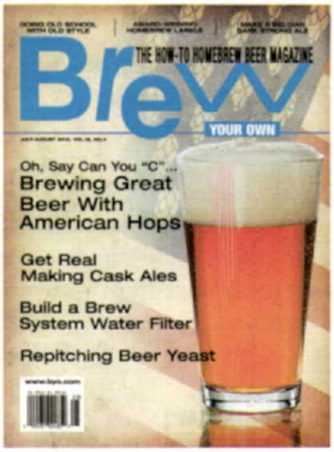


Make mine metric

G'day, I just subscribed to your magazine, and I am from Australia.

I didn't know anything about it before I signed up, but I had to let you know how grateful I am that you've put metric equivalents in brackets after your US imperial values. It makes reading (and understanding of course) the articles so much easier as well as making me a more engaged reader.

If it was imperial only, I would probably just gloss over articles, similar to how I am when reading on-line stuff. So anyway, thanks for making my life easier, I really appreciate it.

Matt Hopsun
via email

Glad you enjoy the magazine. We added metric equivalents a few years ago for our non-US readers, but have found that many of our US readers — particularly those with a scientific background — also prefer the metric system.

Yeast origins insight?

I was just rereading your excellent article on the origin of lager yeast (March-April 2012), while finally reading Noonan's "Brewing Lager Beer." I think I stumbled upon the connection between the wild yeast from Patagonia and European lagers.

"When the kraeusen tradition is being followed, a lattice of beech chips is laid on the bottom of the secondary fermenter and covered with the nearly fermented or ruh beer. From 5 to 15 percent new beer at up to 39 degrees F is roused into it."
— pg 163–164, "Brewing Lager Beer."

So just a thought, but if traditional German breweries used beech chips in the secondary that could explain how yeast from a Patagonian beech tree ended up in beer.

Steve Mills
via email

contributors

Justin Burnsed made the journey from homebrewer to professional brewer and blogged about his time enrolled in the UC Davis Master Brewers program and out in the real world at byo.com. He is currently Partner and Brewmaster at Prospectors Brewing Company in Mariposa, California (near Yosemite National Park), which opened this summer.

In the previous issue, Justin wrote about brewing hoppy, American-style ales and how to get the best hop character from your hops.

In this issue, he tackles the topic of troubleshooting — what to do when something goes wrong with your beer. His article begins on page 36.

Michael Tonsmeire is a homebrewer and fermentation enthusiast from Washington DC. His blog, The Mad Fermentationist, at www.madfermentationist.com, chronicles his fermenting experiments ranging from beer to sake to vinegar to cheese. He is especially fond of soured beers and has written multiple articles on that topic for *BYO*. See, for example, "Sour Beer Orientation," in the November 2010 issue and "Adding Fruit to Sour Beer," in the September 2010 issue.

In this issue of *BYO*, he returns to the topic and discusses brewing beer via spontaneous fermentation — fermentation powered by wild microbes instead of cultured yeast. His article begins on page 46.

Glenn BurnSilver is a freelance writer who enjoys outdoor activities such as hiking and camping in the backwoods. He has lived in Colorado and Alaska and now resides in Scottsdale, Arizona. BurnSilver is also an avid record collector and travels to record conventions across the country. He also maintains a music review blog, Liner Notes, which can be found at www.burnsilver.com.

Glenn has compiled several collections of homebrew clone recipes for *BYO*, including summer beer clones in the July-August 2009 issue and Belgian-inspired brews in the July-August 2008 issue. On page 26, he explores the growing trend of collaborations between commercial breweries and provides homebrew clone recipes from brewers including Sierra Nevada, Stone Brewing Co. and others.

That sounds like a very reasonable hypothesis.

Two words, keg stand

Last year I took the Beer Judge Certification Program (BJCP) course and after some 8 years of extract brewing realized it was time to move to all-grain. I did my first all-grain brew last September and have loved the challenge of it, and especially the flexibility. While my brew library is good sized, I found that your July-August 2010 article, "From Grain to Glass" was just an outstanding help. I use it as a constant reference and it has helped me think through setting up a brew sheet that keeps me on task and marks my critical points in the process.

Last week I bought a kegerator (one that will hold and tap 3 kegs). I have decided to move from bottling to draft now as a logical extension of continuing the brew journey. I must admit, my husband and I were a bit shocked when the instructions seemed to indicate that the beer would need to be drunk within 60 days. We have friends, but not that many! Anyway, we find ourselves quite confused about making this change. We will use our brew club buddies as a source of information, but it made me realize that I have not read much about kegging in *BYO*. Sure, you have articles about fitting kegs for beer, and how to build draft systems; but I think it is time for a more expansive article about kegging. For example, can you fill them half way and bottle the rest, if it will only hold for 60 days? Does the beer really go south after 60 days? How do people truly get rid of so much beer? If I put really different styles of beer in the kegs do I just keep the same CO_2 setting for all the beers? Can you change it for each keg? I just feel like this is truly uncharted territory for me so the assumption is that others who are making the change from bottle to keg must have similar questions.

Susan Ryan
Head Brewer
Dead Cricket Brewery
Floyds Knobs, Indiana

We're not sure why anyone would claim that kegged beer only lasts 60 days. That simply isn't true. Like all homebrew, kegged beer can remain fresh for several months, and often even longer. No need for keg stands to drain your kegs of your precious creations that quickly. The last big traditional kegging article we ran was in the November 2010 issue. However, we have a kegging special issue coming out soon. It collects all the best articles we've ever published on the subject. We believe it will be a useful resource for brewers who are new to kegging. BYO

homebrew nation

READER PROFILE

The Ale Camino
Michael Frenn • Placerville, California

There are many sayings I'm fond of. One is, "Give a man a beer, he'll waste an afternoon. But teach a man to brew, and he'll waste a lifetime!" One has to look no further than my Ale Camino to realize how true that statement is. And there can be no mistaking my passion for beer and brewing.

Admittedly, I bought the "Camino" for several reasons, including needing a truck, wanting a mid 80s GM product (because I can work on those), and for schlepping around all of my brewing stuff, especially for the various team brews that my homebrew club HAZE (Hangtown Association of Zymurgy Enthusiasts) holds throughout the year. But one afternoon, when I was pleasantly wasting time with a frosty pint of homebrew, it occurred to me that the tailgate of the Camino looked awfully dry and barren. Two sips more of my brew and a recurring phrase from grad school began running through my head: "Form follows function!" And then a formula: Brewer + Tailgate + X = Party. X = Taps! At last, my higher education returned a dividend!

The installation took all of 30 minutes (and another pint), once I overcame the fear of drilling two holes in otherwise unblemished sheet metal. I first used some duct tape to help get a visual balance for height and width, and left that in place as I drilled the 1-inch holes. The shank length isn't critical beyond being long enough to get the job done (a law of nature, I'm told). There is one trick, though — I cut several small pieces of dowel the same length as the internal width of the tailgate and wedged them in, two at each hole. This is necessary because if you don't do this, the external tailgate skin will sink in as you tighten down the shanks. But that's all there is to it. When pouring at events, I use two single circuit cold plates in an ice chest. When not in use, two "Road Rubbers" keep the dirt out.

The Ale Camino was a huge hit from the second I first drove it. It gets photographed at least once a week when I'm out driving it around (which is every day). But here's the most important fact of all, I didn't name it Ale Camino! That idea came from Greg Tobin, an excellent homebrewer in HAZE. But once he said it, I knew it was gold! BUV (Beer Utility Vehicle) was a runner-up name that came from Rob Bates, who owns the Reno Homebrew Store. I will take credit for the 350 IBUs, though. And the two questions I get asked more than any other: "Do the cops hassle you?" Nope, don't even give me a second look. And "Do they work?" To which I can't resist, "Do I look like someone who would waste his time on fake taps?!"

byo.com brew polls

Have you ever tried a spontaneous or "wild" fermentation?

No, but I would like to 53%
No, I'm not interested 37%
Yes, a few times 7%
Yes, many times 3%

social homebrews

Join *BYO* on Facebook: www.facebook.com/BrewYourOwn

Follow *BYO* on Twitter at: @BrewYourOwn

what's new?

White Labs Alcohol Test Kits

Based on the hugely popular Big QC Day, which has raised awareness about the importance of testing in craft beer, White Labs' new Alcohol Test Kit Plus gives homebrewers and home winemakers the ability to get accurate numbers about their creations. The kit measures alcohol by volume and alcohol by weight for one sample with the option to purchase additional tests.
http://whitelabs.com/lab/alcoholtestkits_info.html

Cool Brewing Fermenter Insulator

An inexpensive and easy solution to keeping your homebrewed beer fermentation temperatures in control, the Cool Brewing fermenter insulator is designed specifically to accommodate standard 6.5- and 5-gallon (25- and 19-L) fermenters and carboys. Just add ice packs, ice, (frozen 2-liters work great) or anything cold and switch out as needed to reach the desired temperature. $55
www.cool-brewing.com

BeerSmith 2.1 Brewing Software and BeerSmithRecipes.com New Releases

BeerSmith 2.1 is now available for download from beersmith.com. In addition, the folks at BeerSmith have also launched BeerSmithRecipes.com recipe sharing site and cloud service. BeerSmith 2.1 includes a new recipe timer (open any recipe and click on the timer tab) which shows you step-by-step how to mash, steep and boil your recipe and also plays an alarm as each step is reached. BeerSmithRecipes.com is a new cloud folder feature in BeerSmith. BeerSmithRecipes.com is a large online repository for BeerSmith 2 recipes, both public and private. You can visit the site and search from more than 10,000 recipes that others in the BeerSmith community have published.
http://beersmith.com

calendar

September 8
Brighton, Colorado
Orpheus Cup
The second annual Orpheus Cup mead tasting and competition offers a chance to experience more than 30 different meads at a private event to benefit the Orpheus Pagan Chamber Choir. It is not a requirement to compete to come and taste.
Deadline: September 7
Entry fee: $10 per subcategory
Contact: Andrew Adams, orpheuspcc@gmail.com
Web: www.orpheuspcc.org/orpheus-cup.html

September 15
Racine, Washington
Schooner Homebrew Competition
The Belle City Home Brewers and Vintners (Racine), The Bidal Society of Kenosha and The Milwaukee Beer Barons homebrew clubs will again combine forces to present the 8th annual southeast Wisconsin homebrew competition. Held each year in conjunction with Great Lakes Brew Fest, the Schooner features a one-of-a-kind "Club Challenge," which offers a cash reward to the club with the most medal points earned.
Deadline: September 1
Entry fee: $6
Contact: Jay Mollerskov, jay@theschooner.org
Web: www.theschooner.org

September 21–23
Central Point, Oregon
Southern Oregon Beer & Wine Festival Amateur Competition
Held in conjunction with the annual Harvest Festival, this event is the largest amateur wine, beer, soda and label art competitions south of Portland, Oregon.
Deadline: September 6
Contact: Bob Bacolas, 541-499-6777
Web: www.attheexpo.com

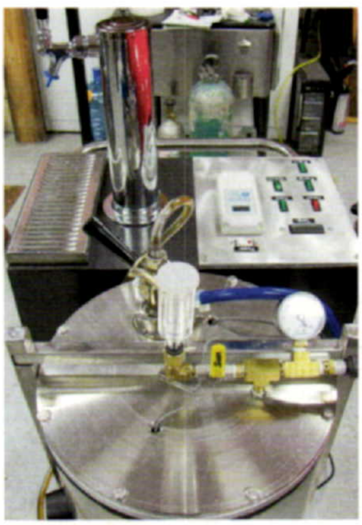
homebrew drool systems

Brammer's Beer Machine

Chris Brammer • Crowley, Louisiana

Being an engineer and machine/fabrication shop owner can be a real plus when the brewing bug bites you. Several months ago, while enjoying a brew with a friend with a brewing background, the bug bit and I had to try it. Having a degree in mechanical engineering I tend to get involved in various projects to relax, from designing and building a hovercraft, to rebuilding a 1972 Corvette Stingray. After surfing the web, reading all I could about homebrewing beer (including getting a subscription and back issues of *BYO* magazine) I decided to build a machine that could boil, ferment, chill and serve. Along the way I added a cooler to chill my mugs and mounted it all on a cart so as to be able to roll it out on the patio.

The unit works very well with the extract brews I have made thus far, and I have gotten good reviews along the way. Not only of the looks and functionality of my machine, but great reviews on the beers I've made. The basic fermenter is a purchased unit that I modified to take the pressure I wanted, with zero leakage and an adjustable pressure relief. It is wrapped with a cooling coil and has an electric heating element, with dual circuit control of +/- 1 degree from boiling to about 26 °F (-3 °C). It works great for critical temperatures of many yeast. A vessel and valve was added at the bottom of the fermenter to catch fermentation residue without having to rack to a second vessel.



A circulation pump of 1 GPM is incorporated to move fluid and maintain an even temperature throughout the fermenter. The stainless steel lid of the fermenter contains dual thermo wells for temperature readout and control, as well as pressure gauge, relief valve, airlock fitting and extraction tube for the sanke valve supplying CO_2 and taking my brew to the tower. Two small refrigeration units are used, one to chill the fermenter and one to chill mugs. I am very careful with sanitation, but find it quite easy, since once yeast is pitched and the airlock installed, NO air hits the brew until bottled or served. Brewing is so much fun that I built a dual 5-gallon (19-L) kegerator, using a 5-cu.-ft. freezer with added controls, so I can have three brews on tap when friends stop by.

YOUR FIRST RECIPE

by betsy parks

Once you feel comfortable homebrewing with pre-written recipes, it's only natural to wonder how to formulate an original recipe of your own. With a little up-front planning and research, you can successfully start coming up with your own original beer.

Decide your objective

The first step toward putting together a recipe idea is to decide exactly what it is you would like to brew. Do you want to brew something to a specific style, such as an IPA? Or would you like to brew something that tastes like a favorite commercial beer, which is known as a clone recipe? Perhaps you want to brew something entirely original — that's fine too! Each objective has a bit of a different approach, however they all involve researching what other brewers have done first.

If you would like to brew something to style, the first step is, of course, to research that style and find out how it is most successfully brewed. There is a wealth of information out there about brewing to style, including the Classic Beer Styles series of books, which covers several classic beer styles in individual titles. *BYO*'s Jamil Zainasheff has also covered the basics of many beer styles during his tenure as the author of "Style Profile," and you can check out his special issue *30 Great Beer Styles* (www.byo.com/store) or check out *BYO* recipes at www.byo.com/stories/recipeindex. The important part of the research is to read several recipes to see what proportions are commonly used and the brewing processes involved.

Similarly, if you want to brew something to taste like a commercial beer you will again need to research the background of the beer. Many, many commercial beers have already been recreated successfully by homebrewers, several of them in the pages of *BYO*, and many thousands more on the Web in homebrew forums. If you can't find it there, however, often times you can contact the brewery who may have a homebrew-friendly brewer on staff who can point you in the right direction. (This is in fact the way that clone recipes are formulated, in part, at *BYO*. For more information about developing clone recipes, visit www.byo.com/component/resource/article/890.)

If you want to brew something not to style and not to replicate an existing beer, you will be attempting a more advanced kind of recipe formulation. You can of course brew anything you want any time you want, but to be able to create an original beer based only on an idea requires practicing brewing existing styles and beers to be the most successful. Try formulating some simple recipes to styles or clones first until you start to master the skill of recipe development.

Try a consensus recipe

Once you have decided on what to brew, the easiest way to put together a simple recipe is by consensus — that is selecting the most common ingredients found in similar recipes and going with an average amount of each. Do the same with the brewing procedure — adopt the most common techniques (boil times, hop schedule, fermentation temps, etc.). From that jumping off point you can brew the recipe over and over, tweaking ingredients and techniques to suit your taste, resulting in your own individual recipe. You can use brewing software, such as BeerSmith or ProMash to calculate your efficiencies and keep track of your recipes as they evolve. You can also do some simple beer recipe calculations on the Web at http://byo.com/resources/brewing.

by marc martin

DEAR REPLICATOR, I AM FORTUNATE IN MY LINE OF WORK TO TRAVEL AROUND THE WORLD AND SAMPLE SOME FANTASTIC BEERS. RECENTLY, I FOUND MYSELF IN ALBANY, N.Y. AT THE C.H. EVANS BREWING COMPANY AT THE ALBANY PUMP STATION. WHILE THERE I TRIED THEIR AWARD-WINNING KICK ASS BROWN ALE. TO BE HONEST, I AM NOT A FAN OF BROWN ALES BUT THIS WAS TRULY EXCEPTIONAL. IT WAS WELL BALANCED AND JUST HOPPY ENOUGH. I WOULD GLADLY BREW MORE BROWN ALES IF I COULD FIND A RECIPE CLOSE TO THEIR KICK ASS BROWN. ANY CHANCE YOU COULD HELP ME REPLICATE THIS FANTASTIC BEER?

DOUG MCCABE
DOUGLAS, MASSACHUSETTS

It is difficult to find a U.S. brewery with a 225 year history but that is exactly what the C.H. Evans Brewing Company can claim. With Neil Evans at the helm this now represents five generations of the Evans family brewing tradition. The original brewery was started in 1786 in Hudson, New York. The Great American Experiment of Prohibition proved to be too much of a burden and the brewery closed in 1920. In the late 1980s Neil started to develop a plan to revive the brewery and produce the Evans' beers that had been so loved by the eastern New York locals. As a first step he began homebrewing in 1990.

After acquiring the famous Albany Pump Station in Albany, New York, Evans Brewery officially opened in 1999. Neil had been successful with homebrewing but soon discovered that he would need much more actual brewing science education to brew on a large commercial scale. He was fortunate to find professional brewer George DePiro who stayed on with him until just this May when he left to open his own brewery. George was responsible for re-creating many of the recipes and for development of the Kick Ass Brown Ale. The new brewer, Ryan Demler, began homebrewing in 2003. After working at the Old Saratoga Brewery in Saratoga Springs, New York for two years he became a production brewer at Cameron's Brewery in Oakville, Ontario before coming home to the Albany area to be C.H. Evans' sole production brewer.

This brown ale is brewed to fit the American style category. Its deep mahogany color is accented by dark ruby highlights and is topped by a fine light tan head. Munich and Caramunich® malts combine to build a heavier body than its English Brown counterpart. Dry hopping leads to a very hop forward nose. The flavor is well balanced and exhibits medium chocolate and caramel flavors.

Doug, now you can enjoy an excellent brown ale anytime because you can "Brew Your Own." For further information about the C.H. Evans Brewing Company and their other fine beers visit the Web site www.evansale.com or call the brewery at 518-447-9000. BYO

C.H. EVANS BREWING COMPANY KICK ASS BROWN ALE CLONE
(5 gallons/19 L, extract with grains)

OG = 1.056 FG = 1.014 IBU = 35 SRM = 14.7 ABV = 5.5%

Ingredients

3.3 lbs. (1.5 kg) Briess light, unhopped, malt extract
1.5 lbs. (0.68 kg) dried malt extract
2 lb. 6 oz. (1.08 kg) Pilsner malt
10 oz. (0.28 kg) CaraMunich® II malt (50 °L)
7 oz. (0.19 kg) Victory® malt (25 °L)
2 oz. (57 g) Carafa® II malt (425 °L)
9.2 AAU Columbus hop pellets (60 min.) (0.65 oz./18.4 g of 14.1 % alpha acid)
1.7 AAU Cascade hop pellets (10 min.) (0.3 oz./8.5 g of 5.75 % alpha acid)
1.1 AAU Crystal hop pellets (10 min.) (0.3 oz./8.5 g of 3.6 % alpha acid)
1.7 AAU Cascade hop pellets (0 min.) (0.3 oz./8.5 g of 5.75 % alpha acid)
1.1 AAU Crystal hop pellets (0 min.) (0.3 oz./8.5 g of 3.6% alpha acid)
10 AAU Amarillo® hop pellets (1.0 oz./28 g of 10 % alpha acid) (dry hop)
5.25 AAU centennial hop pellets (0.5 oz./14 g of 10.5 % alpha acid) (dry hopped)
½ tsp. yeast nutrient (last 15 minutes of the boil)
½ tsp. Irish moss (last 30 min.)
White Labs WLP 001 (American Ale) or Wyeast 1056 (American Ale) yeast
0.75 cup (150g) of corn sugar for priming (if bottling)

Step by Step

Steep the crushed grain in 2 gallons (7.6 L) of water at 151 °F (66 °C) for 30 minutes. Remove grains from the wort and rinse with 2 quarts (1.8 L) of hot water. Add the liquid and dry malt extracts 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 the beer and add the Amarillo® and Centennial dry hops. Allow the beer to condition for one week, remove the dry hops and then bottle or keg. Allow the beer to carbonate and age for two weeks and enjoy your Kick Ass Brown Ale.

All-grain option:

This is a single step infusion mash using an additional 2 lbs. 6 oz. (1.08 kg) of 2-row pale malt and 6 lbs. (2.72 kg) of Munich malt to replace the liquid and dried malt extracts. Mix the crushed grains with 3.7 gallons (14 L) of 172 °F (78 °C) water to stabilize at 151 °F (66 °C) for 60 minutes. Sparge slowly with 175 °F (79 °C) water. Collect approximately 6 gallons (23 L) of wort runoff to boil for 60 minutes. Reduce the 60 minute hop addition to 0.55 oz. (16 g) of columbus hop pellets (7.8 AAU) to allow for the higher utilization factor of a full wort boil. The remainder of this recipe and procedures are the same as the extract with grains recipe.

In The Lab

Pro advice for quality control

by Betsy Parks

BEHIND MANY GREAT BREWS ARE SCIENTISTS TESTING AND TASTING BEERS IN THE LAB. IN FACT, EVERY BEER — BE IT COMMERCIAL OR HOMEBREW — CAN BENEFIT FROM BETTER QUALITY CONTROL. IN THIS ISSUE, TWO BEER LAB EXPERTS SHARE THEIR ADVICE.

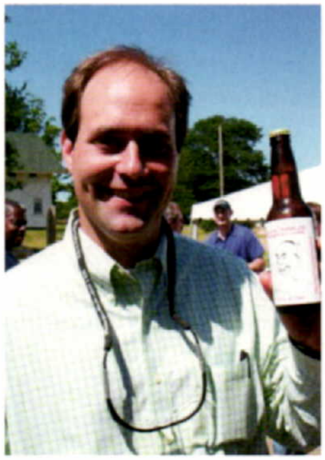
We run three testing programs at Bell's: analytical, microbiological, and sensory. All are carried out to ensure consistency and conformance to the original design of the brew (and, most importantly, to the expectations of our customers). Analytical (chemical/physical) testing includes the measurement of alcohol, bitterness, carbonation, color, pH and diacetyl. Extensive microbiological testing is carried out 1) to ensure the viability and vitality of our yeast and 2) to ensure no contamination has occurred anywhere in the process. Sensory testing encompasses all of the above and it is, at the end of the day, our most important analytical tool.

Sensory analysis is the go-to technique of the homebrewer. Everyone at every skill level can become a better taster. Virtually all of the potential defects that brewers are concerned with have a unique sensory signature. Most everyone has the ability to recognize any given defect with a little bit of training and LOTS of practice. On the flipside of that, most everyone is anosmic to one or more sensory stimuli. In addition, any given person on any given day could have sensory fatigue and not detect something that would normally hit them like a smack in the face. That is why if you are serious about using sensory analysis as a quality control tool, it is imperative to maintain a panel of trained tasters, and to constantly challenge them and "keep them on their nose."

By far the most common flaw I find in my line of work is inconsistent yeast/protein levels. Our ales are unfiltered and unpasteurized. The nature of yeast is such that it tends to flocculate into clumps. We employ a dizzying array of procedures designed to standardize the amount of yeast that makes its way into package, but still discover packages — both bottle and keg — that contain more yeast than we'd like.

If you want to perform better quality control on your homebrews, or if you want to do this kind of work on the professional level, here are my recommendations.

1. Join the American Society of Brewing Chemists (ASBC) (www.asbcnet.org/) and Master Brewers Association of the Americas (MBAA) (mbaa.com) and attend as many meetings, conferences, and webinars as you can. Sign up for the online Methods of Analysis from ASBC and incorporate methods into your operation wherever practical. Take a class at the Siebel Institute. All of these organizations have tons of offerings.
3. Join the Brewers Association (brewersassociation.org); attend their "power hour" webinars.
4. Tour breweries. The lab — in my humble opinion — is the most important stop on the tour! If you can get a few minutes with lab folks, that's a great time to get informed answers to very specific questions.
5. Sensory, sensory, sensory. Hone your tasting skills. Have your friends blind test you. For example, let a beer get infected and see how many times your friend can dilute it and you still detect the spoilage. There are many different beer spoiling organisms — get familiar with the flavors and aromas that the spoilers in your area impart to your brews.
6. Keep excellent records of the procedures and raw materials you use. Lot numbers, age, storage conditions, temperatures — anything that changes from one brew to the next can impact the final product.



Luke Chadwick, Quality/Lab Manager at Bell's Brewery in Kalamazoo, Michigan. Luke earned his B.A. in Chemistry from Kalamazoo College in 1995 and his Ph.D. in Pharmacognosy in 2004 from the University of Illinois at Chicago. His graduate research was focused on the chemistry and pharmacology of compounds derived from the hard resins of hops. After one year of postdoctoral work at the UIC/NIH Center for Botanical Dietary Supplements Research - again working on hops - Luke joined Kalsec, Inc. in 2005 as a Research Scientist and soon became a Lead Research Scientist. In 2008, Luke co-founded Wrightwood Technologies, Inc., went on to spend a year as a Research Scientist on a Metabolomics project within University of Michigan's Center for Translational Pathology, and since October 2010 Luke has been working at Bell's. His work interests include method development, process optimization, and sensory science.

Jim Crooks, Quality Control Manager at Firestone Walker Brewing Company in Paso Robles, California. Jim earned his B.S. in Food Science from California Polytechnic San Luis Obispo in 1997. He began working as the lab manager at SLO Brewing Company in 1999 and was trained to operate in all facets of the brewery. He has been Firestone Walker's Quality Control Manager since 2001.

Many of the routine tests we do in the Firestone Walker lab can be easily done at the homebrew scale. The merits of a quality brew start with healthy yeast and without a microscope and a hemacytometer to look at viability and density, you are just guessing about the quality of your yeast. This tool, as well as with other tools like refractometers/hydrometers for checking gravity, thermometers, pH strips, beer color wheels and basic water testing kits can all be purchased inexpensively ($30–100).

For the advanced homebrewer, setting up a field micro lab can be a little more involved but not out of the question. A homemade laminar hood and sterile sampling technique is the basic backbone of a small scale micro program. WhiteLabs.com is a great homebrewing resource that offers a premade media test kit bundle that can be geared toward either anaerobic or aerobic bacteria as well as wild yeast. The White Labs site also offers a number of educational links as well as actual pictures of what bacteria look like when growing on the media. The potential cost savings to be had by doing a little micro investigation of your process can be well worth the cost of the tools, versus the potential cost of losing a few batches to poor sanitation technique.

Some of the common brewing flaws we catch in the lab are %ABV and color deviations from batch to batch. Although slight color deviation is not a pressing quality flaw, most people drink with their eyes and color is one of the first noticeable attributes a customer will see so we take it seriously. Rushing a sample through the program can also give rise to careless mistakes and often wastes more time by raising questions due to erroneous data. When in doubt, repeat your analysis. BYO

Mystery Spots

Temperature control, oxidation

by Ashton Lewis

Q I'M AN EXTRACT BREWER (THAT ALSO STEEPS) AND I RECENTLY NOTICED A BUNCH OF WHITE SPOTS ON TOP OF MY BREW (WHICH WAS A WHEAT RECIPE) AFTER I TRANSFERRED IT TO THE SECONDARY (SEE PICTURE BELOW). I THOUGHT IT WAS MOLD FORMING BUT READ THAT IT'S PROBABLY "YEAST RAFTS" OR FLOCCULATED YEAST CLUMPS. THE BEER TURNED OUT NICELY BUT I'M CURIOUS AT WHAT CAUSES THIS TO HAPPEN? ARE CERTAIN BEER STYLES MORE SUSCEPTIBLE TO THIS PHENOMENON?

ANDREAS BETTIN
TORONTO, ONTARIO

A I am not completely sure about the nature of these little floaters. I think, however, that it is possibly either yeast, as you suggest, or protein clumps. Some yeast strains have a tendency to form a dense top crop. When these beers are racked some of the top cropping yeast is carried over and the appearance is at times strange. Weizen yeast is an example of an aggressive top-cropper. In the case of *Brettanomyces*, a pellicle is formed on the surface of the beer and also has an odd appearance.

This could very well be the early signs of a *Brettanomyces* pellicle forming on the surface of your beer. If this is the case it is an indication of a problem, unless you intentionally added this yeast type. *Brettanomyces* is one of those strains considered to be "wild" and can be a problem to control if you bring it into your brewery and do not have rigorous sanitation procedures.

The other thing that may be responsible for the unusual appearance in the fermenter is trub carry-over from the brewhouse. Wheat contains a significant amount of gluten proteins and when wheat malt is mashed the glutens tend to be retained in the mash and discarded with the spent grain. If you steeped some wheat malt it is possible that some of these gluten proteins made it into the fermenter and resulted in the odd appearance.

The good news about things like trub and yeast that collect on the top of fermenting beer is that you can rack the beer away from the solids and there is no detrimental effect on beer quality. If this beer begins to start smelling leathery, earthy and like a barnyard after a few months of storage the source was likely *Brettanomyces*. If that proves to be the case you should be careful handling the bottles since *Brettanomyces* is a super-attenuating strain that will slowly ferment dextrins in your beer that *Saccharomyces* species cannot. This can result in bottle grenades.

> "This could very well be the early signs of a *Brettanomyces* pellicle forming on the surface of your beer."

Q FOR THOSE OF US WITHOUT TEMPERATURE CONTROLS THROUGH FERMENTATION, HAS ANYONE DONE ANY EXPERIMENTS WITH CHANGES IN WORT TEMPERATURES? IT WOULD BE GREAT TO HOLD 65 TO 68 °F (18 TO 20 °C), BUT WHAT ABOUT A 70 °F (21 °C) START, DIPPING INTO THE 60s (~18 °C) THEN ALLOWING THE TEMPERATURE TO INCREASE BACK INTO THE 70s (~20S °C)? OR, STARTING IN THE 60s (18 TO 20 °C) AND CREEPING UP INTO THE MID 70s (23 TO 24 °C)? IS THERE ANY WAY TO PREDICT THE YEAST FLAVORS WHEN THE TEMPERATURE IS MOVING?

MICHAEL FLOREZ
VIA FACEBOOK

Photo courtesy of Andreas Bettin

A The batch size for most homebrewers has been around 5 gallons (19 L) for a very long time, and keeping this volume of fermenting beer cool is not difficult. Recently, however, many homebrewers have become interested in controlling fermentation and aging temperature and all types of fancy rigs are being built to make little fermentation cellars for use at home. To boot, batch sizes for many homebrewers has increased and the heat of fermentation is more difficult to remove in these larger vessels.

The short answer to your question is yes; there is a long history of fermenter temperatures moving up and down during fermentation. At one time it was common for tanks to be equipped with attemperation coils, or pipes inserted into fermenters for the purpose of temperature control. A fairly common method used for attemperature coil operation is to monitor the fermenter temperature with a thermometer and to simply turn the cooling valve on for enough time to cool the fermenter and then after some time the valve is turned off. This method of tank control is called "on/off" control and is how most thermostatic controls are operated. Since manually controlling fermenters with attemperation coils requires brewers to manually monitor and control fermenters the result is a temperature profile that moves up and down around the desired temperature.

Predicting how temperature affects flavor is not an exact science, but in general terms the effects of fermentation temperature on beer flavor are well known. Beer flavor is cleanest when the fermentation temperature is as low as possible for a given yeast strain without causing problems with sluggish and/or incomplete fermentations. As temperature increases the production of esters increases and fruity aromas increase, especially for beers made with strains that are noted for the production of aromatics. The production of these compounds is greatest at the peak of fermentation and it follows that the most critical point to consider for temperature control is this peak in activity.

Commercial brewers often begin fermentations cooler, usually about 5 °F (3 °C) cooler, than the controlled temperature, which you can try. One reason for allowing the fermentation to experience this "free rise" is that tank temperature is easier to control when the fermenter is being mixed by the activity of fermentation. After fermentation is complete the temperature is lowered. If you plot temperature over time the result is a curve that goes up and down.

To summarize, temperature fluctuations are normal and the most important temperature to control is the peak temperature experienced during peak activity. Also, starting cool and allowing your fermenter to warm up is a good method to consider if you lack refrigerated cooling. To keep the peak from getting too high you can use a low tech method such as plunging your carboy into an ice bath for 20 minutes or so at a time, a method that mimics turning on the valve of an attemperation coil.

Q I AM WRITING IN REGARDS TO THE ANSWER YOU GAVE IN THE MAY-JUNE 2012 ISSUE TO THE QUESTION "DOES ADDING PRE-BOILED WATER TO THE CARBOY AFTER I RACK MY BEER HELP AGAINST OXIDATION (LESS HEADSPACE) OR HURT IT (RISK OF SPLASHING)". I AM BREWING BEER TO FILL A 13-GALLON (49-L) OAK BARREL. WHEN I FILL THE BARREL I AM GOING TO PITCH A SMACK PACK OF WYEAST ROESELARE AND A WHITE LABS BELGIAN SOUR ALE I VIAL. I AM BREWING TWO 5-GALLON (19-L) BATCHES THAT ARE HIGHER IN GRAVITY THAN DESIRED IN THE BARREL AND GOING TO DILUTE IT WITH BOILED AND COOLED WATER TO TOP OFF THE BARREL. MY QUESTION IS WILL THE YEAST THAT I AM PITCHING METABOLIZE THE OXYGEN THAT IS STILL DISSOLVED IN THE WATER DURING THE AEROBIC GROWTH PHASE OR IS IT DESTINED TO BE OXIDIZED.

RONALD MCGUIRE
VIA EMAIL

A This is a great follow-up to the question I recently was asked about adding water to top-up a carboy in an attempt to minimize oxidation. You are absolutely correct that adding water to the fermenter as the fermenter is filled, or even to the wort following boiling, is not a problem because the yeast will indeed metabolize the oxygen in the early stages of fermentation.

I am a bit confused by your method, however. It seems that you are planning to pitch a mixed culture of yeast and bacteria into your wort and conduct your primary fermentation in the barrel. While there is nothing wrong with this approach, you will experience excessive foaming and beer loss if you top the barrel up before the primary fermentation begins.

An alternate approach that may work best is to adjust your batch size so that you end up with a total of about 14 gallons (53 L) of wort after you have added the dilution water. If you typically ferment in 5 gallon (19 L) carboys you will want to split the batch into three carboys and conduct the primary fermentation. After the peak activity has slowed down in about seven days you can then rack the beer into the barrel. The advantage to this method is that you will be able to completely fill the barrel without worrying about a big mess due to over-foaming during the primary.

If this is your first sour beer you will be tempted to taste the beer during aging. This is hard to avoid and the truth is that tasting is an important part of producing these kinds of beers. But there are a few practical rules that will benefit your end product.

Rule #1 is to taste very infrequently, if at all, for the first several months of aging and then when you feel that the beer is approaching the finish line limit your tasting sessions to once every month or two.

Rule #2 is to keep the pellicle intact to protect the surface of the beer from oxygen and to prevent/limit the potential of acetic acid bacteria from growing on the surface of the beer. One of the best ways to protect the pellicle is to drill a small hole in the head about 9 inches (23 cm) above the bottom of the barrel when it is laid on its side and to plug the hole with a stainless steel nail. As long as the hole is about 1/16-inch smaller than the nail you need not worry about the nail coming loose from the hole. This is your sample valve. Although a wine thief is a handy device, they can damage the pellicle and this really should be avoided at all cost. I have violated this rule in the past and strongly suggest using the sample nail project.

Q CAN GLUTEN PROTEINS BE REMOVED BY USING A CHLORINATED CLEANER WHEN I WANT TO USE MY NORMAL BREWING EQUIPMENT TO MAKE GLUTEN-FREE BEER?

LAWRENCE BANACHOWSKI
OXFORD, MICHIGAN

A As long as the equipment that touches wort or beer is cleaned immediately after use with an appropriate cleaner there will be no problem. I personally do not like chlorinated cleaners because they have the potential to pit stainless steel and have an odor that I find objectionable, but that is just my own pickiness.

The area that poses a challenge for gluten-free brewing is the dry ingredient side of the operation. At Springfield Brewing Company we store our pale malt in an outdoor malt silo and keep our specialty malts in bags stored in the mill room. A conveyor is used to transfer malt from the silo to the mill and a bucket elevator is used to lift special malts from the floor into the top of our mill. The milled malt flowing from our 4-roll mill with shaker box falls into the grist case where it is batched up before dropping it into the mash mixer.

Malt dust is a rich source of gluten proteins and is extremely difficult to clean for one simple reason. Malt handling equipment and dry mills are not designed to be cleaned with cleaning solutions. The goal with dry material handling is to keep the equipment dry, free of dust and to allow for ingredients to be cleanly brought into the operation. These measures greatly help to prevent problems in the dry side of the operation, and eliminate the need to use liquid cleaning in this part of the brewery.

When it comes to eliminating gluten proteins from a brewery, the design of the dry side makes the challenge very real to the commercial brewer. One obvious solution is to invest in dedicated equipment that is only used for the production of gluten-free products. In a commercial operation this solution may not be a realistic thing to do and is one of the reasons that gluten-free beers are not very common. At home the challenge is not nearly as difficult. You may need to buy a separate mill or buy a mill than can be disassembled and cleaned to address the issue. And anything you use to weigh, transfer or store dry materials needs to be thoroughly cleaned before use. BYO

Robust Porter

Brown and roasty

by Jamil Zainasheff

I remember the genesis of my first all-grain robust porter recipe. I was an extract brewer making the transition to all-grain and I wanted to brew a robust porter on my new MoreBeer sculpture. Luckily, I had a chance to ask Regan Dillon, who is a fanatic about robust porter, for a recipe. He came up with a recipe that served me well over the years, winning many awards. I have tweaked that first recipe many times, but the general idea is still the same. When we recently brewed a robust porter at my brewery, Heretic Brewing Company, that recipe was yet another branch from that original tree. It was just coincidence that Regan happened to stop by one day as the beer was ready for packaging. It was a great moment for me to share my first commercial batch of porter with Regan, the person who gave me my first robust porter recipe, and to have him voice his approval of the result.

Robust porter is a complex, rich, roasty ale. Examples of the style range quite a bit, from bigger, bolder American interpretations to less bold English interpretations. This style should always have a fair amount of roasted character, reminiscent of coffee and chocolate. The best examples also exhibit other malt character, such as bready, biscuit, and caramel flavors and aromas. The appearance of a good robust porter ranges from dark brown to almost black. Hop bitterness is firm, but the overall balance can range from slightly sweet to firmly bitter with the finish ranging from dry to medium sweet.

A common mistake many brewers make when attempting this style is on the roast character. Either the amount of roast is too little or too much or the flavor of the roast is far too acrid. It can be tricky getting the right balance, because you also need to account for the effects of residual malt sweetness and specialty grains versus the effects of hopping and yeast attenuation. If you decide to brew an American style robust porter, use clean, neutral ale yeast and a higher starting gravity. The hop bitterness, flavor and aroma are also higher in an American version. If brewing an English version, use a lower starting gravity, less hops and an English-style yeast strain.

You have some flexibility in choosing base malt for robust porter. My preference for almost all "American-style" beers is to use North American two-row, which gives the beer a clean, subtle, background-malt character common to many fine American craft beers. For robust porter you could also use North American pale ale malt which adds a slightly richer background malt character or British pale ale malt which adds an even deeper, fuller rich malt character. When using North American malt, I like to add about 10% Munich malt to the grain bill. It adds a background malt note that helps fill out the character of the beer. Extract brewers should use a light color North American malt extract. All-grain brewers can use a single infusion mash at a mid-range mash temperature, 150 to 156 °F (66 to 69 °C). Use a lower mash temperature when using lower attenuating yeasts or high starting gravities and use a higher temperature when using the higher attenuating yeasts or lower starting gravity beers.

Specialty malts are an important element of robust porter, but there is lots of room for experimenting with rich malt flavors. Every robust porter needs roasted malt notes and most examples include some level of caramel malt flavors. Not including any caramel malt can leave the beer tasting more like a dry stout if there isn't plenty of unfermented sugar in the beer. Experimenting with the amounts and colors of crystal and roasted malts is a great way to change the character of your beer. The roast, chocolate, and coffee character of the style comes from the use of highly

Continued on page 21

ROBUST PORTER
by the numbers

OG:	1.048–1.065 (11.9–15.9 °P)
FG:	1.012–1.016 (3.1–4.1 °P)
SRM:	22–35
IBU:	25–50
ABV:	4.8–6.5%

Photo by Charles A. Parker/Images Plus

Black Widow Porter
(5 gallons/19 L, all-grain)
OG = 1.064 (15.7 °P)
FG = 1.015 (3.8 °P)
IBU = 37 SRM = 37 ABV = 6.5%

Ingredients
10.6 lb. (4.82 kg) Great Western pale malt 2 °L
1.3 lb. (600 g) Best Malz Munich malt 8 °L
14.1 oz. (400 g) Great Western pale malt (or similar) Crystal 40 °L
10.6 oz. (300 g) Briess chocolate malt (or similar) 350 °L
7 oz. (200 g) Briess black patent malt (or similar) 525 °L
7.2 AAU Kent Goldings, pellet hops, (1.44 oz./41 g) at 5% alpha acids) (60 min.)
3.15 AAU Fuggle, pellet hops, (0.63 oz./18 g at 5% alpha acids) (15 min.)
3.15 AAU Kent Goldings, pellet hops, (0.63 oz./18 g at 5% alpha acids) (0 min.)
White Labs WLP001 (California Ale) or Wyeast 1056 (American Ale) yeast

Step by Step
Mill the grains and dough-in targeting a mash thickness that will enable your system to achieve the necessary pre-boil volume and gravity. Hold the mash at 153 °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 1.054 (13.4 °P).

The total wort boil time is 60 minutes. Add the first hop addition once the wort starts boiling. Add Irish moss or other kettle finings and the second hop addition with 15 minutes left in the boil. Add the last hop addition at flame out. Chill the wort to 67 °F (19 °C) and aerate thoroughly. The proper pitch rate is 2 packages of liquid yeast or 1 package of liquid yeast in a 2.4-liter starter.

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

Black Widow Porter
(5 gallons/19 L, extract with grains)
OG = 1.063 (15.5 °P)
FG = 1.015 (3.7 °P)
IBU = 37 SRM = 36 ABV = 6.4%

Ingredients
6.6 lb. (3 kg) Alexander's Light liquid malt extract (or similar) 2 °L
1.3 lb. (600 g) Best Malz Munich malt (or similar) 8 °L
14.1 oz. (400 g) Great Western pale malt (or similar) Crystal 40 °L
10.6 oz. (300 g) Briess chocolate malt (or similar) 350 °L
7 oz. (200 g) Briess black patent malt (or similar) 525 °L
7.2 AAU Kent Goldings, pellet hops, (1.44 oz./41 g) at 5% alpha acids) (60 min.)
3.15 AAU Fuggle, pellet hops, (0.63 oz./18 g at 5% alpha acids) (15 min.)
3.15 AAU Kent Goldings, pellet hops, (0.63 oz./18 g at 5% alpha acids) (0 min.)
White Labs WLP001 (California Ale) or Wyeast 1056 (American Ale) yeast

Step by Step
Mill or coarsely crack the specialty malt and place loosely in a grain bag. Avoid packing the grains too tightly in the bag, using more bags if needed. Steep the bag in about 1.5 gallon (~6 liters) of water at 165 °F (74 °C). The idea is that your temperature, once you add the grain, is in the malt conversion range and will convert some of the starch from the Munich malt. After about 30 to 60 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 the gravity is 1.054 (13.3°P). Stir thoroughly to help dissolve the extract and bring to a boil.

The total wort boil time is 60 minutes. Add the first hop addition once the wort starts boiling. Add Irish moss or other kettle finings and the second hop addition with 15 minutes left in the boil. Add the last hop addition at flame out. Chill the wort to 67 °F (19 °C) and aerate thoroughly. The proper pitch rate is 2 packages of liquid yeast or 1 package of liquid yeast in a 2.4-liter starter. Follow the remainder of the all-grain recipe at left.

Regan Dillon Porter
(5 gallons/19 L, all-grain)
OG = 1.063 (15.4 °P)
FG = 1.015 (3.7 °P)
IBU = 36 SRM = 39 ABV = 6.4%

This was my first porter recipe!

Ingredients
9.4 lb. (4.25 kg) North American pale malt 2 °L
1.4 lb. (630 g) Munich malt 8 °L
1.4 lb. (630 g) crystal malt 40 °L
11.3 oz. (320 g) chocolate malt 350 °L
7.4 oz. (210 g) black patent malt 525 °L
7.4 oz. (210 g) CaraPils® malt 2 °L
5.5 AAU Kent Goldings pellet hops, (1.23 oz./35 g at 4.5% alpha acids) (60 min.)
3 AAU Fuggle, pellet hops, (0.67 oz./19 g at 4.5% alpha acids) (30 min.)
2.7 AAU Fuggle, pellet hops, (0.60 oz./17 g at 4.5% alpha acids) (15 min.)
2.7 AAU Kent Goldings, pellet hops, (0.31 oz./9 g at 4.5% alpha acids) (0 min.)
1.4 AAU Fuggle, pellet hops,

(0.31 oz./9 g at 4.5% alpha acids) (0 min.)
White Labs WLP001 (California Ale) or Wyeast 1056 (American Ale) yeast

Step by Step

Mill the grains and dough-in targeting a mash thickness that will enable your system to achieve the necessary pre-boil volume and gravity. Hold the mash at 154 °F (68 °C) until enzymatic conversion is complete. Infuse the mash with near boiling water while stirring or with a recirculating mash system raise the temperature to mash out at 168°F (76°C). Sparge slowly with 170 °F (77 °C) water, collecting wort until the pre-boil kettle volume is around 5.9 gallons (22.3 L) and the gravity is 1.053 (13.2 °P).

The total wort boil time is 60 minutes. Add the first hop addition once the wort starts boiling. Add Irish moss or other kettle finings and the second hop addition with 15 minutes left in the boil. Add the last hop addition at flame out. Chill the wort to 67 °F (19 °C) and aerate thoroughly. The proper pitch rate is 2 packages of liquid yeast or 1 package of liquid yeast in a 2.4-liter starter.

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

Web extra:

For an extract with grains version of Jamil's first porter recipe, visit us on the Web:

www.byo.com/component/resource/article/2587

kilned grain, such as chocolate, black patent, and roasted barley. When I first learned to brew porter, other brewers told me roasted barley was for stout and black patent was for porter. I still follow that guidance to this day, but I think it is just from habit more than anything else. Each maltster has their own way of crafting black malt and roasted barley and the flavors of one product might be far better in your ideal porter than another. Highly kilned malts vary considerably from maltster to maltser, varying 100 °L or more for a similarly named malt or roasted grain. Experimenting with side-by-side taste tests is the best way to decide on which grain to use. Using a blend of highly kilned and lighter kilned roasted malts will give the best result. These roasted malts should be no more than 10% of the

> "Most robust porter fermentation should be around the 65 to 70 °F (18 to 21 °C) range depending on the yeast strain and recipe. Try to pick a temperature and stick with it, holding the temperature steady throughout fermentation."

grist. Keep in mind that beers at the higher end of this range can be acrid depending on the blend of roasted malts. A 40/60 mix of highly kilned and lighter kilned grain, like black patent and chocolate malt, strikes a nice balance of sharper roasted notes and less burnt coffee/chocolate notes. It really depends on the other balancing factors in the beer, such as hopping and residual sweetness, which can either emphasize the acrid sharpness or mellow it out.

Crystal malts add caramel flavors and residual sweetness, which helps balance the bitterness of the roast grains and hops. For caramel flavors, I like a mid-color crystal for this style, but the type of crystal malt you use can range dramatically. The quantity and the color of crystal malt is a key part of the balancing act. The lower the color of the crystal malt the sweeter it often seems. Darker crystal malts (80–150 °L) add caramelized, raisin-plum notes, but do not seem as sweet. You want to try to balance the sweetness of the crystal malt, the residual sweetness from unfermented sugars, the sharpness of the highly roasted grains, and the hop bittering to achieve a balanced, drinkable finish. In general, your crystal malt amounts are going to range from 5 to 10% of the total grist, although exceptions are possible.

If you are looking for more complexity, mouthfeel, or increased head retention, it is possible to add other malts as well. Oats, wheat malt, CaraPils®, and more are common additions. Just use restraint so the beer does not become saturated with unfermentable dextrins or cloying flavors. Target between 0 and 5% for these additional specialty grains.

Hop flavor and aroma comes from British or American-type hops and can vary from low to high. While you have plenty of leeway when making your hop choices, watch out for citrus hop character. Trying to combine sharp citrus notes with roasted malt flavors and carbonation often results in a sharp, acidic bite that is too much for this style. Keep in mind you are trying to build a malty ale, not a dark

IPA. My preference for this style is to stick with British or American-grown versions of traditional British hops. They lend mostly floral and earthy notes, which go well with the dark malt character.

Robust porter should have a medium to high bitterness, with the balance of bittering versus malt sweetness ranging from balanced to firmly bitter. The calculated bitterness to starting gravity ratio (IBU divided by OG) can range anywhere from 0.4 to 1.0, but the extremes of that range are not likely to produce the best results. Stick in the range from 0.5 to 0.7 and it should be correct for most recipes. While you can bitter with a neutral flavor higher alpha acid hop, I like to use some lower alpha acid British-type hops, such as Kent Goldings or Fuggles, for the bittering addition. Since they are lower alpha acid, you end up using enough that the bittering addition provides a background, subtle hoppy character instead of just bittering.

Fermentation should result in a well-attenuated, low ester beer. If you prefer a cleaner, less fruity, more American ale version, ferment with one of the clean American-type strains, such as White Labs WLP001 (California Ale) or Wyeast 1056 (American Ale), which are my favorites for this style. You will not have to worry about having an overly sweet beer with these yeasts either, as they usually attenuate well and at a range of temperatures. Other good choices along these lines are White Labs WLP051 (California V Ale Yeast) and Wyeast 1272 (American Ale II). If you want a more complex beer, you can try British or Irish ale yeast, such as White Labs WLP004 (Irish Stout) or WLP002 (English Ale) and Wyeast 1968 (London ESB) or 1084 (Irish Ale Yeast).

Regardless of the yeast, you want good attenuation and a relatively clean profile so make certain you oxygenate the wort and pitch an appropriate amount of clean, healthy yeast. Most robust porter fermentation should be around the 65 to 70 °F (18 to 21 °C) range depending on the yeast strain and recipe. Try to pick a temperature and stick with it, holding the temperature steady throughout fermentation. Holding the temperature steady is important to getting a proper level of attenuation and avoiding off-flavors, especially if you are making a bigger beer. Letting the beer go through large temperature swings can result in the yeast flocculating early or producing solventy and/or overly estery beers. You can raise the temperature a few degrees near the end of fermentation to help the yeast clean up some of the intermediate compounds produced during fermentation, but with an appropriate pitch and proper temperature control, it shouldn't be necessary. BYO

Jamil Zainasheff writes "Style Profile" in every issue of BYO.

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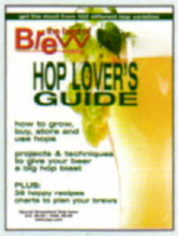

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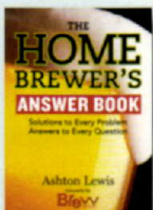

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Teaming up to brew is twice the fun

Story by **Glenn BurnSilver**

In the brewing world, everything typically starts off with a beer. So, you and your homebrew buddies sit around sampling the latest from your cellar, and the words start flying: "This is great." "What type of hops is in here?" "Which yeast strain did you use?" "Can I have another?" "We should brew together."

There it is. In the blink of an eye, the seed of a brewing collaboration has been planted.

Considering how much fun it is to share the homebrew, it's even more fun to share the brewing experience as well. It's something major craft brewers like Russian River, Stone Brewing Co., Ninkasi, Firestone Walker, Dogfish Head, Sierra Nevada and many others have been doing for years, though it's become a much more popular pastime in the last five years. And more often than not, it starts just as described above — over a beer.

"Our collaborations often are the result of drinking too much at a festival or a brewing convention, and telling your buddy at another brewery, 'Hey! We should do collaboration!'" explains The Bruery founder Patrick Rue, who has done several collaborations, including a recent pairing with Dogfish Head. "We tend to look at it as a friendly endeavor."

Firestone Walker Brewing brewmaster Matt Brynildson agrees, "A conversation might start about a common desire to make a crazy concept brew or simply how one brewer would like to visit another brewer's facility . . . Then you wake up in the morning and realize that you have committed to traveling to the Czech Republic to brew."

That's all well and good, but these brewers all stress that before committing to a brew session with another brewer that your brewing philosophies are in the same ballpark. There are many steps to the brewing process, from deciding what to brew and what ingredients will be used, to boil times and

COLLABORATIVE CLONES

Shaun O'Sullivan (21st Amendment), Mitch Steele (Stone Brewing Co.) and Matt Brynildson (Firestone Walker) mug it up while collaboratively brewing El Camino (Un)Real Black Ale (clone recipe on p. 33) at Stone Brewing Co.

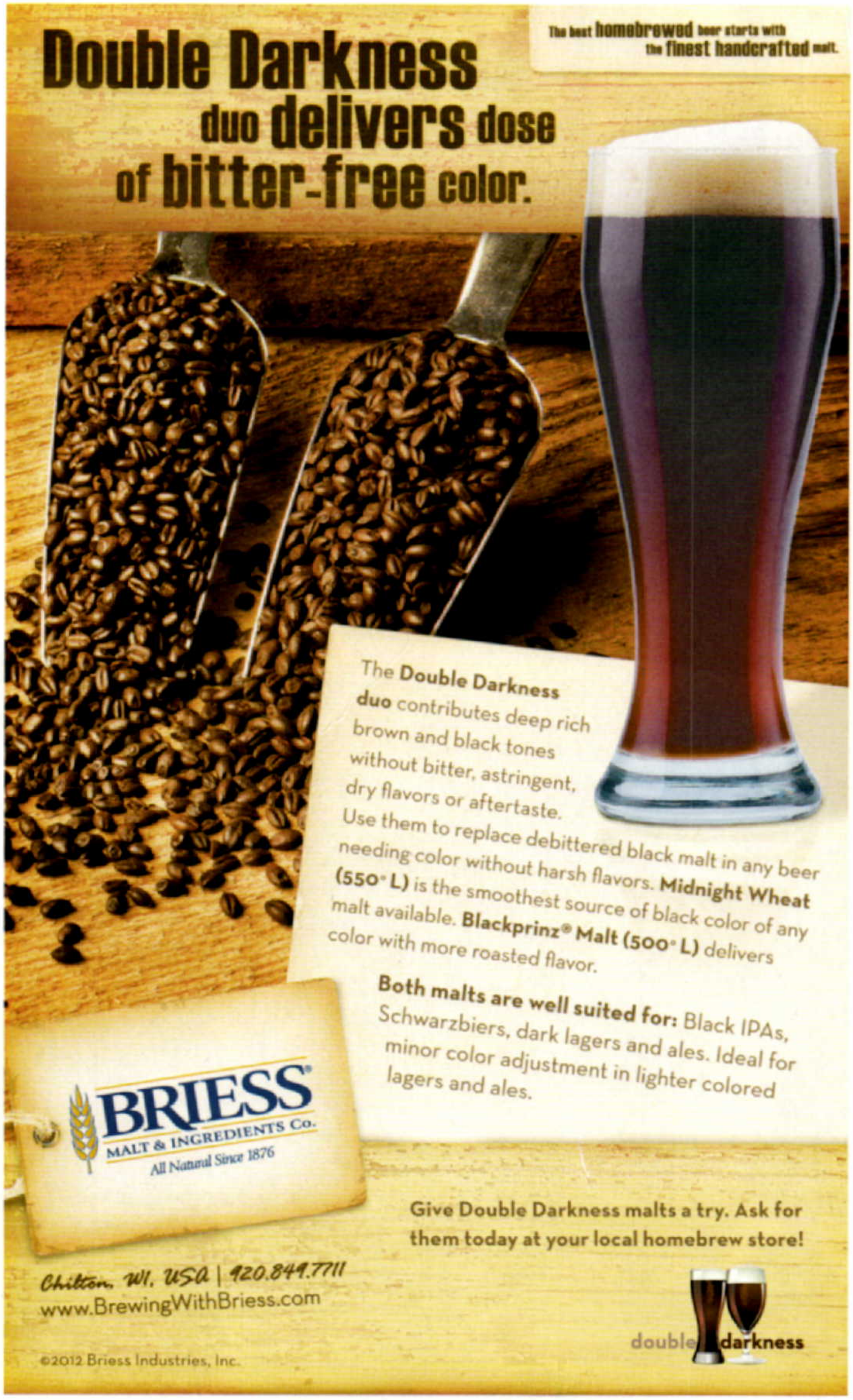
Photo courtesy of Stone Brewing Co.

fermentation temperatures. If you like big, crazy hop-forward beers and your buddy prefers malty lagers, it might be hard to find a middle ground. Collaborating is a meeting of the minds, but they must begin more or less with the same ideals.

"If (we) have similar philosophies towards craft brewing (not necessarily with what beers we brew, but with how we approach brewing), that is where we start," says Stone Brewing Co. brewmaster Mitch Steele.

What to Brew

Once you've settled on a collaborative partner, the next step is deciding what to brew. Do you want to make a hoppy Pilsner or milk stout, imperial IPA or German-style wheat beer? This is where the collaborations take root. It's also important to consider brewing knowledge, skill and techniques. Collaboration should be a positive learning experience for everyone involved.



"I always look at collaboration as an opportunity to commune with a fellow brewer, to live a day in his or her moccasins and see how he or she thinks," says Brynildson, who has collaborated with a handful of breweries, including Bell's, De Proef (Belgium), 21st Amendment and Stone Brewing Co. "(But) there are always those moments when you are in another brewer's space and you think to yourself, 'What the hell is he doing!?' But you have to go into these things with an open mind. You do these things to create something new and to learn."

This brings up the question: What is expected of the style? Does your vision of an IPA pack a hop wallop, while your partner prefers a maltier British style? Or do you want to merge recipes, as 21st Amendment and Ninkasi did when creating Allies Win the War? Be clear on the beer's direction and desired outcome so there are no surprises along the way, then determine the specifications required to achieve that goal.

Formulating the Recipe

Deciding which ingredients to use, even with a clear goal in mind, can still be tricky as every brewer has favorite touches they like to add. Steve Dressler, brewmaster at Sierra Nevada Brewing, notes that he uses a signature blend of finishing hops for many beers and wanted to incorporate them into Sierra's collaboration with Boulevard Brewing in Kansas City. In other words, communicate precisely what you think the beer, in your eyes, must have. If at all possible, Dressler suggests a literal hands-on approach to ingredient selection by rubbing hops to assess characteristics and examining grains for color. This, of course, is easy for breweries, which have bulk materials at hand, so lacking such access the homebrewer should hit the books to find the proper ingredient mix.

But if these aspects of the process seem tedious, it shouldn't be. While homebrew shops these days have

Continued on page 34

COLLABORATIVE BEER

Jack and Ken's Ale Sierra Nevada 30th Anniversary Ale
Collaboration between Sierra Nevada and Jack McAuliffe from New Albion Brewing
(Black barleywine)
(5 gallons/19 L, all-grain)
OG = 1.101 (24 °P)
FG = 1.025 (6.2 °P)
IBU = 80 SRM = 90 ABV = 10.4%

Sierra Nevada put together this recipe in collaboration with Jack McAuliffe from New Albion Brewing (1976–1982) in Sonoma, California using raw materials available in the late 1970s. This was one of four Sierra Nevada 30th Anniversary Collaboration Ales.

Ingredients
20 lbs. (9.1 kg) 2-row pale malt
1 lb. 2 oz. (0.52 kg) caramel malt (60 °L)
5.2 oz. (0.15 kg) roasted barley
13 AAU Brewers Gold hops (60 mins) (1.5 oz./43 g of 8.5% alpha acids)
14 AAU Cluster hops (60 mins) (2 oz./57 g of 7% alpha acids)
1.0 oz. (28 g) Cascade hops (0 mins)
0.75 oz. (21 g) Northern Brewer hops (0 mins)
1.5 oz.(43 g) Cascade hops (dry hop)
1.5 oz. (43 g) Northern Brewer hops (dry hop)
Wyeast 1056 (American Ale), White Labs WLP001 (California Ale) or Fermentis US-05 yeast (7 qt./7 L yeast starter or 18 g dried yeast)

Step by Step
Heat 6.75 gallons (25 L) of strike water. Mash at 150 °F (66 °C) for 60 minutes. Mash out to 168 °F (76 °C) and hold for 5 minutes. Recirculate and then collect the wort. Fully sparging the grain bed would yield over 11 gallons (42 L) of wort. Decide how much wort you want to collect. (It takes about an hour to boil away a gallon/4 L of liquid on a typical homebrew system). Boil to reduce wort volume to 5 gallons (19 L), adding hops at times indicated. (If you collected less than the full amount of wort, you may need to add malt extract to hit your target OG. Take a hydrometer reading with 10 minutes left in the boil. For every "gravity point" you are low, add 1.8 oz. (51 g) of dried malt extract.) Chill wort and transfer to fermenter. Aerate and pitch sediment from yeast starter. Ferment at 68 °F (20 °C). Dry hop for 1 week.

Jack and Ken's Ale
(Black barleywine)
(5 gallons/19 L, partial mash)
OG = 1.101 (24 °P)
FG = 1.025 (6.2 °P)
IBU = 80 SRM = 90 ABV = 10.4%

Ingredients
2.5 lbs. (1.1 kg) 2-row pale malt
1 lb. 2 oz. (0.52 kg) caramel malt (60 °L)
5.2 oz. (0.15 kg) roasted barley
4 lb. 14 oz. (2.2 kg) light dried malt extract
6.0 lbs. (2.7 kg) light liquid malt extract (late addition)
13 AAU Brewers Gold hops (60 mins) (1.5 oz./43 g of 8.5% alpha acids)
14 AAU Cluster hops (60 mins) (2 oz./57 g of 7% alpha acids)
1.0 oz. (28 g) Cascade hops (0 mins)
0.75 oz. (21 g) Northern Brewer hops (0 mins)
1.5 oz.(43 g) Cascade hops (dry hop)
1.5 oz. (43 g) Northern Brewer hops (dry hop)
Wyeast 1056 (American Ale), White Labs WLP001 (California Ale) or Fermentis US-05 yeast

Step by Step
Mash grains at 150 °F (66 °C) for 60 minutes. (One option is to put the 4 lbs./1.8 kg of grain in a grain bag and place the bag in a 2.0-gallon/7.6-L insulated beverage cooler.) Collect wort and sparge grains with hot water (~190 °F/88 °C, but don't let the temperature of the grain bed rise above 170 °F/77 °C). (If you are using the beverage cooler option, collect one cup of wort from the spigot, then add one cup of hot sparge water to the top of the cooler and repeat until you collect around 2.0 gallons (7.6 L) of wort.) Add water to wort to make at least 3.5 gallons (13 L) of wort, stir in dried malt extract and bring to a boil. Boil for 60 minutes, adding hops at times indicated. Stir in liquid malt extract during the final 15 minutes of the boil. (Stir well to avoid scorching malt extract.) Cool wort and transfer to fermenter. Top up to 5.0 gallons (19 L) with cool water, aerate well and pitch yeast. Ferment at 68 °F (20 °C). Dry hop for 1 week.

Jack and Ken's Ale
(Black barleywine)
(5 gallons/19 L, extract with grains)
OG = 1.101 (24 °P)
FG = 1.025 (6.2 °P)
IBU = 80 SRM = 90 ABV = 10.4%

Ingredients
0.5 lbs. (0.23 kg) 2-row pale malt
1 lb. 2 oz. (0.52 kg) caramel malt (60 °L)
5.2 oz. (0.15 kg) roasted barley
6.0 lbs. (2.7 kg) light dried malt extract
6.0 lbs. (2.7 kg) light liquid malt extract (late addition)
13 AAU Brewers Gold hops (60 mins) (1.5 oz./43 g of 8.5% alpha acids)
14 AAU Cluster hops (60 mins) (2 oz./57 g of 7% alpha acids)
1.0 oz. (28 g) Cascade hops (0 mins)
0.75 oz. (21 g) Northern Brewer hops (0 mins)
1.5 oz.(43 g) Cascade hops (dry hop)
1.5 oz. (43 g) Northern Brewer hops (dry hop)
Wyeast 1056 (American Ale), White Labs WLP001 (California Ale) or Fermentis US-05 yeast

Step by Step
Place grains in a steeping bag. In a large (at least 4 qt/4 L) kitchen pot, steep grains at 150 °F (66 °C) for 60 minutes in 2.7 qts. (2.6 L) of water. Begin heating at least 3.0 gallons (11 L) of water in your brewpot as the grains steep. Rinse grains with 1.5 qts. (1.4 L) of 170 °F (77 °C) water and add "grain tea" to water in brewpot. Stir in dried malt extract and bring wort to a boil. Boil for 60 minutes, adding hops at times indicated. Stir in liquid malt extract during the final 15 minutes of the boil. (Stir well to avoid scorching malt extract.) Cool wort and transfer to fermenter. Top up to 5.0 gallons (19 L) with cool water, aerate well and pitch yeast. Ferment at 68 °F (20 °C). Dry hop for 1 week.

Tips for Success
This is a big beer, so pitching an adequate amount of yeast is critical. If you make a simple yeast starter (not continuously stirred and/or continuously aerated), it should optimally be about 7 qts. (7 L). You can get by with one half this size, but don't go any lower than that. If you aren't going to make a starter, use just short of two 11-g sachets of dried yeast.

Adding some yeast nutrients in the final 15 minutes of the boil is not a bad option and be sure to aerate your wort well. In addition, watch that your fermentation temperature doesn't rise too high.

CLONE RECIPES

More Brown Than Black IPA

Collaboration among The Alchemist, Ninkasi and Stone Brewing Co.

(Black IPA)
(5 gallons/19 L, all-grain)

OG = 1.066 (16.5 °P)
FG = 1.016 (4 °P)
IBU = 100 SRM = 23 ABV = 6.4%

"We decided to brew a dark IPA, because John Kimmich from The Alchemist is one of the first brewers in the United States to ever brew one, back in the early/mid 90s when he worked with Greg Noonan at The Vermont Pub and Brewery."

Ingredients

12 lbs. (5.4 kg) Maris Otter pale ale malt
1.0 lb. (0.45 kg) light Munich malt
5.6 oz. (0.16 kg) Carafa® Special III malt
4.6 oz. (0.13 kg) Carahelles malt
0.071 oz. (2 g) Super Galena CO_2 hop extract
1.9 oz. (55 g) Delta hops (0 mins)
1.9 oz. (55 g) Nelson Sauvin hops (0 mins)
1.9 oz. (55 g) Citra® hops (dry hop)
1.9 oz. (55 g) Galaxy hops (dry hop)
White Labs WLP090 (San Diego Super) yeast
(2.75 qts./2.75 L yeast starter)

Step by Step

You will need 4.25 gallons (16 L) of strike water. Infusion mash at 152 °F (67 °C) for 60 minutes, then raise temperature to 165 °F (74 °C) for mash off. Recirculate wort, then run off and sparge to yield about 6.5 gallons (25 L) of wort. Use sparge water hot enough to maintain grain bed temperature at around 170 °F (77 °C), but not over. Boil wort for 90 minutes, adding hops at times indicated. Chill wort and transfer to fermenter. Aerate well and pitch sediment from yeast starter. Ferment at 68 °F (20 °C). At end of fermentation, dry hop and hold warm for 3 days, then chill to 34 °F (1.1 °C) and age for a week.

More Brown Than Black IPA

(Black IPA)
(5 gallons/19 L, partial mash)

OG = 1.066 (16.5 °P)
FG = 1.016 (4 °P)
IBU = 100 SRM = 23 ABV = 6.4%

Ingredients

2 lb. 6 oz. (1.1 kg) Maris Otter pale ale malt
1.0 lb. (0.45 kg) light Munich malt
5.6 oz. (0.16 kg) Carafa® Special III malt
4.6 oz. (0.13 kg) Carahelles malt
2.0 lbs. (0.91 kg) light dried malt extract
4.5 lbs. (2.0 kg) light liquid malt extract
0.071 oz. (2 g) Super Galena CO_2 hop extract
1.9 oz. (55 g) Delta hops (0 mins)
1.9 oz. (55 g) Nelson Sauvin hops (0 mins)
1.9 oz. (55 g) Citra® hops (dry hop)
1.9 oz. (55 g) Galaxy hops (dry hop)
White Labs WLP090 (San Diego Super) yeast

Step by Step

Mash grains at 152 °F (67 °C) for 60 minutes. (One option is to put the 4 lbs./1.8 kg of grain in a grain bag and place the bag in a 2.0-gallon/7.6-L insulated beverage cooler.) Collect wort and sparge grains with hot water (~190 °F/88 °C, but don't let the temperature of the grain bed rise above 170 °F/77 °C). (If you are using the beverage cooler option, collect one cup of wort from the spigot, then add one cup of hot sparge water to the top of the cooler and repeat until you collect around 2.0 gallons (7.6 L) of wort.) Add water to wort to make at least 3.5 gallons (13 L) of wort, stir in dried malt extract and bring to a boil. Boil for 60 minutes, adding hops at times indicated. Stir in liquid malt extract during the final 15 minutes of the boil. (Stir well to avoid scorching malt extract.) Cool wort and transfer to fermenter. Top up to 5.0 gallons (19 L) with cool water, aerate well and pitch yeast. Ferment at 68 °F (20 °C). Dry hop for 3 days.

More Brown Than Black IPA

(Black IPA)
(5 gallons/19 L, extract with grains)

OG = 1.066 (16.5 °P)
FG = 1.016 (4 °P)
IBU = 100 SRM = 23 ABV = 6.4%

Ingredients

6.0 oz. (0.17 kg) Maris Otter pale ale malt
1.0 lb. (0.45 kg) light Munich malt
5.6 oz. (0.16 kg) Carafa® Special III malt
4.6 oz. (0.13 kg) Carahelles malt
2.5 lbs. (1.1 kg) light dried malt extract
5.25 lbs. (2.4 kg) light liquid malt extract
0.071 oz. (2 g) Super Galena CO_2 hop extract
1.9 oz. (55 g) Delta hops (0 mins)
1.9 oz. (55 g) Nelson Sauvin hops (0 mins)
1.9 oz. (55 g) Citra® hops (dry hop)
1.9 oz. (55 g) Galaxy hops (dry hop)
White Labs WLP090 (San Diego Super) yeast

Step by Step

Place grains in a steeping bag. In a large (at least 4 qt/4 L) kitchen pot, steep grains at 152 °F (67 °C) for 60 minutes in 2.7 qts. (2.6 L) of water. Begin heating at least 3.0 gallons (11 L) of water in your brewpot as the grains steep. Rinse grains with 1.5 qts. (1.4 L) of 170 °F (77 °C) water and add "grain tea" to water in brewpot. Stir in dried malt extract and bring wort to a boil. Boil for 60 minutes, adding hops at times indicated. Stir in liquid malt extract during the final 15 minutes of the boil. (Stir well to avoid scorching malt extract.) Cool wort and transfer to fermenter. Top up to 5.0 gallons (19 L) with cool water, aerate well and pitch yeast. Ferment at 68 °F (20 °C). Dry hop for 3 days.

Tips for Success

What do you mean you don't have any Super Galena CO_2 extract laying around? Doesn't everybody? In reality, hop extracts generally aren't available on the homebrewing market. So, try substituting any neutral high-alpha hop that will get you to 100 IBUs — for example, 1.6 oz. (45 g) of Summit™ hops, at 17.5% alpha acids (for 28 AAU total), boiled for 60 minutes.

This is a very hoppy beer, but also moderately dark. It is likely that adjusting your water chemistry will help you bring out the best in this beer. If you aren't familiar with how to adjust your water chemistry, try downloading John Palmer's water worksheet from his website (www.howtobrew.com, see chapter 15).

For this beer, adjust your water's chemistry to an appropriate residual alkalinity (RA) for the color and the right amount of sulfates (and sulfate to chloride ratio) for a bitter or very bitter beer. When brewing this beer, gypsum is your friend.

Allies Win the War

Collaboration between
21st Amendment and Ninkasi

(5 gallons/19 L, all-grain)

OG = 1.072 (18 °P)
FG = 1.018 (4.5 °P)
IBU = 49 SRM = 32 ABV = 7.1%

Ingredients

11 lb. 12 oz. (5.3 kg) 2-row pale malt
12 oz. (0.34 kg) English crystal malt (15 °L)
12 oz. (0.34 kg) English crystal malt (45 °L)
12 oz. (0.34 kg) English crystal malt (120 °L)
8 oz. (0.23 kg) English crystal malt (155/165 °L)
12 oz. (0.34 kg) English light Munich malt
1.6 oz. (45 g) chocolate malt
6.0 oz. (170 g) dates (macerated, in the secondary)
8.4 AAU Warrior hops (90 mins) (0.5 oz./14 g of 16.8% alpha acids)
7.0 AAU Willamette hops (30 mins) (0.9 oz./26 g of 7.8% alpha acids)
0.6 oz. (17 g) East Kent Goldings hops (0 mins)
Wyeast 1968 (London ESB) or White Labs WLP002 (English Ale) yeast (3.3 qt./3.3 L yeast starter)

Step by Step

For the mash, you will need 4.5 gallons (17 L) of strike water. Mash at 155 °F (68 °C) for 50 minutes. Mash out to 168 °F (76 °C) and hold for 5 minutes. Recirculate and then collect enough wort such that you can boil it down to 5.0 gallon (19 L) in 90 minutes. Boil wort for 90 minutes, adding hops at times indicated in ingredient list. Chill wort and transfer to fermenter. Aerate well and pitch sediment from yeast starter. Ferment at 68 °F (20 °C). Rack to secondary and add dates. Bottle or keg after 5 days in secondary.

Allies Win the War

(5 gallons/19 L, partial mash)

OG = 1.072 (18 °P) FG = 1.018 (4.5 °P)
IBU = 49 SRM = 32 ABV = 7.1%

Ingredients

4.0 lbs. (1.8 kg) 2-row pale malt
12 oz. (0.34 kg) English crystal malt (15 °L)
12 oz. (0.34 kg) English crystal malt (45 °L)
12 oz. (0.34 kg) English crystal malt (120 °L)
8 oz. (0.23 kg) English crystal malt (155/165 °L)
12 oz. (0.34 kg) English light Munich malt
1.6 oz. (45 g) chocolate malt
1.5 lbs. (0.68 kg) light dried malt extract
3.5 lbs. (1.6 kg) light liquid malt extract
6.0 oz. (170 g) dates (macerated, in the secondary)
8.4 AAU Warrior hops (90 mins) (0.5 oz./14 g of 16.8% alpha acids)
7.0 AAU Willamette hops (30 mins) (0.9 oz./26 g of 7.8% alpha acids)
0.6 oz. (17 g) East Kent Goldings hops (0 mins)
Wyeast 1968 (London ESB) or White Labs WLP002 (English Ale) yeast

Step by Step

For this partial mash recipe, you'll need two large grain steeping bags and a 2-gallon (7.6-L) beverage cooler. Place the 4.0 lbs. (1.8 kg) of 2-row pale malt in one steeping bag and the remaining specialty grains in the other. In the cooler, mash the pale malt grains at 155 °F (68 °C) for 50 minutes. This will take 5.5 quarts (5.2 L0 of water. In your brewpot, steep the specialty grains at 155 °F (68 °C) in 1 gallon (3.8 L) of water while you are mashing. Collect wort from the cooler in the following manner. Collect one cup of wort from the spigot, then add one cup of hot sparge water to the top of the cooler and repeat until you collect around 2.0 gallons (7.6 L) of wort. Use ~190 °F (88 °C) water for sparging, but don't let the temperature of the grain bed rise above 170 °F (77 °C). As you collect the wort, add it to your brewpot, where the specialty grains are steeping (and still being held at 155 °F/ 68 °C). Once all the wort is collected from the cooler, add water to brewpot to make at least 3.5 gallons (13 L) of wort, stir in dried malt extract and bring to a boil. Boil wort for 90 minutes, adding hops at times indicated. Stir in liquid malt extract during the final 15 minutes of the boil. (Stir well to avoid scorching malt extract.) Cool wort and transfer to fermenter. Top up to 5.0 gallons (19 L) with cool water, aerate well and pitch yeast. Ferment at 68 °F (20 °C).

Allies Win the War

(5 gallons/19 L, extract with grains)

OG = 1.072 (18 °P)
FG = 1.018 (4.5 °P)
IBU = 49 SRM = 32 ABV = 7.1%

Ingredients

12 oz. (0.34 kg) English crystal malt (15 °L)
12 oz. (0.34 kg) English crystal malt (45 °L)
12 oz. (0.34 kg) English crystal malt (120 °L)
8 oz. (0.23 kg) English crystal malt (155/165 °L)
12 oz. (0.34 kg) English light Munich malt
1.6 oz. (45 g) chocolate malt
2.5 lbs. (1.1 kg) light dried malt extract
5.0 lbs. (2.3 kg) light liquid malt extract
6.0 oz. (170 g) dates (macerated, in the secondary)
8.4 AAU Warrior hops (90 mins) (0.5 oz./14 g of 16.8% alpha acids)
7.0 AAU Willamette hops (30 mins) (0.9 oz./26 g of 7.8% alpha acids)
0.6 oz. (17 g) East Kent Goldings hops (0 mins)
Wyeast 1968 (London ESB) or White Labs WLP002 (English Ale) yeast

Step by Step

Place grains in a large steeping bag. In a large (at least 6 qts./6 L) kitchen pot, steep grains at 155 °F (68 °C) for 50 minutes in 3.9 qts. (3.7 L) of water. Begin heating at least 3.0 gallons (11 L) of water in your brewpot as the grains steep. Rinse grains with 2.0 qts. (1.9 L) of 170 °F (77 °C) water and add "grain tea" to water in brewpot. Stir in dried malt extract and bring wort to a boil. Boil for 60 minutes, adding hops at times indicated. Stir in liquid malt extract during the final 15 minutes of the boil. (Stir well to avoid scorching malt extract.) Cool wort and transfer to fermenter. Top up to 5.0 gallons (19 L) with cool water, aerate well and pitch yeast. Ferment at 68 °F (20 °C).

Tips for Success

This recipe contains a lot of specialty grains, including a high percentage of dark crystal malts and some chocolate malt. Darkly roasted grains are, of course, very flavorful, but they are also more likely to give up an excessive amount of tannins if handled improperly.

Be careful not to oversparge when collecting wort. If you have a pH meter, monitoring the final runnings and ensuring they don't climb above 5.8 would be a good idea. And of course, use the best quality crystal malts you can find.

Also, be sure to make a yeast starter. This yeast strain has a tendency to flocculate early if the pitching rate is too low.

CLONE RECIPES

El Camino (Un)Real Black Ale

Collaboration among 21st Amendment, Firestone Walker and Stone Brewing Co.

(5 gallons/19 L, all-grain)

OG = 1.096 (23 °P)
FG = 1.021 (5.2 °P)
IBU = 49 ABV = 7.1%

Ingredients

15 lb. 8 oz. (7.0 kg) North American 2-row pale malt
13 oz. (0.38 kg) Caramunich® malt
12 oz. (0.34 kg) Special B malt
10.5 oz. (0.30 kg) Carafa® III malt
9.5 oz. (0.27 kg) roasted barley
6.1 oz. (0.17 kg) flaked oats
5.3 oz. (0.15 kg) chocolate malt
15 oz. (0.41 kg) Belgian dark candi sugar (90 mins)
14 AAU Challenger hops (90 mins) (2.1 oz./60 g of 6.5% alpha acids)
1.3 oz. East Kent Goldings hops (10 mins) (1.3 oz./37 g of 4.5% alpha acids)
1.5 oz. (43 g) Styrian Goldings hops (0 mins)
0.46 oz. (13 g) fennel seeds (0 mins)
0.46 oz. (13 g) chia seeds (0 mins)
0.25 oz. (7.1 g) pink peppercorns (0 mins)
1.7 oz. (48 g) Styrian Golding hops (dry hop)
0.9 oz. (26 g) dried black mission figs (steep 7 days) (chopped, soaked in bourbon)
8.0 oz. (230 g) oak chips (steep 3 days)
White Labs WLP001 (California Ale) yeast (6 qt./6 L yeast starter)

Step by Step

For mashing in, you will need 6.0 gallons (23 L) of strike water. Mash at 149 °F (65 °C) for 60 minutes. Mash out to 165 °F (74 °C). Recirculate and collect wort. Collect enough to be able to boil wort for 90 minutes. (Fully sparged, you would get at least 10 gallons/38 L out of the grain bed, but then you would have to boil your wort longer to concentrate it. If you boil less than you can get from the grain bed, you may have to supplement the wort with a little malt extract to reach your target OG.) Boil wort to reduce volume to 5 gallons (19 L), adding hops and other spices at times indicated. Chill and transfer to fermenter. Aerate and pitch yeast sediment from yeast starter. Ferment at 68–70 °F (20–21 °C). Transfer to secondary and add dry hops and figs, then 4 days later add the oak chips; 3 days after that, package the beer.

El Camino (Un)Real Black Ale

(5 gallons/19 L, partial mash)

OG = 1.096 (23 °P)
FG = 1.021 (5.2 °P)
IBU = 49 ABV = 7.1%

Ingredients

4.0 lbs. (1.8 kg) North American 2-row pale malt
13 oz. (0.38 kg) Caramunich® malt
12 oz. (0.34 kg) Special B malt
10.5 oz. (0.30 kg) Carafa® III malt
9.5 oz. (0.27 kg) roasted barley
6.1 oz. (0.17 kg) flaked oats
5.3 oz. (0.15 kg) chocolate malt
15 oz. (0.41 kg) Belgian dark candi sugar (90 mins)
2.0 lbs. (0.91 kg) light dried malt extract
5 lb. 10 oz. (2.6 kg) light liquid malt extract
14 AAU Challenger hops (90 mins) (2.1 oz./60 g of 6.5% alpha acids)
1.3 oz. East Kent Goldings hops (10 mins) (1.3 oz./37 g of 4.5% alpha acids)
1.5 oz. (43 g) Styrian Goldings hops (0 mins)
0.46 oz. (13 g) fennel seeds (0 mins)
0.46 oz. (13 g) chia seeds (0 mins)
0.25 oz. (7.1 g) pink peppercorns (0 mins)
1.7 oz. (48 g) Styrian Golding hops (dry hop)
0.9 oz. (26 g) dried black mission figs (steep 7 days) (chopped, soaked in bourbon)
8.0 oz. (230 g) oak chips (steep 3 days)
White Labs WLP001 (California Ale) yeast

Step by Step

For this partial mash recipe, you'll need two large grain steeping bags and a 2-gallon (7.6-L) beverage cooler. Place the 4.0 lbs. (1.8 kg) of 2-row pale malt in one steeping bag and the remaining specialty grains in the other. In the cooler, mash the pale malt grains at 149 °F (65 °C) for 60 minutes. This will take 5.5 quarts (5.2 L) of water. In your brewpot, steep the specialty grains at 149 °F (65 °C) in 4.5 qqts. (4.2 L) of water while you are mashing. Collect wort from the cooler in the following manner. Collect one cup of wort from the spigot, then add one cup of hot sparge water to the top of the cooler and repeat until you collect around 2.0 gallons (7.6 L) of wort. Use ~190 °F (88 °C) water for sparging, but don't let the temperature of the grain bed rise above 170 °F (77 °C). As you collect the wort, add it to your brewpot, where the specialty grains are steeping (and still being held at 149 °F/ 65 °C). Once all the wort is collected from the cooler, add water to brewpot to make at least 3.5 gallons (13 L) of wort, stir in dried malt extract and bring to a boil. Boil wort for 90 minutes, adding hops and other spices at times indicated. Stir in liquid malt extract during the final 15 minutes of the boil. (Stir well to avoid scorching malt extract.) Cool wort and transfer to fermenter. Top up to 5.0 gallons (19 L) with cool water, aerate well and pitch yeast. Ferment at 68–70 °F (20–21 °C). Transfer to secondary and add dry hops and figs, then 4 days later add the oak chips; 3 days after that, package the beer.

Extract with grains option:

Omit 2-row pale malt from partial mash recipe and increase liquid malt extract to a total of 8.5 lbs. (3.9 kg) Place specialty grains in a steeping bag. In a large (at least 6 qt./6 L) kitchen pot, steep grains at 149 °F (65 °C) for 60 minutes in 1.1 gallons (4.2 L) of water. Begin heating at least 2.0 gallons (7.6 L) of water in your brewpot as the grains steep. Rinse grains with 2.0 qts. (1.9 L) of 170 °F (77 °C) water and add "grain tea" to water in brewpot. Stir in dried malt extract and bring wort to a boil. Boil for 90 minutes, adding hops and spices at times indicated. Stir in liquid malt extract during the final 15 minutes of the boil. (Stir well to avoid scorching malt extract.) Cool wort and transfer to fermenter. Top up to 5.0 gallons (19 L) with cool water, aerate well and pitch yeast. Ferment at 68–70 °F (20–21 °C). Transfer to secondary and add dry hops and figs, then 4 days later add the oak chips; 3 days after that, package the beer.

Tips for Success

This is a big beer, be sure to make a yeast starter with enough volume to grow a sufficient number of cells to ferment the wort efficiently — a minimum of roughly 3 qts. (3 L), but optimally twice that. Barring that, 17 g of Fermentis US-05 dried yeast would also work. Aerate the wort well and consider adding yeast nutrients in the final 15 minutes of the boil.

Getting the right amount of spice in a beer can be tricky. Consider adding half of the amount of each of the spices listed here, and soaking the remaining spices in vodka. If, when it comes time to bottle or keg the beer, the beer seems under-spiced, add some or all of the vodka.

When adding the figs, put these in a dry hopping bag and do not add the bourbon used for soaking to the beer.

almost anything anyone could need or want to brew, sourcing as many local or regional ingredients as possible adds to the fun.

21st Amendment brewmaster Shaun O'Sullivan sourced dates from Indio, California, the only place dates are grown in North America, to regionally balance the Oregon hop blend used in Allies. Dressler sites his collaborations with Boulevard and Dogfish Head as examples of regional pride. With the Boulevard collaboration, which is a barrel-aged beer, Midwest wheat was selected as the primary grain while Midwest oak was used in the barrels. With Dogfish Head, east coast maple and birch syrups were used. In both collaborations, from California came the hops.

One advantage to brewing on the homebrew scale is a lack of government regulations that could get in the way of long distance collaborations. Various state or federal regulations prevent the transport of beer in certain forms across state lines. When Colorado's Avery Brewing and California's Russian River Brewing decided to blend their like-named Salvation ales and create Collaboration Not Litigation Ale, they discovered rules in place to prevent beer made at one brewery being mixed with beer from another. Thus, Russian River's recipe was produced in Colorado and then blended with Avery's. Other brewers noted similar issues and the need to produce collaborations in one place. Returning to the homebrew scale, it's never a bad idea to brew in someone else's kitchen. Everyone operates in a slightly different manner and brewing outside the carboy, as it were, is a great way to learn.

"When we collaborate at another brewery, we get to see how they do their processes and often we leave with some things we could do better in our own processes," Rue says.

"Sharing brewing philosophies and experiences make all of us better at what we do," Steele adds. "You can learn something new and valuable from anyone. I'm a big believer in that. And, if you stop learning, you stagnate, and craft brewers cannot afford to stagnate!"

The First Sip

Of course, after picking the style, determining the ingredients and formulating the recipe, and finally, brewing the beer, the most difficult part of the collaboration arrives: the wait. It's important that the first collaborative beer be opened together and shared together. That's what collaborations are all about.

"The anticipation of drinking that beer together is the beauty of it," Dressler says. "That's the end game. If you're homebrewers and friends, sharing that first beer together is the ultimate." BYO

Glenn BurnSilver is a frequent contributor to Brew Your Own. *He lives and brews in Arizona.*

Story by **Justin Burnsed**

TROUBLE SHOOTING...

Avoiding the Most Common Brewing Mistakes

Photo by Charles A. Parker/Images Plus

Learn from experience. We've made these mistakes so you don't have to.

In the early years as a rookie homebrewer, there were many times where I poured myself a beer from a newly readied batch and said, "You know, this didn't turn out quite how I expected." Most of these variations were fairly minor and the beer was still quite good, just different than anticipated. Admittedly there were a few batches where saying a few words over a case of bottles before letting them flow down the drain crossed my mind. This was obviously a last resort of course, as it takes a pretty bad beer to make me want to commit such a dastardly act.

As with anything in life, practice only makes you better equipped to prevent these surprises and allows your liquid masterpiece to more closely mimic your artistic vision. In the hopes of helping the less than expert brewer avoid some of the most troublesome issues I encountered way back when, I am here to share a handful of tips to ensure your path to brewing success is as smooth as a cask conditioned stout.

Problem: Inconsistent Original Gravities (OG)

Other than watching a beer that is stuck in fermentation purgatory, having your hydrometer settle in at 10 or 20 gravity points off what you thought it was going to be can be pretty frustrating. Some people may say that is just part of homebrewing, but so much of what we do is about control and I feel this subject deserves a fair amount of attention.

Dialing in the efficiency of your individual equipment takes time and can be very trying if you allow other variables to come into play. Having the right amount of extraction has a huge impact on how your beer will taste and its eventual alcohol level. This is more of an issue for all-grain brewers than for those of you that use mostly extracts, but it is good information to have if you ever want to make that leap of faith.

The first culprit that I identified for variation in original gravity was how the malt was getting milled. Sometimes I would mill it myself using a Corona mill or have it milled at one of my favorite homebrew suppliers. There was an obvious difference between doing it myself, and the various roller mills from the guys I bought my malt from. Different gap sizes in these devices can have an impact on how much starch gets extracted during the mash. You need to make sure your grains are getting crushed the same way each time you brew. If you have an issue with wheat or rye based beers coming in at low gravity, adjusting the mill for a finer grind may help as their kernels are a little smaller than barley.

It should also be noted that there are small variations in brewing grains that are from the same category, which could have a small impact on your wort gravity. Don't expect all 2-row base malts (pale, pale ale, Pilsner, etc.) to perform the same.

Your water to grist ratio should also be consistent and not range too far outside the norm of 1.0 to 1.5 quarts per gallon (1 to 3 L/kg). Mash thickness has a direct impact on wort fermentability and extraction levels and should be tailored to beer style. Keep it the same when brewing a particular recipe multiple times, unless you are looking for different results. Mash and sparging temperature will also have an impact on how much carbohydrate is pulled from the grain, so keep an eye on that as well.

This may seem like a no brainer, but when you conduct the boil, be sure that the starting boil volume, boiling time and the heat source output are consistent each time you brew. Variations in these factors will either concentrate or dilute your wort.

One of the most exciting days as a homebrewer is when you get some new equipment to add to your arsenal. But when you upgrade from that little 3-gallon (11-L) pot on your stove to that Blichmann stainless steel 10-gallon (38-L) pot with a 50,000 BTU burner, there will be a big difference in how your wort turns out. Just be aware of that and consider your first batch on any new equipment as a test run, then adjust accordingly.

When it comes to measuring your OG, also be sure to follow the guidelines on your hydrometer in terms of temperature correction. It is always best to cool your wort down if possible to the baseline level when taking a reading. If you want the ability to make any adjustments to your wort's gravity, I would suggest taking a reading with about 15 minutes left in your boil and add a small amount of malt extract or sugar to get it right if it looks like it will finish a bit low. If it's on the high side, you can always boil a measured amount of water and add it to the kettle just before cooling (although this will dilute the hop character).

If you are like me and you are the type of person that likes to create their own recipes rather than follow the path of others, then you may only have to look in the mirror for your gravity woes. Being off on your calculations when formulating a recipe just a little bit can have a big impact on your OG. My recommendation is to make use of any of the great beer recipe programs out there like ProMash, BeerTools, BeerSmith or Beer Calculus (which is free and only requires internet access). This will severely reduce the chance of human error and it's a heck of a lot easier to boot!

Bottom Line: Consistency in all areas you have control over during the mash and the boil is key for an accurate original gravity.

Problem: All of Your Beers Have Signature Harshness

My very first batch of beer was supposed to mimic the flavors of Sierra Nevada's Celebration Ale. It had all the right ingredients in terms of malt, hop varieties and yeast. But when I took that first sip, I noticed this taste that I couldn't quite put my finger on. I just knew that whatever it was, it was the complete opposite of smooth. If you've entered your beer into a contest and have gotten a BJCP scoresheet back with the "astringent" box checked or comments about it having a strange/harsh bitterness, you know

Troubleshooting

Key: "X": For beers made with malt extract, "AG": For all-grain beers	
Problem	**Cause**
Fermentation does not start	• Inadequate amount of yeast pitched • Wort too hot (yeast stunned/killed) • Wort too cold (yeast dormant) • Fermentation fine, but bucket not sealed (so you can't see bubbles in airlock) • Fermentation already complete (look for ring of "crud" around inside of fermenter)
Stuck fermentation	• Not enough yeast pitched • Inadequate aeration • Wort temperature too low • Yeast strain flocculated early (rousing yeast may help) • Fermentation is finished, not stuck (take specific gravity to check)
A puckering, tea-like quality; sometimes confused with bitterness (astringency)	• X: steeped grains in too much water (over 3 quarts water per pound of grain) • X: steeping water too hot (over 170 °F) • AG: excessive volume of sparge water (collected wort less than SG 1.008 or above a pH of 5.8) • AG: excessively hot sparge water (over 170 °F)
Sour or tart beer	• Contamination • Tart ingredients (like raspberries or cranberries) • AG: mash sat overnight and temperature dropped to 120 °F (or below)
A buttery or butterscotch-like flavor or aroma (diacetyl)	• Yeast did not absorb diacetyl (a diacetyl rest is required for some lager yeast strains) • Contamination • Racked beer too early • Yeast strain
Overly fruity aromas, especially banana (estery)	• High fermentation temperatures • Inadequate pitching rate • Yeast strain (some British and Belgian ale strains are supposed to be very fruity)
Chloraseptic-like or Band-aid-like aroma or flavor (phenolic)	• Contamination
Vinegar flavor or aroma (acetic)	• Contamination, especially in conjunction with exposure to oxygen
Wort darker than expected	• X: concentrated wort boil • X: scorching of malt extract (stir in thoroughly)
Stuck mash	• Running off wort too quickly • Grains crushed too finely • High percentage of wheat or rye
Low extract efficiency	• Crush too coarse • Collecting wort too fast • Collecting too little volume of wort per unit of grain • Poor lauter tun design • Water chemistry not conducive to good mash (check calcium levels first) • pH outside of 5.2-5.6 range

Chart

Problem	Cause
Overly high final gravity (FG)	• Maybe the beer was supposed to have a high FG • High percentage of specialty malt in recipe • Yeast strain • Any of causes listed under "stuck fermentation" on page 42
Chill haze	• Use Irish moss (at rate of 1 tsp. per 5 gallons) • Boil too short or not vigorous enough
Poor foam	• Glassware dirty • Weak fermentation • Too little protein in wort (esp. when high amounts of adjunct are used) • AG: overly-long rest at 122-131 °F
Mold on surface of beer	• It may be yeast, not mold (different yeast strains behave differently) • Wort is exposed to oxygen, which encourages surface growths
Bottle-conditioned beer is flat	• Move bottles to warmer location for conditioning • Give beer more time to condition • Beer and priming sugar not adequately mixed in bottling bucket • You forgot the priming sugar • Not enough yeast left in beer to bottle condition (rarely happens)
Bottle-conditioned beer is overcarbonated	• Contamination • Beer and priming sugar not adequately mixed in bottling bucket • Too much priming sugar
Beer's original gravity (OG) too low	• X: wort and topping up water not mixed thoroughly • AG: poor extract efficiency (see above)
Cheesy aroma or flavor	• Hops are old and stale
Corn-like aroma or flavor (DMS)	• Wort cooled too slowly when certain very pale malts used • Contamination
Solvent-like or nail polish aromas (higher alcohols, fusel oils)	• Fermentation temperature too high • Inadequate aeration • High original gravity
Skunk-like aroma	• Beer exposed to light (especially due to bottling in clear or green bottles)
Wet cardboard aromas and flavors (oxidation)	• Beer exposed to oxygen during late fermentation or conditioning
Sherry-like aromas or flavor (oxidation)	• Beer exposed to oxygen during late fermentation or conditioning • Long aging of high-alcohol beers (appropriate in some cases)
Excessive sediment in bottle conditioned beer	• Some sediment is always present • Let beer fall clear before bottling
Water, wort or beer on floor	• Be sure all valves are closed before transferring liquid to a vessel
Beer on ceiling	• Fermentation lock clogged (use blow-off tube next time)

what I'm talking about. Let's look at the potential causes for this all too common flaw.

Most of the reasons for why this undesirable flavor occurs can be found in the mash tun or boiling pot. The grain or extract itself is very rarely the problem unless you are only brewing really dark beers with copious amounts of roasted malts. If you are experiencing harshness across a large spectrum of beer styles, it is most likely your water that is to blame.

For all-grain recipes, you should try to keep your sparge water temperatures at a maximum of 170 °F (77 °C), especially near the end of wort collection, to avoid pulling excessive amounts of tannins from the husks. You also want to quit sparging before the pH of your runoff rises above 5.8 (or the specific gravity of the final runnings drops below 1.008).

The composition of your brewing water could have a number of factors working against you, so getting a water report is highly recommended if you think this could be the root of your problem. You should be able to get a copy of this information if you are on a municipal water supply. If you are on a well, you could have a sample analyzed at a lab for around $25-50.

Having this information is great, but you'll need to know how to use it. Without diving too much into water chemistry, an excessive amount or lack of balance between any number of ions or compounds are common contributors to harsh flavors. I have personally done battle with very alkaline water carrying high levels of bicarbonates and way too much magnesium. My tap water was wreaking havoc on my beers for about a month until I figured out what the issue was. Water that has a high alkalinity keeps your mash pH high and is another way to extract harsh tannins from the grains. Treating the mash with brewing salts is one way to combat this, but only to a certain extent.

Other sources of harshness could be high levels of sulfate, calcium chloride and sodium. If you are looking for a quick solution to this problem, you could always dilute your water with bottled drinking water (which is what I did), use it entirely to brew with, or get a reverse osmosis (RO) system. If you choose to go the RO route, you may want to consider using brewing salts to add some calcium and other beer friendly ions back in to it.

Last but not least are the variety and amount of hops you are using. Most brewers believe that hops with high amounts of the alpha acid cohumulone contribute a more harsh bitterness than those with lower levels. Be sure you are not adding too much hops early on in the boil. If you are dry hopping a beer with pellets, you may also want to give it extra time to let the particles settle out or filter the beer with a sanitized, fine mesh bag before kegging or bottling. Those little hop pieces can be a little tough on the pallet.

Bitterness (a flavor) and astringency (a mouthfeel) are difficult to distinguish for some people and a problem with one can be compounded by a problem with the other. If your beers are "harsh," examine everything in your brewing process that would affect either of these.

Bottom Line: Keep your temperature, pH and hopping rates in check and try using bottled water if you think your tap water is the problem.

Problem: Carbonation Too Lengthy and Variable

If you are bottling your beer and are frustrated with the turnaround time, I would highly recommend switching to kegs if you have the means to do it. It's really not as hard as you think. All you have to do is get a CO_2 tank, a pressure regulator, some food grade tubing, the proper connectors, a Corny keg, a refrigerator to put it in and a finger tap. Using physics to carbonate rather than relying on a biochemical reaction is much quicker and more exact. Using a carbonation chart, you can dial in the pressure and temperature to get the carbonation level you want in 7–10 days. Trust me, you'll never go back once you do.

If that is still too long to wait and you are in a pinch to get some beer to your buddy's bachelor party, there is another way. I'm not an advocate for the "crank and shake" method, but I've had good results with a slightly less crude version of this. Once your beer has been adequately cold conditioned at around 34–40 °F (1.1–4.4 °C), you could easily be sipping on it by that same afternoon by doing this without any adverse effects to the beer.

When filling your keg, be sure to leave about 10–15% head space. Connect the CO_2 tank and purge the air out of it a couple times. Turn the pressure up to 20 PSI and lay the keg sideways on a flat surface with the CO_2 connector facing up. Grab a chair a place it right in front of the keg. Gently rock the keg back and forth with your feet for about 10 minutes. Turn off the gas pressure at the regulator and place the keg in the refrigerator for a few hours. Come back and relieve the head pressure and then turn it to 1–2 PSI (if your serving tube isn't more than a couple feet). I have used this method dozens of times and have never been disappointed. It hits the sweet spot of around 2.5 volumes of CO_2, which is good for most ales. If you desire more or less carbonation, you can change the pressure setting or

rock the keg for more or less time. You'll get the hang of it.

Bottom Line: You don't have to wait 2–3 weeks for complete carbonation of your beer if you don't want to.

Problem: Accurately Predicting Perceived Bitterness

Have you ever had a pale ale that turns out more like an IPA? Or perhaps a brown ale that ends up tasting a bit Scottish? Any significant deviation from the intended bitterness of your recipe can completely change the eventual style of your beer even with all else being equal. In my opinion, the play between sweet and bitter is probably the most basic and critical factor in how your beer will end up tasting.

When we are just getting started creating recipes on your own, many of us think that outright estimated IBU's will give us all we need to know, but that is only half the story. Right now the shelves at our favorite local stores carry bottles with various IBU ratings that are supposed to represent the level of iso-alpha acids in the beer that were contributed by various hop additions during brewing. Those numbers mean very little without knowing how much sweetness is left in the beer.

For example, if I told you a beer only had 20 IBUs, you'd think it wasn't going to be bitter at all right? Well if that beer had a starting gravity of 1.025 and finished at 1.005, you might be singing a different tune after tasting it. The reason a 10% barleywine can have 60 IBUs and actually taste somewhat balanced is because there is a ton of residual sugars left behind.

I have found that the best indicator to use when putting a beer recipe together is the BU:GU ratio (where BU and GU stand for bitterness units and gravity units). All you have to do is take the estimated IBUs and divide them by the last few digits of the estimated OG like so: 40 IBU and 1.080 OG would be 40/80 or a 0.50 ratio. Most people would consider this to be a balanced beer. As you go above this number, the perceived bitterness increases with the opposite being true as you go lower.

I'm sure someone out there is wondering why the final gravity reading isn't used in this formula instead. My guess is because the OG not only has a fairly direct correlation to the residual sugars, but also actually takes into account other flavor compounds yet to be produced by the yeast, which will be vying for influence over your taste buds along with the alpha-acids.

As mentioned earlier in this article, your water could also have something to contribute to bitterness in addition to any highly-kilned malts you've got in your grain bill. There's no numerical way to measure their affect on your beers flavor or an individuals personal sensitivity to iso-alpha acids for that matter. That being said, the BU:GU ratio will get you on the right track to having better control over what you eventually taste and your own recipes as a whole.

Bottom Line: Bitterness is a function not only of the number of IBUs, but of what else is in your beer. This includes the grain bill and water chemistry.

Problem: Stuck Fermentation or High Final Gravity (FG)

Almost every homebrewer has faced this situation. Your fermentation has slowed to a stop. You go to take a hydrometer reading and it is way too high. You spin the hydrometer to dislodge any bubbles clinging to the glass, but the reading doesn't change. What went wrong (and can it be fixed)?

An overly high final gravity can have several negative impacts on your beer. First, the beer will likely be too sweet, compared to what you expect. In addition, residual sugars left behind could become a food source for contaminating bacteria.

So where do you start when your fermentation has stopped too soon. The first thing you should do is to double check your expectations — what final gravity (FG) did you expect to reach and why?

For most homebrews, the expected apparent attenuation (the degree of attenuation you measure with your hydrometer) is around 75%. Yeast suppliers will give the range of apparent attenuations for each yeast strain, but the 75% figure is worthwhile to remember for quick reality checks. If you think your FG is too high, take the OG (in "gravity points") and divide by 4 to get an estimated FG. (For example, if your OG was 1.080, your expected FG would be 1.020, because 80 divided by 4 is 20.) There are many factors that influence your FG, so the above is just a quick check that works best for all-malt beers that aren't brewed to be overly sweet or overly dry. Sometimes homebrewers are expecting an FG lower than is realistic, especially those new to brewing beers that start at a high OG.

If you consistently deal with higher than expected FGs, you can get an accurate idea of what your final gravity should be by performing a forced wort test. On brew day, take a small sample of your chilled wort (perhaps in a small jar), aerate it well and pitch an abundance of yeast (many times your actual pitching rate). Keep the sample warm (preferably around 80 °F/27 °C) until fermentation stops, then take a hydrometer reading.

This reading — from "over-pitched," well-aerated wort, fermented warm — will tell you days ahead of time what your actual FG should be. If the FG of your full batch of beer is higher, you have an actual problem with your fermentation.

Another thing to check is the accuracy of your hydrometer. If your hydrometer were reading high, your beer would be fine, but the measurement would be off. For starters, do a quick calibration by floating your hydrometer in water. In pure water, it should read 1.000 — and even in most tap waters, the deviation due to dissolved minerals would be negligible. If you think your hydrometer is reading wrong, you will need to calibrate it. (For instructions, go to byo.com/component/resource/article/414.)

If you think that you are consistently getting great extract efficiency (from your high OG readings), but poor attenuation (from the FG readings), yet your beer does not taste inappropriately sweet, your hydrometer is a likely culprit.

But what if your expectations are realistic and your hydrometer is accurate? In other words, what if something is actually wrong and your fermentation stopped short?

The reason that stuck fermentations are common in homebrewing is that there are many different factors that lead to them. In some cases, the fermentation can easily be restarted; in others, there is no easy remedy.

One reason that some fermentations stick is that the temperature in the fermenter drops too low. This is the easiest type of stuck fermentation to fix. Simply stir the yeast back into suspension (without aerating the wort) and warm the fermentation up. This can be done by moving buckets or carboys to warmer locations or with a heating blanket. Fermentations stopped by the cold can almost always be restarted when a proper temperature is re-established.

Another reason fermentations can stick is due to poor yeast performance, and there are many causes of this. If your wort was lacking in nutrients, not sufficiently aerated prior to pitching or you pitched an inadequate amount of yeast, they can perform sluggishly and stop fermenting early. And unfortunately, most often this cannot be corrected after the fact. Adding yeast nutrients when a fermentation is mostly completed may revive the yeast, but residual nutrients will leave you with very biologically unstable beer. Likewise, adding oxygen to mostly fermented beer will definitely reinvigorate the yeast, but it will also cause them to excrete an excessive amount of diacetyl into your beer. It will also accelerate staling.

In these cases, you may be able to salvage the beer by making a yeast starter and repitching some healthy yeast to the batch. If you try this, do not aerate the main batch or add yeast nutrients. For a 5-gallon (19-L) batch, make a ½-quart (½-L) starter, aerate well and pitch it at high kräusen.

You should know, however, that this procedure is not guaranteed to work. When yeast are stressed, they secrete certain proteins into their environment that suppress growth. So, if you try to revive a stressed fermentation by adding active yeast, they may simply shut down when they encounter the "stress proteins" in the wort. If you are really determined to rescue a batch, you can fine the beer with something that removes proteins (such as silica gel), and then try repitching with fresh, actively-fermenting yeast.

In all of the above cases — inadequate nutrition, underaeration and underpitching — it is much easier to take care of the potential problem on brew day than to try to compensate for it later. And remember, you can add yeast nutrients to your yeast starter as well as giving the starter periodic shots of oxygen.

A final potential cause for an overly high final gravity may be the fermentability of your wort. Some worts may contain an overabundance of non-fermentable carbohydrates. Even with an adequate amount of nutrients, oxygen and yeast cells, the fermentation will stop when all of the fermentable sugars are gone. The non-fermentables may come from large additions of some malt extracts, lactose or crystal malts, or they could result from a "short, high" mash (a mash where the saccharification rest temperature was at the high end of the range and the overall duration was short).

There is a possible remedy to this problem, but it is tricky. You can add Beano® (the dietary supplement that helps people digest beans more agreeably) to your beer and convert some of the non-fermentable carbohydrates to fermentable sugars. However, there is no way to know how much Beano® to add. Beano® is an enzyme and keeps working until it breaks down. There is no formula for how much of this to add because its action is unpredictable. Hombrewers who have tried this frequently report that overly sweet batches of beer were transformed into "rocket fuel" — dry, highly alcoholic tasting beverages.

Bottom Line: A stuck fermentation or overly high FG are two of the most common problems in homebrewing. There are many possible causes for this and in every case it is easier to avoid the problem by using proper brewing techniques than to remedy the situation afterwards.

Problem: Overly Dark Extract Beers

Brewing using malt extract is a convenient way to brew and most popular beer styles can be made using extract. One of the biggest problems extract brewers face, however, is beers that turn out darker than expected.

There are basically three reasons that extract beers sometimes have too much color — stale extract, scorching or Maillard reactions.

Malt extract is a food product made from grains and, as with anything made from grains, it will eventually go stale. When it does so, its color darkens. Since liquid malt extract contains water, it goes stale more quickly than dried malt extract. As such, if you use liquid malt extract, find a source that gets it fresh and use the extract within a couple months. Dried extract will store longer, but is not immune from staling (especially if it is not stored in an airtight container).

When brewing with extracts, it is easy for clumps of incompletely dissolved extract to fall to the bottom of your brewpot. There, with a thick sugary solution next to the hot metal surface, malt sugars will caramelize (a reaction between sugars) and scorch. Whenever stirring malt extract into your brewpot, turn off the heat briefly. Also, continue stirring longer than you think is necessary before turning the heat back on.

Extract brewing frequently involves making very thick worts in your brewpot, then diluting them to working strength in the fermenter. Unfortunately, at higher concentrations of wort solids, reactions between sugars and amino acids (Maillard reactions) are more favored and these reactions will darken a wort. If you can't boil your full wort volume, try adding as much of the malt extract as is feasible late in the boil (for the final 5–15 minutes). Malt extract does not need to be boiled for longer than the amount of time it takes to sanitize it.

Finally, extract brewers should also know that malt extract makes wort that is slightly darker than the equivalent wort made from grains. This is because malt extract picks up some color as it is concentrated. For all but the lightest beers, you can adjust the darkest specialty grains downward a bit, if color matters to you.

Bottom Line: Use fresh malt extract, stir well and minimize the amount of time you boil the wort when it is at its thickest (i.e. add the extract late). BYO

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AMERICAN WILD ALES
Running Feral Fermentations at Home

Take a walk on the wild side and brew a soured beer with microorganisms from your backyard

Story by
Michael Tonsmeire

"I remember several years ago Jean Van Roy at Cantillon telling me, 'You can spontaneously ferment in the United States, but, keep in mind that it probably won't be the same way we do it here. You might have to come up with your own program.' In the case of Allagash they've pretty much been able to copy how it is done in Belgium and they are getting amazing/similar results as our friends in Belgium. For us, we've had to come up with a couple of hybrid methods to make it happen."
– Vinnie Cilurzo, Brewmaster and Co-Owner of Russian River Brewing Co.

Sour beers are frequently aged in used barrels. The microorganisms in the wood contribute to the wort flora and the barrels "breathe" just enough to let a small amount of oxygen in.

Out of all of the ways to sour a beer, the most romantic is to let the fresh wort ensnare wild yeast and bacteria from the air as it slowly cools. People often refer to *Brettanomyces* as "wild yeast," but the truth is that the strains most brewers pitch have been selected, isolated, and propagated and are no longer truly wild. While using untamed microbes may not be as easy as pitching a mixed culture from a Wyeast or White Labs, the flavors created can be far more exciting.

A mixed culture of wild yeast and bacteria was the only option for fermenting beer until Louis Pasteur identified and isolated brewer's yeast (*Saccharomyces*) 150 years ago. While brewers in Germany and England con-

The coolship at Cantillon (the corner of which you can see at right) and the louvers that let in air to cool the wort. Some US brewers have now installed coolships for sour beer production, but homebrews can simply use any relatively shallow container, even their kettles.

tinue to produce beers with microbes in addition to *Saccharomyces* (like Berliner weisse and a few traditional old ales), the only place where spontaneous fermentation survived on a commercial scale was in Belgium. However, as public tastes gravitated more towards sweetness, most large Belgian producers began blending pasteurized lambic, fermented in stainless steel, with fruit syrup. With dry, sour beers regaining popularity, the handful of traditional Belgian lambic brewers and gueuze blenders who remain are lauded for producing beers with a balance of acidity and complexity unrivaled by any other fermentation.

Over the last decade, a small number of American brewers have not only started to experiment but have also succeeded with their own spontaneous fermentations. Despite the risks, more than a dozen craft brewers scattered across the country (including New Hampshire, California, Texas, Alaska and Michigan) are fermenting with their own local microflora. Although I have not yet tasted a spontaneously fermented American beer to equal a gueuze from 3 Fonteinen, Girardin or Cantillon, it may only be a matter of time and commitment.

Wort Production

When planning to spontaneous ferment any beer, you need to start with suitable wort. Standard pale ale wort, for example, is not a good candidate for spontaneous fermentation. Aside from the fact that sour and bitter flavors don't generally work well together, this type of wort is a poor choice in that even moderate hop levels inhibit some of the bacteria that are needed to produce these beers.

Using the right recipe and wort production techniques will increase the probability of a success. Produce a wort rich in chains of sugar molecules too long to be fermented by *Saccharomyces*, dextrins and starches. For lambics, this result is traditionally accomplished with a turbid mash. No complex regimen is required, but I suggest using a conversion rest at least in the high 150 °F (around 70 °C) range. Wild *Brettanomyces*, *Lactobacillus* and *Pediococcus* produce the enzymes necessary to ferment these complex carbohydrates. (If you don't do a turbid mash or accidentally end up with mash temperatures near the lower end of the usual range, don't worry that your wort won't sour at all; even the driest beers achieve only about 75% real attenuation.)

While any grain bill suitable for a pitched sour beer could be used, every American brewer experimenting with spontaneous fermentation that I have spoken with has stayed close to the lambic template: between 30 and 40 percent unmalted wheat, with the remainder being Pilsner malt. Extract brewers can substitute wheat malt extract supplemented with 10% maltodextrin to boost the percentage of dextrins in the wort.

Spontaneous fermentation is the single sour beer brewing method that absolutely requires aged hops. Their antimicrobial contribution prevents wild *Lactobacillus* from reducing the pH of the wort too far before

DCambic
(5 gallons/19 L, all-grain)
OG = 1.050 FG = 1.004
SRM = 4 ABV = 6.0%

Ingredients
6.25 lbs. (2.8 kg) German Pilsner malt
3.20 lbs. (1.5 kg) unmalted wheat
3 oz. (85 g) three-year-old Willamette hops (195 mins)

Step by Step
Use a turbid mash. See the July-August 2008 Issue of *BYO* for details (or see below). Boil wort for 3 hours 45 minutes with 3 oz. (85 g) of three-year-old Willamette added at 195 minutes left in boil. In the primary fermenter, add 0.75 oz. (21 g) oak cubes that have been boiled for 10 minutes. Age in the primary fermenter until the desired flavor is reached and the gravity is stable. Carbonate to 3.0 volumes. This can be accomplished with the addition of sugar. If using the traditional method, blending old and younger batches, target a combined gravity of 0.003 higher than the gravity of the driest component (carbonation with this method can take a year of bottle conditioning to achieve).

Mash Option: Substitute flaked wheat for the unmalted wheat berries and use a single infusion mash rested at 158°F (70°C) for 45 minutes.

Extract Option: Substitute all of the grain for 5 lbs (2.25 kg) of wheat DME and 9 oz (.25 kg) of maltodextrin.


Photo by Michael Tonsmeire

A pellicle floating on top of beer in a carboy. The pellicle is comprised of numerous kinds of microorganisms and slowly grows as the fermentation progresses.

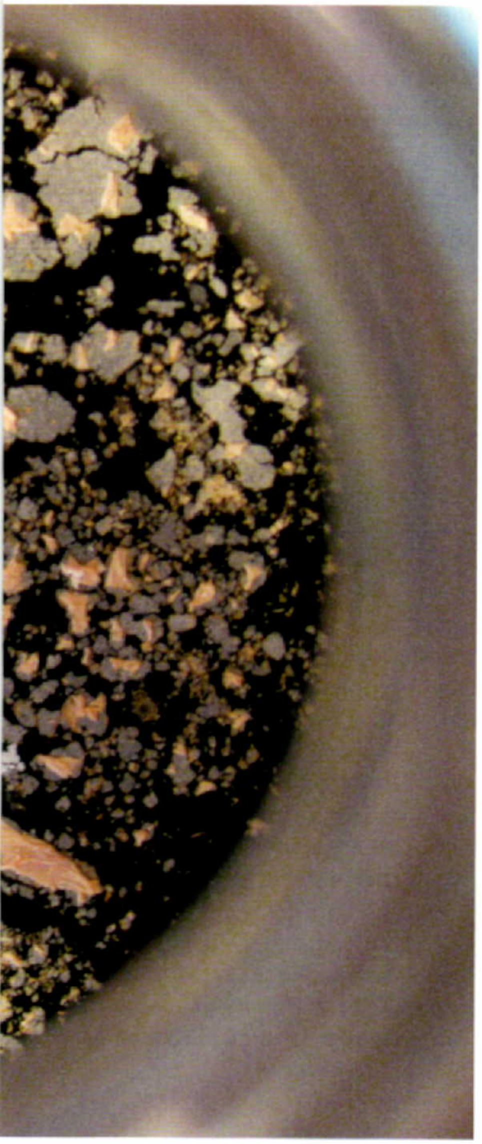
Saccharomyces has sufficient time to complete its fermentation.

Aging hops at a warm temperature and exposing them to air causes their alpha acids to oxidize, thus reducing their bitterness contribution. While isomerized alpha acids are partly responsible for the antimicrobial properties of hops, enough other compounds survive, or are created by oxidation, to maintain the desired effect. Many of these other compounds have low solubility characteristics in wort, which is part of the reason that aged hops should be boiled in the wort for an extended period of time (three to four hours). If, on the other hand, you were to use a sufficient amount of un-aged hops to inhibit *Lactobacillus*, the bitterness they contributed would clash with the sourness in the resulting beer.

You can usually buy hops that have already been aged or debittered for a reasonable price. Homebrewers might also consider aging their own hops if planning on frequent spontaneous fermentations. The standard approach is to place whole, low alpha acid hops in a container large enough to allow air circulation. Keep the container out of direct sunlight, and in low humidity to prevent mold growth. After three years properly (poorly) stored hops will smell similar to dried hay. Adequately aged hops will not smell excessively cheesy or off, although their aroma may be slightly unappealing. The extended boil also helps to volatilize any off-aromas.

In the absence of aged hops, a method for accelerating the debittering process is to bake the hops at your oven's lowest temperature setting, stirring occasionally, until tan and crisp.

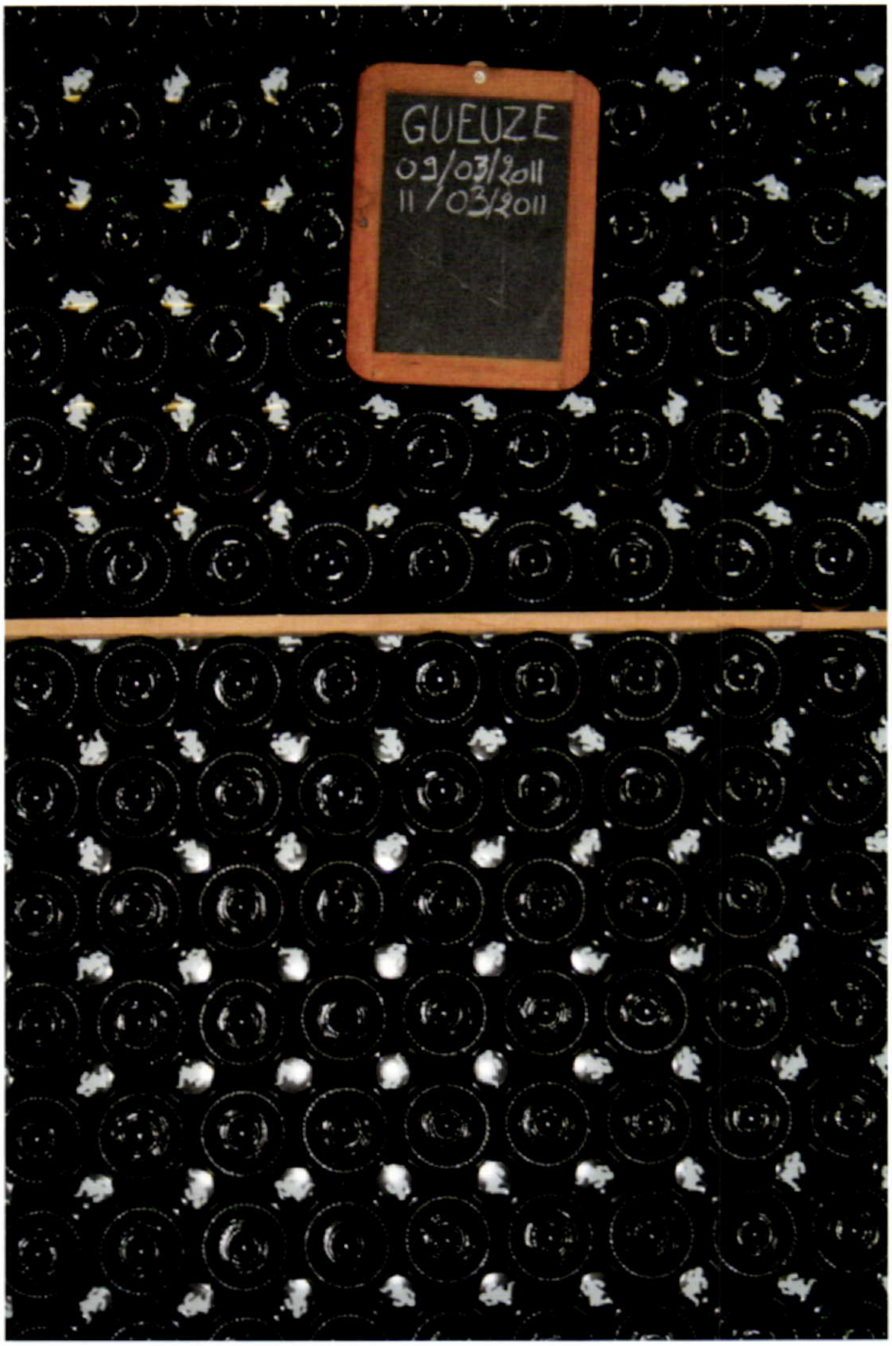
Jeff Sparrow's book, "Wild Brews" (2005, Brewers Publications) suggests 4 ounces of aged hops per 5-gallon batch (120 g in 20 L) as the traditional rate used by Belgian lambic brewers. However, the American brewers I talked to have all settled on lower hop-



ping rates. The range spanned from 2.6 to 3.3 ounces per five gallons (80-100 g per 20 L). The brewers of Allagash tasted a metallic off-flavor in early batches of their spontaneously fermented beers and traced the cause to the traditional lambic hopping rate.

Safety

An oft-repeated reassurance to beginning brewers is that no matter how bad a beer tastes, it will not make you sick. Although true with standard fermentation, it is not necessarily the case when it comes to spontaneous fermentation. When I spoke with Jason Perkins, Head Brewer of Allagash, about his coolship, he was audibly nervous at the thought of homebrewers attempting something similar. He warned me that "the things that usually keep you safe



Stacks of gueuze (blended lambic) aging at Cantillon, the Belgian brewery that has inspired many American brewers to attempt spontaneously fermented beers.

aren't there. You are making a big yummy nutrient soup that all the things you worry about can grow in."

For the first few weeks of fermentation, there is a chance that pathogenic enteric bacteria, like *Escherichia coli* and *Salmonella*, might take up residence in your beer. Luckily, as soon as the desired yeast and bacteria lower the pH and produce sufficient alcohol, the danger is gone. Evaluate spontaneous fermentations only by sight and smell for the first month. Do not taste samples early in fermentation.

If growing a big vat of *E. coli* seems like a bad idea, then artificially lower the pH of the wort below 4.4 to prevent these bacteria from reproducing. Acidification could be accomplished with a sour mash, sour worting or acid malt, but adding food grade lactic acid is the easiest method. The off flavors some enteric bacteria produce during the early stage of a spontaneous fermentation can be used by *Brettanomyces* to produce complex fruity esters, but for many brewers the risk is not worth the reward.

Timing Your Brew

Outside temperature is the key indicator for determining the best time to capture wild microbes. "Wild Brews" reports that during the hot summer months lactic acid bacteria are too prevalent for successful spontaneous fermentation. Several brewers suggested to me that vinegar-producing *Acetobacter* is the graver concern. Hot summer temperatures also slow natural cooling, allowing thermophilic bacteria more time to flourish before the wort cools below 105 °F (41 °C) where yeast can thrive.

Before undertaking their spontaneous fermentation project, the brewers at Allagash compared their weather pattern in Portland, Maine to the epicenter of lambic brewing, Brussels, Belgium. During most of the year, temperatures are similar, but since Maine is much colder in the winter and lambic brewers do not brew in the heat of the summer, Allagash decided to avoid starting spontaneous fermentations in both winter and summer. Jason considers an outside temperature of 40 °F (4.5 °C) to be ideal.

Inoculation

One way to think about the process for producing lambic/gueuze is that the wort is being fermenting by a carefully selected and propagated mixed house culture. Microbes floating on the breeze land in the wort and initiate fermentation in the "horny tank," but at this point the beer is pumped into microbe rich barrels that held previous batches of fermenting lambic.

For decades lambic brewers and blenders have been reusing the barrels that have yielded good beer, and getting rid of the ones that have produced less pleasing brews. The first time a barrel is filled with wort it is usually inoculated with microbe laden beer from an established barrel to increase the chances that it will produce high-quality beer. Obviously, for your first batch, you will not have this option.

Cool the hot wort in a wide vessel to speed the dissipation of heat and provide more surface area for potential microbe landing sites. While a copper or stainless steel coolship is traditional for lambic brewers, American breweries without this specialized vessel have used mash tuns, open fermenters, and oak barrels. Rapid cooling is less of a concern for homebrewers because of the smaller volume of wort. As such, your boil kettle is a fine option.

Location

There are ongoing debates over the best location to expose your cooling wort for inoculation. Lore holds that areas near orchards or vineyards are ideal because the sugar-loving yeasts that ferment the fallen fruit are well adapted to sugary wort. Interestingly, Brasserie Cantillon is located in an urban part of Brussels where only a few cherry trees remain, not the bucolic landscape depicted on their labels.

If for any reason you have a pessimistic outlook on the microbes in your neighborhood, you can move your wort to a more favorable location for inoculation. Gabe Fletcher inoculated his first batch of spontaneous fermented beer at Anchorage Brewing by driving the wort filled barrels several hours outside of Anchorage into the wilderness of Slana, Alaska. In Slana, Gabe opened small lids which he had cut into the top of each barrel, thus exposing the wort for two days to the air next to wild blueberry bushes.

It seems as if there are as many inoculation techniques as there are breweries attempting it, some prominent examples are highlighted below.

For their Coolship series, Allagash installed a shallow stainless steel basin in a small room attached to the side of the brewery. When each three-and-a-half hour boil is complete, the brewers pump the wort into the coolship through a screen that catches any stray hops. The wort is then allowed to sit undisturbed with the windows open and an exhaust fan running until it cools to 60–65 °F (16–18 °C). The exact amount of time to cool depends on outside temperatures, but 12 to 18 hours is the expected range. Once the wort is cool it is moved to a stainless steel tank to ensure that the microbes that landed on its surface are evenly distributed among the barrels.

Three days is the fastest Allagash coolship wort has started fermenting, and some barrels take as long as a week. Fermentation, once it has started, is often so vigorous that the kräusen overflows out of the barrels. *Saccharomyces* fermentation lasts 10 to 11 days, at which point 80% of apparent fermentables have been consumed.

> "For decades lambic brewers and blenders have been reusing the barrels that have yielded good beer, and getting rid of the ones that have produced less pleasing brews."

At Jolly Pumpkin in Michigan, the boiled wort for Lambicus Dexterius is sprayed into one of their shallow open-fermenters to kick-start cooling. The wort temperature drops slowly overnight as the brewery's HVAC (heating, ventilation and air conditioning) system draws in microbe laden air from the outside. The next day, the now cool wort is ready to be pumped into well-used barrels. Fermentation usually starts within 24 hours in oak, 48 hours at the most. Owner and Brewmaster Ron Jeffries credits the quick onset of activity to the microbes in the wood rather than those that land in the cooling wort from the air. Those same wild microbes also serve to sour all of the other beers that Jolly Pumpkin releases, although they are also pitched with cultured brewer's yeast.

Cambridge Brewing Company in Massachusetts (CBC) spontaneously inoculates the base beer for their potent "imperial" lambics using a unique method. The five oak barrels holding the current batch were first filled with boiling water to kill the microbes living in the wood. The water was emptied and each barrel was filled 20 percent full with boiling wort directly from the kettle. The bunghole of each barrel was covered with cheesecloth. The goal was to draw air from the barrel cellar into each barrel via the vacuum created as the wort and air cooled. The remaining 80 percent of the batch was pumped into CBC's clean mash tun. The manway was left open, the doors and windows of the brewpub were opened, and fans were run to introduce wild microbes. One day later, the cool wort in the mash tun was used to fill the barrels. The batch took three days to show signs of fermentation, at which point the barrels began erupting with kräusen.

The original process for Russian River's Sonambic (it is transformed into Beatification when it is blended and packaged) started with a complex step mash. After mash-out an overnight sour mash prepared the mash tun for its role as makeshift coolship. The following day, while the wort boiled, the empty mash tun was rinsed with cold water. This water ensured that most of the spent grain was removed, but the lactic acid bacteria that multiplied during the sour mash were still present. Once the boil was complete the wort was pumped through the heat exchanger and into the mash tun. Vinnie eventually settled on 60 °F (16 °C) for the target wort temperature going into the mash tun. This temperature delayed the peak of fermentation for a couple of weeks and led to lower final acidity compared to warmer knockout temperatures. After spending a night in the mash tun, the wort was pumped into wine barrels which had previously aged Russian Rivers' other sour beers.

In late 2011, Russian River installed a 19 ft long by 4 ft wide (5.8 m by 1.2 m) coolship that they began inoculating Sonambic in. As the primary purpose of the sour mash was to inoculate the mash tun with microbes, the sour mash procedure is no longer part of the brewing process.

Personal Experimentation

Despite the success that American craft brewers have had with Belgian inspired methods, most homebrewers report poor results from the combination of traditional inoculation methods and fermentation in a glass carboy or plastic bucket. (Because some of the microorganisms at work in a sour fermentation are microaerophiles, organisms that thrive on small amounts of oxygen, buckets are a better choice than carboys since they let in tiny amounts of oxygen over time.)

For my first attempt at fermenting with microbes native to Washington, DC, I decided to use a more reliable method. To reduce the risk of catastrophic off-flavors, I captured and propagated multiple wild cultures in advance of brew day.

On a chilly March night, I concocted a half gallon (1.9 L) of low gravity, 1.030 (7.5 °P), wort from light dried malt extract, half an ounce (14 g) of three-year-old Willamette hops, and a pinch of yeast nutrient. For this method, the hops do not need to be aged because the bitterness imparted by un-aged hops would be diluted when the starter is pitched into the wort. (However, keep in mind that hops have anti-bacterial properties, so keep the hopping rate low.)

After the 15 minute boil, I divided the still hot starter wort into three sanitized metal pots. To prevent insects from getting into the wort as it cooled, I covered each with a single layer of cheesecloth secured with a rubberband. I placed starters in my backyard (at 42 °F/6 °C), living room (at 62 °F/17 °C) and basement barrel room (at 57 °F/14 °C). The following morning, with the wort cooled, I poured each into its own growler and left them at 62 °F (17 °C). I did not aerate the wort any more than what occurred as it was being funneled into the growlers. I immediately attached a

stopper and airlock to each.

The first signs of fermentation took three days to appear in the starters, and even then the visual signs indicated only weak activity. I left the three starters alone for three weeks, thus providing adequate time for alcohol and acid production to inhibit enteric bacteria (like *E. coli*). Even after three weeks, I did not feel safe tasting the starters. I dumped out the "upstairs" starter because it smelled foul and was covered in black mold. The "outside" starter had a few spots of white mold and smelled spicy while the "barrel room" starter had no mold and smelled like over-ripe fruit.

Using freshly brewed starter wort, I doubled the volume of the two remaining starters. For this growth step, I crimped a piece of sanitized aluminum foil over the opening of each growler, shaking a few times per day to oxygenate. Both starters resumed fermenting quickly and smelled clean and pleasant. When fermentation slowed, I attached airlocks to limit oxygen exposure thus preventing the mold from reappearing. At this point I finally tasted the starter beers, and to my relief discovered that they had each developed a fruity yeast flavor and light lemony tartness.

I force chilled 5 gallons (19 L) of traditional lambic style wort to 65 °F (18 °C) using my wort chiller. I shook both starters and pitched 1 quart (0.95 L) from each into the cooled wort in a 6-gallon (23-L) fermenter. Visible fermentation took less than 24 hours to appear.

Making wild starters is no guarantee of success, since you will not be able to tell how the character of the wild yeast and bacteria will change with additional aging, but it will reduce the chance of producing an undrinkable beer. If you get a particularly wonderful culture, then follow the lead of lambic brewers by repitching your microbes into future batches rather than starting from scratch each time.

Fermentation

Whatever technique you choose, once the wort is inoculated, your work is complete for a year or two. Lambics are traditionally left in the primary fermenter so that the *Brettanomyces* can benefit from the nutrients ejected by autolysing (dying) *Saccharomyces* cells. I find that this enhances the beer's rustic, funky character. If you want a cleaner character — think Flemish Red compared to a traditional gueuze — rack the beer off of the trub into another fermenter after the initial vigorous fermentation subsides.

While it lasted, the kräusen of my batch was composed of large, delicate bubbles. A light kräusen is a sign that the yeast strains at work are less flocculant than brewer's yeasts. For the first few months the beer exhibited a strong tropical fruit aroma combined with moderate clove, but these faded as the beer aged. Gabe Fletcher described tasting a similar flavor progression from the spontaneously fermented beer he brewed while still Head Brewer at Midnight Sun (thousands of miles from where I live). At one year old, my beer has a light acidity and a wonderful aroma with hints of pipe tobacco, and spicy *Brett* funk.

Blending/Flavoring

With the wide variations in character that spontaneous fermentation produces, all commercial breweries blend batches and barrels to produce their final beer. Allagash Resurgam, the non-fruit version of their Coolship series, is produced by blending several vintages (for example 24-month, 18-month, and 6-month old). Russian River, and Jolly Pumpkin have similar blending programs to produce Beatification and Lambicus Dexterius.

You have to be daring to start several of these batches simultaneously, but blending is a requirement of producing a beer with the balance of a great gueuze. Try to inoculate batches in different locations or at different times of the year, to create a wide variety of characters to blend with. Even the best lambic breweries have barrels that are so acidic that their only use is in shining the copper kettles.

Spontaneously fermented beers can be flavored just as you would any other sour beer. Allagash produces three fruited versions Red (raspberries), Cerise (Montmorency cherries), and Balaton (Balaton cherries). Before you ask, founder Rob Tod has sworn off the idea of adding the ubiquitous Maine blueberry. CBC adds fruit to their imperial lambic to create Kriek du Cambridge (cherry), and Rosé de Cambrinus, which takes its name (and inspiration) from Cantillon's cherry and raspberry infused Rosé de Gambrinus. Honey Badger is a similar concept to Hanssens Mead the Gueuze, although rather than blending with mead, Brewmaster Will Meyers adds honey to the base beer. Russian River made their first batch of Framboise for a Cure by aging Sonambic on raspberries. Rather than adding fruit, Jolly Pumpkin blends a small amount of Lambicus Dexterius into its light hoppy Bam Bière to create Bambic.

My plan is to add a few pounds of

mulberries, harvested from the tree growing in my backyard, to half of the DCambic to impart their unique earthy fruit flavor and deep purple color. Local fruit will contribute wild yeast of its own, and could be added earlier in the process to increase the role these microbes play in the fermentation. See my article "Adding Fruit to Sour Beer" in the September 2010 issue of *BYO* for more information.

What Are You Waiting For?

As with most aspects of brewing sour beer, there is no single preeminent method for starting a spontaneous fermentation. What works for one location or brewer will not work for all. It is important to focus on the commonalities of the methods, ensuring a quick start to fermentation while avoiding too much early activity from *Lactobacillus*. Once fermentation starts, make sure that you heed the advice presented in "Sour Beer Orientation" from the November 2011 issue of *BYO* to monitor the progress of the microbes.

A quick overview of a plan to spontaneously ferment at home might look something like this: First, decide how much beer you want to produce and in how many batches. More batches will give you more potential different contributions to your sour beer blend, but also (obviously) are more work and each has a non-trivial chance of failure. Round up the requisite numbers of buckets, airlocks, etc., and be sure you have a place to store them long term. Fermentation takes many months at a bare minimum.

Second, find out when your overnight temperatures are likely to be in the low 40s °F (around 5 °C) and schedule your brew days. If you live in a rural or semi-rural area, you may also want to scout locations to let your worts cool or to set out starter worts to collect wild microbes to pitch later.

Although you could attempt to inoculate your batches by simply exposing them to the air as they cool, you will greatly increase your chances of success by gathering many samples of wild microbes and determining which have the highest potential.

On brew day, make your wort in the evening and let it cool overnight. Using cheesecloth or something similar to screen your wort will keep insects out. The next morning, transfer the wort to a bucket and add your wild microbe starter, if you made one. From this point onward, all you need to do is wait for the beer to ferment and sour.

This style of fermentation demands patience, blending and the willingness to dump beer, but with some skill and luck you can make a beer that is more exciting and rewarding than anything fermented with the relative safety of cultured microbes from a tube. BYO

Michael Tonsmeire is a frequent BYO *contributor. He blogs as The Mad Fermentationist.*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Story by **Bill Pierce**

DREWRYS
A Good Time for a Beer

A look at a historical American brewery and a brewing technique used to expand production in breweries worldwide.

In 1933, when the United States was deep in the throes of the Great Depression, patience with the thirteen-year-old "noble experiment" of Prohibition had waned. It had turned millions of otherwise law-abiding citizens into scofflaws and provided a huge source of income for organized criminals who were only too happy to cater to the public's thirst. One of the earliest acts of newly inaugurated President Franklin Roosevelt, who had campaigned on a pledge to end Prohibition, was to shepherd through Congress the Cullen-Harrison Act, which again legalized beer with an alcohol content of 3.2 percent or less by weight (4 percent by volume). The night before he signed the bill, the President remarked to guests at a small dinner, "I think this would be a good time for beer."

The act took effect on Friday April 7, 1933. Grateful for the opportunity to reopen, and seeking publicity, brewers in at least four cities sent beer to the White House on that day. Two cases were shipped by chartered airplane on behalf of seven Milwaukee breweries. Notable among the other beers was one brewed in Evansville, Indiana, with the intriguing name of Drewrys Canadian Ale.

Photos courtesy of Derrick Morris

Drewrys brewed their original brands, brands acquired in mergers and beers that were contract brewed, including beers brewed for a liquor store (905) and a department store (Katz).

Born in the UK

How a beer with a name associated with Canada had a role to play in US history is an interesting story, one that like so many other North American brewing legacies begins with immigration. E. L. (Edward Lancaster) Drewry was born in England, in London in 1851. His interest in brewing came naturally, as his father was a brewer. In 1857 the family immigrated to St. Paul, Minnesota, where they founded the North Star Brewery and young E. L. learned the trade. By 1874 he was able to find a position as manager of a brewery in Pembina, Dakota Territory. Today it is a quiet small town in North Dakota near the Minnesota and Canadian borders, but at the time it was a rollicking frontier settlement.

There were even greater opportunities farther north. The nearest place of any size was 70 miles away in the growing Canadian city of Winnipeg, and in 1877 Drewry again moved in

"How a beer with a name associated with Canada had a role to play in US history is an interesting story"

The front of the Drewrys plant in South Bend, Indiana still bears the name of the brewery. A historical marker gives the date the brewery was founded.

order to take over the lease of the Redwood Brewery that had closed. In 1881 he purchased the brewery outright, and a year later production was 20,000 barrels. Business grew with the booming city's population. Drewry was civic-minded and took an interest in his adopted hometown. He was elected to the city council and became Winnipeg's first parks chairman; he also served in the Manitoba Legislature. In 1927 he helped to found Western Breweries Limited, a consortium of several Canadian breweries, including his own.

Southern Exposure

By the early 1930s, it was apparent that Prohibition would end in the US. Drewrys was among the Canadian brewers who had not ceased operations and now eyed the large potential market just to the south. The preferred choice would have been to create a US subsidiary and brew in the US, which would avoid import duties on foreign beer and enable distribution from a US location. However, at the time US law limited foreign ownership of US breweries. The alternative was to enter into a licensing agreement with an existing US brewer, which is exactly what Drewrys did with Sterling Brewers of Evansville, Indiana. Production at Sterling continued under license until 1936. By then Drewrys

Cream Ale Recipe

Here is a popular cream ale recipe courtesy of homebrewer Scott Abene of East Kingston, New Hampshire. The beer can be brewed in the usual manner, or by using high-gravity brewing techniques to yield an extra gallon (3.8 L) of beer.

Genesee My Butt (American Cream Ale)
(5 gallons/19 L, all-grain)

OG = 1.047 FG = 1.008
IBU = 17 SRM = 2–4 ABV = 4.6%

Ingredients

5.0 lbs. (2.3 kg) 6-row pale malt
2.25 lbs. (1.0 kg) flaked maize
1.75 lbs. (0.79 kg) Vienna malt
0.75 lbs. (0.34 kg) crystal malt (10 °L)
4.8 AAU Liberty hops (60 mins) (1.2 oz./34 g of 4% alpha acids)
4.0 AAU Liberty hops (5 mins) (1.0 oz./28 g of 4% alpha acids)
Wyeast 2112 (California Lager), or White Labs WLP810 (San Francisco Lager) yeast
Alternate yeast:
Wyeast 1056 (American Ale), or White Labs WLP001 (California Ale,) or Fermentis US-05

Step by Step

Single infusion with a 60-minute saccharification rest at 149 °F (65 °C). Boil wort for 75 minutes. Ferment at 65 °F (18 °C).

Genesee My Butt (American Cream Ale)
(5 gallons/19 L, extract with grains)

OG = 1.047 FG = 1.008
IBU = 17 SRM = 2–4 ABV = 4.6%

Ingredients

5.0 lbs. (2.3 kg) American lager liquid malt extract
1.5. lbs. (0.68 kg) Light liquid malt extract
0.75 lbs. (0.34 kg) crystal malt (10 °L)
4.8 AAU Liberty hops (60 mins) (1.2 oz./34 g of 4% alpha acids)
4.0 AAU Liberty hops (5 mins) (1.0 oz./28 g of 4% alpha acids)
Wyeast 2112 (California Lager), or White Labs WLP810 (San Francisco Lager) yeast
Alternate yeast:
Wyeast 1056 (American Ale), or White Labs WLP001 (California Ale,) or Fermentis US-05

Step by Step

Steep crystal malt in approximately 1.5 quarts (1.5 liters) 150 °F (65 °C) water for 30 minutes before adding the resulting "tea" to the boiling kettle with additional heated water and the extract. Boil wort for 60 minutes. Ferment at 65 °F (18 °C).

High Gravity Brewing Option:

These recipes — or just about any 5-gallon (19-L) homebrew recipe below ~14 °Plato (OG 1.056), really — can be brewed to yield 6 gallons (23 L) of beer. First, multiply the amounts of all the ingredients in the 5-gallon (19-L) recipe by 1.2. This will yield the equivalent 6-gallon (23-L) recipe. However, brew the beer as you would a 5-gallon (19-L) batch. (Your original gravity in this case will now be 1.056) Be sure to pitch an adequate amount of yeast — yeast from a 3.5-quart (3.5-L) yeast starter should suffice for these beers. Ferment the beer on the cool side of the yeast strain's recommended range. Immediately before packaging, boil a little over a gallon (~4 L) of water, then cool it rapidly. Bubble CO_2 — or, preferably, if you have a nitrogen tap in your brewery, use nitrogen — through the water for about 20 minutes. (Finer bubbles are better for this procedure.) Bottle or keg the beer and let it condition. Once it's ready, consume within a few weeks as it is not suited for long aging.

had decided the best strategy was to create a separate American company under majority American ownership, and the newly incorporated Drewrys Ltd. USA purchased the Muessel Brewing Co. of South Bend, Indiana, which had reopened but had not prospered after Prohibition's repeal. The Muessel beers were discontinued and equipment was upgraded so that brewing of the Drewrys brands could begin.

Meanwhile, E. L. Drewry died in 1940. The original brewery in Winnipeg was closed and Canadian operations absorbed into Western Breweries, which eventually became part of Molson Breweries (now Molson Coors). Drewrys survived south of the border, where it became solely an American beer. They continued to acknowledge its Canadian roots, however, with the figure of a red-uniformed Mountie that appeared on labels and cans into the 1970s.

Rumor has it that the Mountie disappeared when the Royal Canadian Mounted Police filed an objection, but there is no record of this.

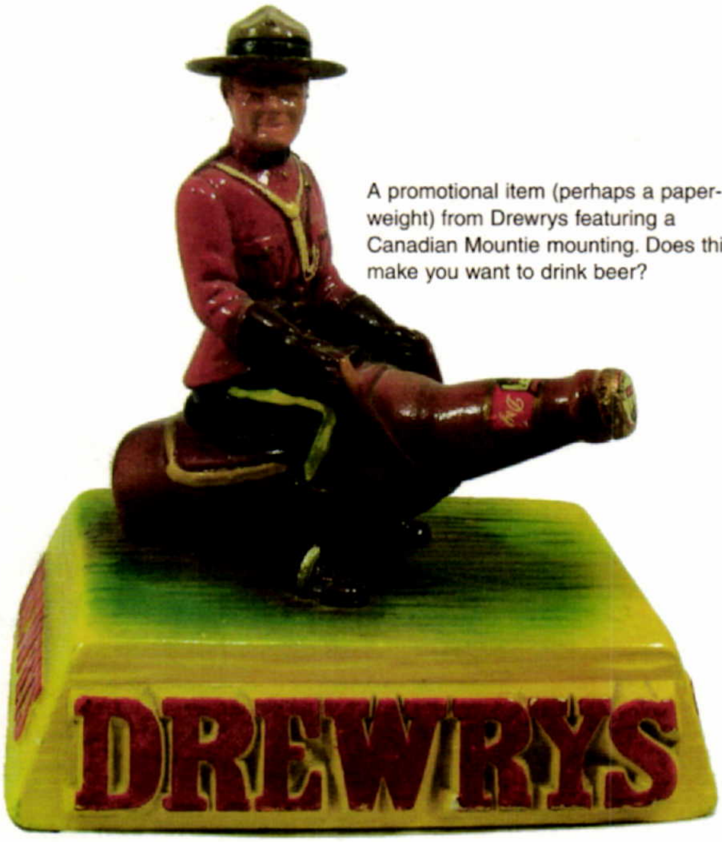
The brand developed a regional following in an area of the Midwest bounded roughly by northern Kentucky, Michigan, Ohio and Illinois. The most popular of their beers was

Once a large regional brewery, Drewrys is now a footnote in US history.

Drewrys Extra Dry lager. Drewrys was one of the first brewers to stress drinkability, a trend that continues into today with American light beer. Ads as early as the 1960s foreshadowed a more modern slogan for another popular beer, boasting that Drewrys was "less filling, more satisfying!" They were also one of the first brewers to use aluminum cans, and pointed out that the lighter cans (and by extension lighter beer) allowed them to float in a cooler. Another campaign marked one of the rare times a brewery promoted a specific brewing ingredient, touting Drewrys as "the beer with Fuggle hops." One radio commercial featured "the Fuggle Hop" as a dance craze with a catchy beat.

Times Were A-Changin'

Drewrys made one acquisition in 1951 with the purchase of Atlas Brewing in Chicago. Two of Drewrys major shareholders also owned an interest in Associated Brewery Co., which resulted in 1962 from the merger of two Detroit breweries, Pfeiffer and E&B, which had acquired other smaller brewers. They offered Drewrys a stronger distribution network and the opportunity to expand, and in 1963 Drewrys was folded into Associated.



A promotional item (perhaps a paper-weight) from Drewrys featuring a Canadian Mountie mounting. Does this make you want to drink beer?

Production at the South Bend brewery was 1.25 million barrels in 1965. The 1960s and '70s were a period of major consolidation for American brewers as regional players jockeyed to become national brands. By 1972 Associated found itself a target of Wisconsin brewer G. Heileman, which was swallowing up regional brands in a major expansion move. Heileman had excess capacity at other breweries, and one of their first actions was to close the South Bend facility. More than 300 workers lost their jobs; today the building and site remain empty, still awaiting redevelopment efforts. Ironically, production of Drewrys beers was shifted to the former Sterling brewery in Evansville, where they had originally been brewed following the end of Prohibition.

In a highly competitive market, Heileman stressed low price, and so Drewrys became a "value-priced" brand aimed at budget-minded consumers. It was one of the earlier beers offered in the 40-oz. (1.18-liter) bottle that has become a staple for low-income beer drinkers.

Heileman itself struggled in the 1980s, eventually filing for bankruptcy reorganization and selling off some of its brands and assets. Among these were Drewrys and the Evansville brewery. After a brief closure in 1988, a group of local investors that included three former brewers purchased and reopened the brewery under the name of the Evansville Brewing Co.

They continued to brew Drewrys, along with other brands and contract beverages, until 1997, when they sold the company to Pittsburgh Brewing. The last can of Drewrys left the brewery in November 1997 when it closed its doors. Pittsburgh Brewing never resurrected the brand. Beset by its own financial woes, the company shuttered its flagship Pittsburgh brewery in 2007. Today its beers are contract brewed at the former Rolling Rock brewery in Latrobe, Pennsylvania, now owned by City Brewery of La Crosse, Wisconsin.

By the way, if you are wondering what happened to those beers sent to the White House by grateful brewers to mark the end of Prohibition back in 1933, it is unlikely President Roosevelt himself ever drank any of them. Instead they were donated to the National Press Club "with the President's compliments," where thirsty journalists undoubtedly enjoyed them after toasting his popularity. We homebrewers can only follow FDR's advice: "I think this would be a good time for a beer."

Let's Play Concentration

No records have surfaced for the recipe for the original Drewrys Canadian Ale, but it is likely to have been an American cream ale, a style common in North America after the end of Prohibition and which persists today in a few commercial examples — most notably Genesee (Genesee Brewing Company) and Little Kings (Hudepohl-Schoenling). Drewrys portfolio of brands also contained 20 Grand Cream Ale in the 1950s.

Typically cream ales were brewed by ale brewers to compete with the mass market lagers that were achieving great popularity. North American ingredients, including six-row malt, corn as an adjunct and American hops, were the norm. Cream ale is relatively light in flavor and body, with only a little of the fruitiness associated with other ale styles. Hopping is low to moderate, and the emphasis is on drinkability. In general this is a dry beer, but it may have a slight sweetness in the finish from the corn. In my earlier article on Old Style (July-August 2012), I discussed kräusening, which was associated with that brand through its advertising. In this article, the associated brewing angle is high gravity brewing.

It's common for commercially produced American light beers to be brewed using this method, which involves brewing a strong version of the beer then diluting it to working strength post-fermentation.

The advantage of such brewing is that larger volumes of beer can be brewed with a brewery's vessels, both on the hot (mashing and boiling) and cold (fermenting) sides of the process. As fermenter space is at a premium in breweries, there are strong economic incentives to brew in this manner. However, this requires careful planning before the fact. The recipe needs to be designed for dilution; otherwise the beer could easily be watery and thin-bodied, lacking in both malt flavor and hop character. For homebrewers, there is no economic incentive to brew this way, but there are times he or she may want produce more beer or simply learn another brewing technique. If you try this at home, there are two main considerations — how strong to make your concentrated beer and how to deaerate your dilution water.

Typical commercial practice for brewing American Pilsners around 11 °Plato (OG 1.044) is to make and ferment a 16 °Plato (OG 1.064) wort, then dilute the beer to 11 °Plato (OG 1.044) at packaging. Higher gravity worts would result in too much ester production during fermentation, so brewers do not attempt to brew the absolute strongest beer they could possibly manage. For homebrewers — who can use this technique to "expand" any style of beer — it's best to pick a specific gravity for the strong beer for which you know you can run a relatively clean fermentation. Also, you will have a higher probability of success at home if you don't try to expand your batch volume beyond about 20% — for example, from 5 gallons (19-L) to 6 gallons (23 L).

One major concern in high gravity brewing is that oxygen dissolved in the dilution water will promote rapid oxidation. Commercial brewers have specialized equipment to thoroughly deaerate their dilution water. Homebrewers, however, will have to rely on simpler methods.

At room temperature, water that is exposed to air will hold about 9 ppm oxygen (at equilibrium). If it is boiled and quickly cooled (no splashing), it will contain less than 1 ppm oxygen. To further deaerate the water, you could bubble either CO_2 or (preferably) nitrogen through the water. The gas bubbles rising through the water will partially scrub it. Nitrogen works better for this as it produces finer bubbles. Boiling alone may be sufficient if you plan to expand the volume of your batch by only 10–15% and then drink the beer within a few weeks. See the recipe on page 60 for more detailed instructions on this technique. BYO

Bill Pierce wishes to thank the Franklin D. Roosevelt Presidential Library and Museum, as well as homebrewer Scott Abene for information and their assistance.

Lighten Up

Late extract additions

by Terry Foster

Many authors (including me) recommend that you do a full wort boil (5 gallons/19 L if that is to be the final volume of wort at pitching) when brewing with malt extract, having added all the extract at the beginning. That's a good rule of thumb, for it ensures a proper hot break, and means that it is relatively easy to calculate hop bitterness and to reproduce it from beer to beer. But, as always there are cases where you may not want to follow the rule, the first being that maybe you just don't have the equipment or space to do a full wort boil. But there is another case where you deliberately add a portion of the extract late on in the boil.

In fact malt extract does not need an extended boil, since it has already been boiled in its manufacture. If you use a 90-minute boil (as you might with an all-grain beer) an extract-based beer can be thin and lacking in mouthfeel because of excessive breakdown in proteinaceous material. That is why most brewers recommend a 45- to 60-minute boil for extract beers. And it is clear that adding a significant amount of extract towards the end of boiling will limit the breakdown of protein residues which will help both the beer's head retention ability and its body.

But the main reason for late extract addition is to make your beer paler than if all the extract was added at the beginning. This is because during boiling certain reactions occur in the wort, which result in browning and darkening. The extent of browning is partly a function of boiling time and of the concentration of the wort, so that the longer the boil and the higher the wort concentration the darker the wort will be. Therefore, if you add, say, two thirds of the total amount of extract 15 minutes before the end of a 60-minute boil you can expect your beer to be paler than if all the extract was added at the start. Exactly how much paler is impossible to say without carrying out an involved series of tests coupled with color measurements, to which homebrewers are unlikely to have access. But if you are brewing a light-colored beer this approach is obviously a good insurance against getting too dark a color, and it is one that is used successfully by a number of homebrewers. Of course it would be of most value if brewing an American light lager, or a genuine Pilsner, but many brewers consider it useful to use late extract addition in all their pale beers. You can also do it with dark beers, but I don't recommend it, not just because the lessening of color is unimportant in such beers, but because most of them benefit from the flavor compounds that are produced by the browning reactions. And do be careful with late addition — turn off the heat source and make sure all the extract is fully dissolved before turning it on again. If it is not dissolved it will scorch and caramelize on the bottom of the pot and your efforts will have been in vain.

> "Malt extract does not need an extended boil, since it has already been boiled in its manufacture."

This browning effect is caused by what are called Maillard reactions, whereby reducing sugars react with amino acids to form a variety of compounds. One group of these compounds is known as melanoidins because they are highly colored; other, usually simpler, molecules are produced that are intensely flavored and can have beneficial effects on the palate of the beer, especially dark beers. As a flavor reference one source states that the ultimate product of Maillard reactions is caramel. Indeed caramel flavoring is usually manufactured by heating sugar in the presence of ammonium ions, although it can be produced without the presence of the latter.

That's a little bit of the chemistry behind late extract addition and its effect on beer color, but we need not get too much into that for it should be obvious to even the most simple-mind-

> "You can also see that doing a 3-gallon (11-L) boil gives about 6–7 IBU less than you would get for a 5-gallon (19-L) boil, whether you use late extract addition or add it all at the beginning of the boil. Such a difference is marginal and might not be enough to be perceived by all drinkers. So all you "3-galloners" might not be so far off the money as you may have been led to believe!"

ed astrophysicist that the technique is a very useful one for an extract brewer, whether using only extract or using the partial mash plus extract technique. It is not much good for brews produced using steeped grains plus extract, because the grains in that case are usually highly-colored and full of melanoidins anyway!

But are there any downsides to using late extract addition? Well, there is one drawback, and a quick trawl around homebrewing websites reveals a common complaint about this technique — that the beer is too bitter. The reasoning behind this is that for most of the boil time the wort specific gravity is significantly lower than that of the final wort going to fermentation. As a result, hop utilization is much higher and the beer is likely to end up with a higher concentration of iso-alpha acids than would have been the case if all the extract had been present at the commencement of the boil and the wort SG during boiling would have been closer to that of the final wort SG. Since bittering hop additions are usually calculated for the full wort gravity in the boil, a beer produced by late hop addition is going to have a higher bittering level than you originally targeted. This will obviously be most noticeable in a lightly-flavored, delicate beer which may well be just the type of beer which benefits from this technique in terms of color.

Well, I am nothing if not a critical scientist, and my first inclination was to ask, "How many of these people did a control test, as all good experimentation requires?" In other words, were the beers produced by late extract addition significantly higher in bitterness than those where the extract was added at the start? Given that IBU measurement is impractical for the homebrewer, is there some way we could calculate them at least to a reasonable approximation? I've seen several pieces on late extract addition and they all seem to think that it is far too complicated to do so, because of the changes in wort gravity when this method is used. In "All About Bitterness" (*BYO* September 2011) I quoted two authors who offer formulae that make allowance for the effect of increasing wort gravity on hop utilization. These were Rager and Garetz whose formulae have been widely used by homebrewers. However, these only deal with beers of OG 1.050 (12.4 °P) or higher, and the first part of the boil using late extract addition will be below this gravity (see below).

In the earlier article I also mentioned a very complicated equation for calculating IBUs, that from Glenn Tinseth. Since this does allow for lower wort gravities than 1.050, we can use this equation to do a little "thought experiment" on IBUs. Glenn has thoughtfully given an IBU calculator on his website: www.realbeer.com/hops/. This made life easy for me and I used it in what follows, with some reservations, which I shall detail later in this column.

Bittering effects in late extract addition

1. Let's assume, for simplicity's sake that we are going to make 5 gallons (19 L) of a pale beer using 6 lbs. (2.7 kg) malt extract syrup, and adding 1.5 oz. (43 g) of hops at 5% alpha-acid. We'll add all the hops and ⅓ of the extract at the start of the 60 minutes boil, and the remaining ⅔ for the last 15 minutes, using a full 5-gallon (19-L) boil.

The gravity at start is (2 x 36)/5 = 1.014, which Tinseth says will give 33 IBU in 45 minutes boiling. Now gravity in last stage is (6 x 36)/5 = 1.043, which the calculator gives as yielding 14 IBU in 15 minutes boiling. Therefore total IBU this way would be 47. If all the extract had been added at the start, then at 1.043 throughout the boil would give a wort with only 28 IBU.

2. Let's do it all over again, but this time using only a 3-gallon (11-L) boil. The gravity at the start will be (2 x 36)/3 = 1.024, which will give 30 IBU via Tinseth for a 45 minute boil. But gravity for the last 15 minutes will be (6 x 36)/3 = 1.072, and the calculator says that will provide 11 IBU. So that means total IBU would be 41 by this method. If all the extract were to be added at the start, then we would have had 21 IBU in the finished wort.

What all this means

In the first case, the difference between late extract addition and total addition at the start is 19 IBU, while in the second it is 20 IBU. If those numbers are correct then this is certainly a big difference in bitterness for a beer of OG 1.043, and would certainly be noticeable in the taste of the beer. So all those brewers who tried late extract addition and said that the bitterness of their beers was way over the top were correct! That verifies the old brewing adage of "always taste it and rely on what your palate tells you."

You can also see that doing a 3-gallon (11-L) boil gives about 6 to 7 IBU less than you would get for a 5-gallon (19-L) boil, whether you use late extract addition or add it all at the beginning of the boil. Such a difference is marginal and might not be enough to be perceived by all drinkers. So all you "3-galloners" might not be so far off the money as you may have been led to believe!

Finally, this strongly suggests that if you want to do a late extract addition you must adjust the amount of hops you use if you don't want to overshoot on bitterness. But by how much should you reduce the hop addition? Well, you could just work it out for yourself as I have done using Tinseth's calculator. Or you could use the numbers I have given above to make an approximation as to how much to add. These show that for a 5-gallon (19-L) boil you would need to reduce the amount to 28/47, or 60% of the original quantity to bring it down to 28 IBU as from early extract addiction, while the corresponding number for a 3-gallon (11-L) boil would be 21/41, or 50% of the original to bring it to the 21 IBU you would get from early addition. However, if you wanted to get 28 IBU in a 3-gallon (11-L) boil with late addition you should only reduce the hops to about 70% of the original amount. Of course, these numbers are just guidelines and should be used with care; they may be very different for different recipes and different original gravities.

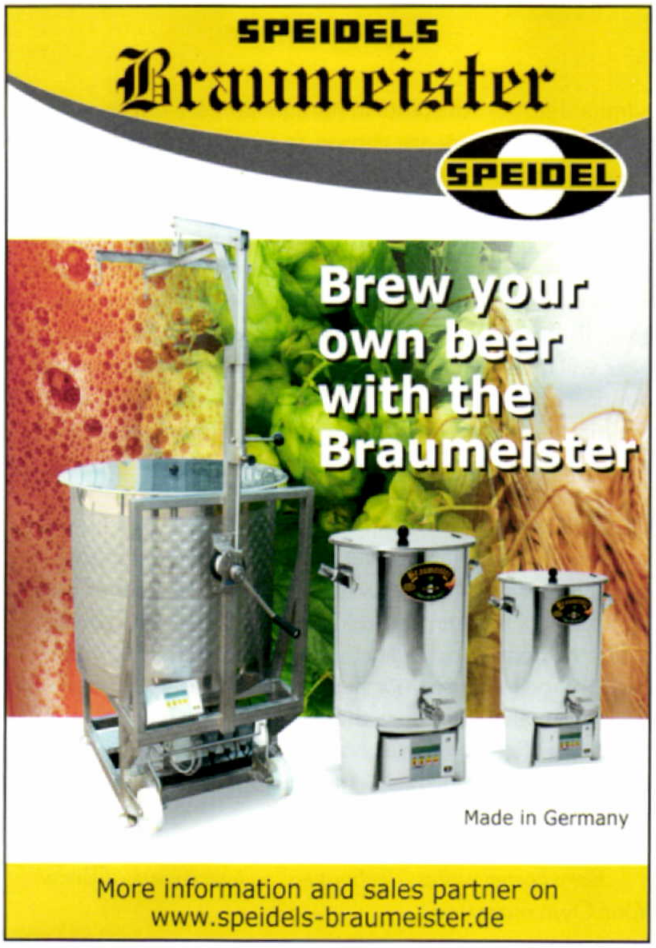
Reservations

All the bitterness calculations above assume that Tinseth's equation is correct, which may not be the case. He himself admits that the constants in his equation are empirically derived; that is they are chosen to make the data fit the equation, and are not absolute. In fact, they may apply only to his brewing procedures, and could be different for somebody else. And, he derived this equation using whole, fresh hop cones, so that quite different results could be obtained if you were using pellets. Finally, Tinseth's equation only gives IBU for the wort, and we know that IBU levels in the beer will be lower. Losses of iso-alpha acids occur throughout processing, particularly when foam is formed, so that the major loss occurs in fermentation. Always remember it's the taste not the math that counts.

Conclusions

Late extract addition is a very useful technique for any extract brewer who wants to keep his or her beer as pale as possible. I recommend that you try it, providing that you make the appropriate adjustment to the amount of hops used, or it can cause your beer to be excessively bitter. That may take a bit more thought than you want to put in, but this is life and you get nothing for nothing. And if any of my number handling has confused you, remember to let your palate be your judge! BYO

Terry Foster writes "Techniques" in every issue of Brew Your Own *magazine.*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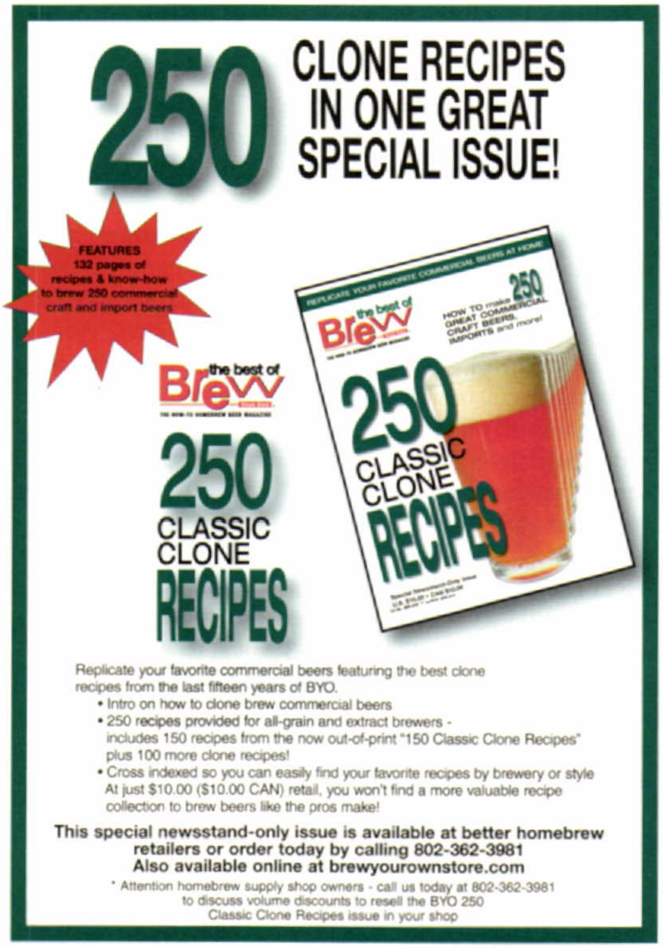
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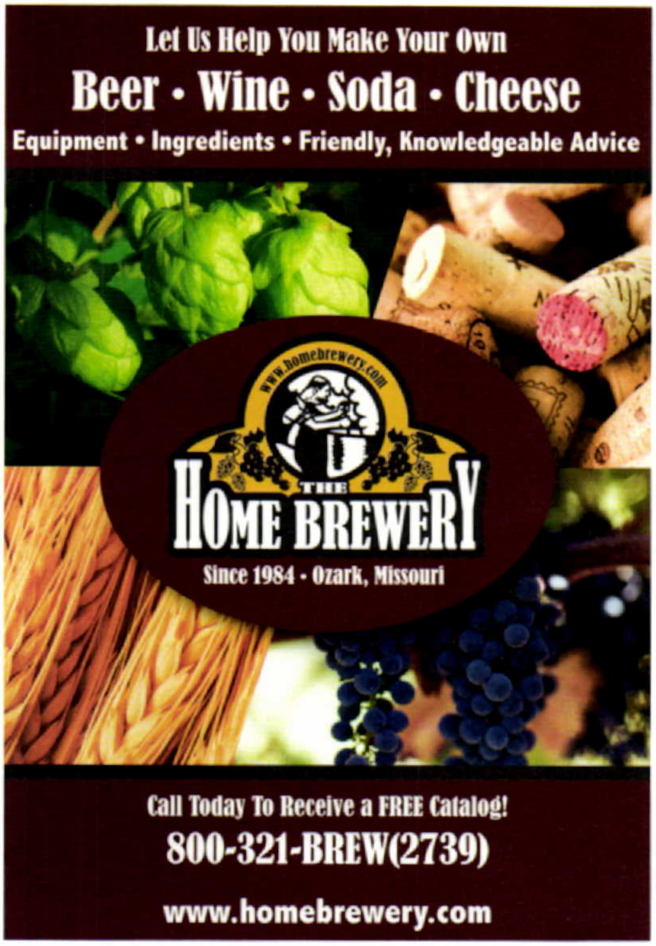
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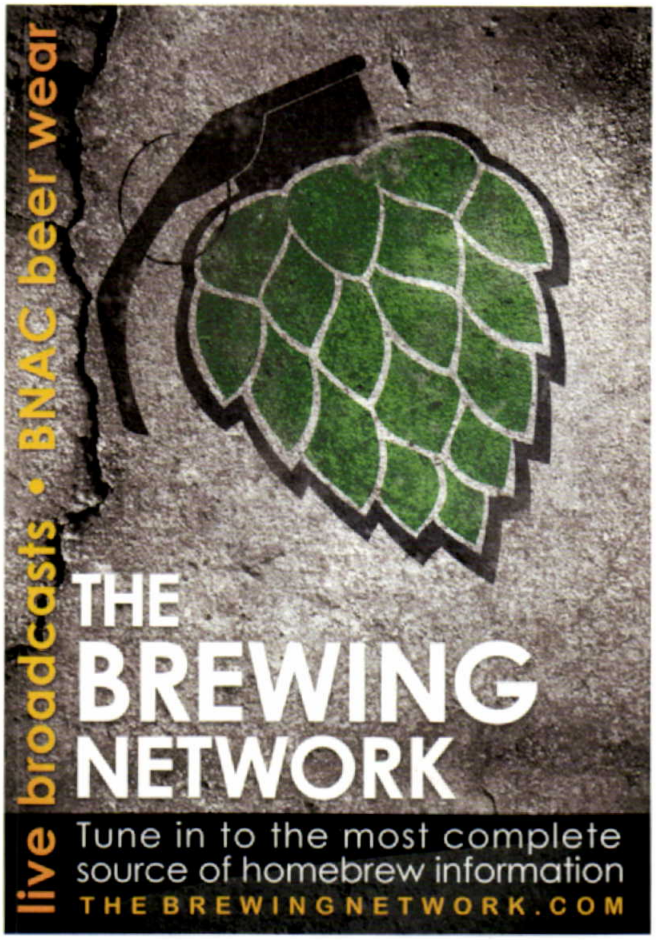
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Yeast Metabolism

What yeast do during fermentation

by Chris Bible

Yeast are microscopic, unicellular fungi that are capable of converting various types of sugar into ethanol and other byproducts. Yeast take in sugars and anaerobically (without oxygen) metabolize them to produce energy, additional yeast cells, ethanol, carbon dioxide and other metabolic byproducts:

Sugar + Yeast → More Yeast + Ethanol + Carbon Dioxide + Metabolic By-products + Heat

The two species of yeast that are most widely used by brewers are *Saccharomyces cerevisiae* (ale yeast) and *Saccharomyces pastorianus* (lager yeast). These two species of yeast differ in several important ways, including their optimum fermentation temperatures (lager yeast can ferment at colder temperatures), ability to ferment different kinds of sugars (lager yeast can ferment maltotriose) and production of fermentation byproducts (lager yeast produces fewer esters and is generally described as producing "cleaner" beer).

Yeast metabolism

When fermenting wort, yeast have several distinct phases of metabolism, including cell wall synthesis/O_2 uptake, sugar uptake, nitrogen uptake, fermentation, energy production, cell growth, acidification, production of byproducts (from the yeast's perspective . . . CO_2, ethanol, others). These stages are not discrete, in other words one blends into the other as the fermentation progresses and a cell may be doing more than one thing at a time. Different cells within the population of yeast will be in different phases. For example, when a fermentation slows, some cells are quicker to shut down and flocculate than others.

Fermentation is also sometimes described as proceeding through lag phase (where there is little or no indication of active fermentation at the macroscopic level), exponential growth phase (when the yeast are multiplying most rapidly and cell counts increase exponentially over time), stationary phase (when the cell count is relatively stable and the bulk of fermentation occurs) and death (or in beer production, flocculation and perhaps the cells are reused for another fermentation).

Some of the major metabolic pathways relevant to beer production are shown in the figure on page 70.

Cell wall synthesis / O_2 uptake

In order for yeast to begin cell wall synthesis, the yeast cells must have access to cell-wall building blocks: sterols and oxygen. Sterols can be synthesized by the yeast, or they may be scavenged from the wort (if present). Additionally, the yeast cells must be permeable enough to allow nutrient and oxygen uptake to occur.

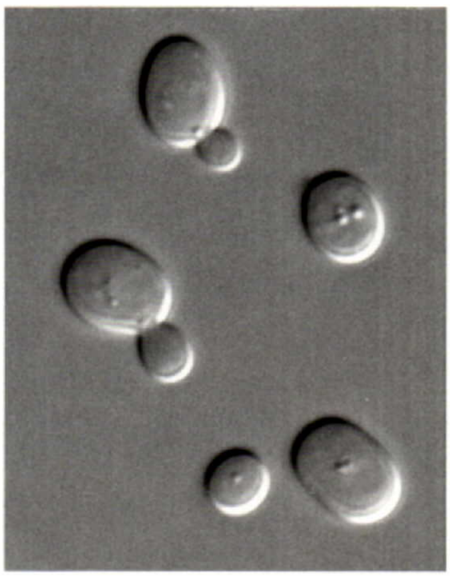
Synthesis of cell walls using sterols and oxygen requires the yeast to consume internal reserves by using internally-stored glycogen in order to supply the needed energy. (As the fermentation progresses, newly assimilated wort sugars also contribute.) Glycogen reserves are slowly depleted during the storage of yeast, so older yeast will have less stored glycogen. Low oxygen levels or low glycogen levels can lead to a sluggish fermentation.

Sugar uptake

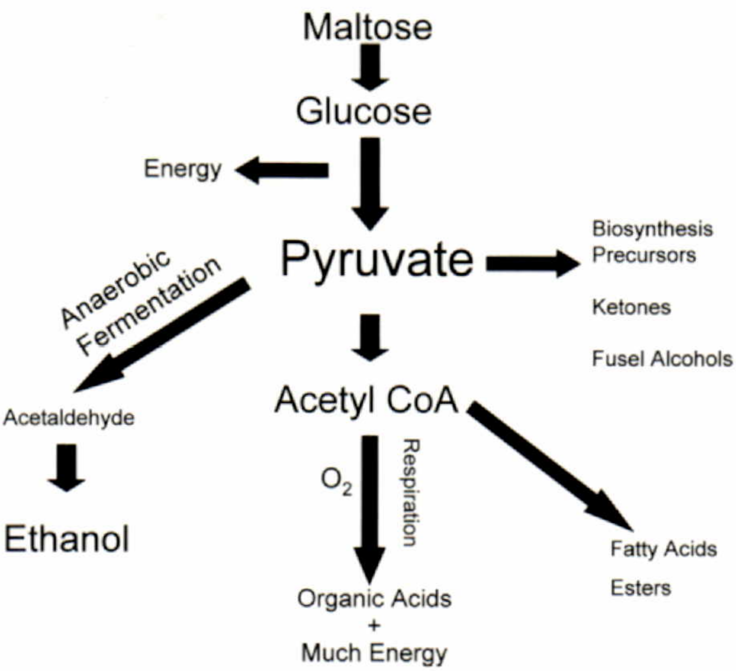
After the yeast has built up a cell wall structure, the next step is sugar uptake. In an anaerobic environment, yeast generally take up and preferentially ferment sugars in the following order: glucose, fructose, sucrose, maltose (the most abundant) and maltotriose.

Different enzymes help process the different sugars. For example, the enzymes sucrose permease and sucrase transport sucrose inside the cell and split it into glucose and fructose. Different enzymes take in maltose and maltotriose and split them into their constituent glucose residues.

"Yeast are microscopic, unicellular fungi that are capable of converting various types of sugar into ethanol and other byproducts."



Metabolic Pathways In Beer Production



Nitrogen uptake

Nitrogen in the form of amino acids is next taken up by the yeast. Amino acids can be thought of as consisting of an NH_3^+ component that is attached to various carbon chain skeletons. The NH_3^+ component is used by the yeast cells for protein synthesis. Amino acids are also the precursors for the formation of fusel alcohols.

Under certain conditions, yeast may excrete essential nitrogen-containing compounds back into the wort. This can occur if a yeast cell experiences larger osmotic pressures than they can cope with due to high wort gravity. This phenomena is known as shock excretion.

Fermentation

From the perspective of the yeast, fermentation produces numerous byproducts (things not associated with making more yeast) including ethanol, acetaldehyde, fusel alcohols, esters and ketones.

Ethanol is a major excretion product from fermentation. Excretion of ethanol is a cell detoxification mechanism from pyruvate and acetaldehyde build up within the yeast cell. Ethanol is, of course, the two carbon alcohol that provides the "kick" to beer and is also toxic to many other microorganisms that could potentially spoil wort.

Acetaldehyde is an intermediate anaerobic fermentation product that is mostly converted to ethanol during the fer-

Factors Affecting Yeast During Fermentation and Effects on Flavor of Finished Beer

Factor	Effect on Yeast During Fermentation	Effect on Flavor & Quality of Beer
Yeast Strain	---	Different yeast strains produce different flavor compounds. Select strain appropriate for desired beer style.
Yeast Condition at Time of Pitching	Healthy and Fresh Yeast: Lots of glycogen reserves available. Short lag phase. Unhealthy and Old Yeast: Less glycogen reserves available. Longer than desirable lag phase	Optimal for good beer 1) Off-flavor production more likely 2) Potential for contamination increased
Amount of Yeast Initially Pitched (Pitching Rate)	High Initial Cell Count: Yeast ferment wort more quickly Low Initial Cell Count: 1) Yeast ferment wort more slowly (increased chance of stuck fermentation) 2) Decreased attenuation	Almost always desirable for homebrewers 1) Fusel alcohols, esters & diacetyl production increased. 2) Residual sweetness possibly higher than desired 3) Potentially higher sulfur levels in finished beer
Dissolved Oxygen Content (Wort Aeration)	High Initial Dissolved Oxygen Content: 1) Short lag phase 2) High yeast viability Low Initial Dissolved Oxygen Content: 1) Longer than desirable lag phase. 2) Low yeast viability	Almost always desirable for homebrewers Esters, diketone & acetaldehyde production increases
Micronutrient Availability (Zinc, Magnesium, other trace minerals)	Enzyme functions require trace mineral ions. Influences speed of fermentation. Readily-available micronutrients allow for cleaner fermentation through normal metabolic pathways.	Off-flavors are more likely if micronutrient concentration is lower than optimal during fermentation.
Wort Gravity	Higher: 1) Decreased fermentation rate 2) Increased production of metabolic by-products Lower: 1) Increased fermentation rate 2) Decreased production of metabolic by-products	Higher wort gravities may lead to increased ester production, more fusel alcohols, and more phenolic compounds in the finished beer. Yeast can more easily ferment lower gravity wort, so fewer by-products are produced. Cleaner fermentation happens with lower gravity wort.
Wort pH	Higher pH increases organic acid formation . Wort pH <5.3 desired.	Ester and fusel alcohol production more likely higher if excess organic acids present. Fruity or sour flavors produced.
Wort Temperature During Fermentation	Too high for Yeast Strain: Rapid fermentation due to increased metabolic rate. Higher metabolic rate leads to increased production of compounds other than ethanol and CO_2	Increased amounts of fusel alcohols, esters, lactones, organic acids, sulfur compounds, & diacetyl
	Optimal Range for Yeast Strain: Ideal fermentation condition Too low for Yeast Strain: Slow, incomplete or no fermentation	Always desirable 1) Poor attenuation 2) Residual sweetness possibly higher than desired
Flocculation Characteristics of Yeast Strain	Highly Flocculent Yeast Strain: Premature settling possible Decreased attenuation possible	1) Clear beer 2) Higher residual sweetness 3) Higher diacetyl level 4) Fuller body possible
	Less Flocculent Yeast Strain: Yeast remains in suspension longer. Increased attenuation.	1) Potentially hazy beer 2) Lower residual sweetness 3) Dryer beer 4) Thinner body possible 5) "Yeasty" flavor possible

mentation process. Acetaldehyde is the compound associated with a green apple flavor within finished beer. If yeast cells are present, acetaldehyde will continue to be converted to ethanol during aging.

Fusel alcohols — alcohols that contain more than two carbon atoms — are formed when the carbon skeletons from amino acids in the wort are taken up and biochemically reduced within the yeast cell to an alcohol of corresponding chain length. Different fusel alcohols have different flavors and aromas. Fusel alcohols can have flavors that are described as "hot," solvent-like, rough, chemical, medicinal and rosy. These are not wanted in beer and can cause headaches for the drinker at moderate concentrations.

Esters are formed when an alcohol combines with an acetyl-CoA-produced fatty acid. Ethyl acetate, the most common beer ester, is formed from ethyl alcohol and acetyl-CoA. Ester compounds can have flavors described as fruity banana and are more prevalent in ales than lagers.

Ketones and vicinal diketones (VDKs) are formed by the oxidation of the amino acid synthesis intermediates valine and isoleucine. Ketone flavors are described as buttery or butterscotch (e.g. diacetyl), fruity, musty, honey (e.g. 2,3-pentadione) and rubber. These molecules are not desired in most beers, although some English-styles have a noticeable level of residual diacetyl. VDKs can be removed by yeast during the later stages of fermentation. This is the primary reason that brewers are advised not to separate their beer from their yeast to quickly following primary fermentation.

Factors in the fermentation process that impact yeast performance

Fermentation involves complex interactions of biological, chemical and physical factors. Factors such as wort temperature, wort gravity, yeast nutrient availability, dissolved oxygen content and yeast pitching rate all affect how the yeast will ferment the wort. The table on page 71 shows how these factors can impact the yeast and affect the quality of the finished beer.

Conclusions

Yeast are the living organisms that do the biochemical work of making beer. The ability of yeast to ferment wort and produce beer is affected by myriad variables. In order to ensure that you have optimized the conditions for the best yeast performance you should use fresh, healthy yeast; ensure that the wort is fully aerated; pitch an appropriate amount of yeast (frequently, this involves making a yeast starter); fermentation within the optimal temperature range for quality beer production (varies with yeast strain) and don't separate the beer from your yeast too soon. BYO

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

Bottle Washer/Sanitizer

A quick way to get bottle cleaning done

by Jeff Shoemaker

I built this bottle washer to help out with the huge task of bottling in my homebrewery (and also for my home winemaking efforts). As any homebrewer can agree, anything that can be done to make bottling time easier is worth it.

Instead of washing each of the bottles one at a time, with this washer build I am able to sanitize twelve bottles at one time quickly and easily. At bottling time this bottle washer works so well I thought other people should know how to build one of their own. It's easy to assemble and fairly inexpensive (I spent around $140 for all of the components). I was able to source everything I needed from the Internet and my local big box hardware store. I would advise, however, buying your Rubbermaid tub, water pump, bottle rinsing base, bulkhead fitting and barbed garden hose fitting before buying the rest of the fittings so that you can be sure that all of the parts will fit properly. Take your bulkhead fitting with you to the hardware store when you buy the threaded barbed fitting to be sure of a tight fit. I also listed a remote on/off switch in the parts and tools list (to the lower left), but you don't have to include that modification if you don't want to.

The choice of which portable water transfer pump model to use is up to you as long as it will fit comfortably in the tub. Remember to always run your pump fully submerged so that you don't run it dry. Also, as with any project that requires combining electricity and liquid, be sure to always plug your pump into an outlet with a GFCI adapter for added safety.

The bottle washer design is completely self contained. The sanitizer solution of your choice is held within the tub and is circulated through the pump and into the bottles, then back into the tub through holes in the lid so there is no need to be near a sink.

If you're also using inert gas prior to bottling, you can modify this design to use another sparging base for the gas and just transfer the bottle rack from the washer to the gas set up. It works very well for both beer and wine bottles.

Before you start building, I have to remember to give credit where credit is due. I got the original idea for building the washer in this style from Alan Holtzheimer, the owner and winemaker of Silver Bell Winery in Burlington, Washington. Please visit Alan at Silverbellwinery.com and support him!

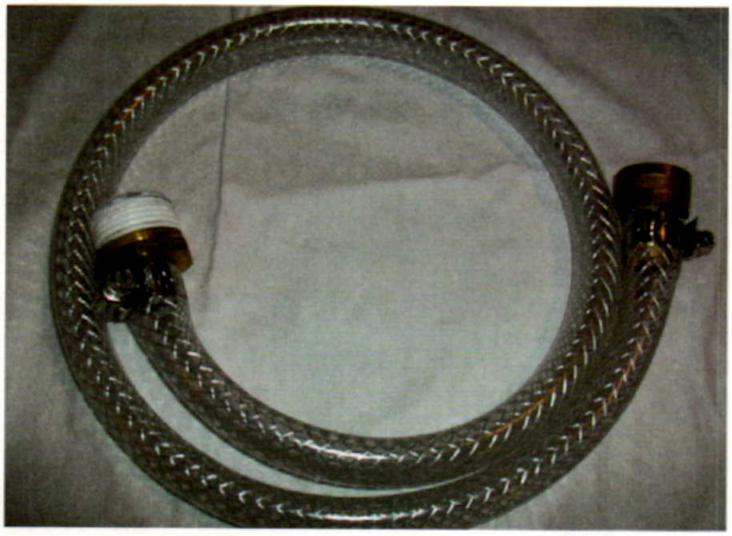
Parts and Tools

- (1) 10- to 20-gallon (38-76- L) Rubbermaid (or similar) tub
- Portable, water transfer pump
- Bottle rinsing base (part # CE970 from morewinemaking.com)
- 2 bottle racks (part #CE971 from morewinemaking.com)
- ~2 feet (~1 m) of ⅝-inch diameter heavy duty tubing (length will depend on how far your away your pump will be)
- 1-inch diameter bulkhead fitting (found at aquarium stores)
- Barbed garden hose fitting
- 1-inch threaded to ⅝-inch brass barbed fitting (the threaded end needs to fit into the bulkhead fitting. Take it to the store to make sure a snug fit is achieved before you buy anything.)
- 2 pipe clamps
- Remote on/off switch for the pump (optional, but helpful)
- Drill
- Razor knife
- Flat-head screw driver
- Zip-ties
- Teflon tape

"Instead of washing each of the bottles at one time, with this washer I am able to sanitize twelve bottles at one time quickly and easily."

1. BULKHEAD FITTING

Once you have all of your parts together, the first step to making the bottle washer is to put a hole in the side of the plastic tub for the bulkhead fitting. Trace a circle around the bulkhead fitting about 1 inch (2.5 cm) or so from the bottom of the tub and use the razor knife to carefully cut out the circle. Insert the bulkhead fitting with the flat side on the outside of the tub, you'll want a nice snug fit to help prevent leakage.



2. TUBE ASSEMBLY

Now it is time to construct the tube assembly that will go from the bulkhead fitting to the water pump. Slide one end of the tube over the barbed side of the threaded 1-inch brass fitting, and apply the pipe clamp. Wrap the Teflon tape tightly around the threaded part of the fitting to help avoid leaking. The other end of the tube can be slid on to the barbed end of the garden hose fitting. A separate pipe clamp can be applied there too, to ensure a nice tight fit with no leaking. Once this is assembled you may screw the 1-inch brass fitting into the bulkhead fitting and the garden hose fitting can be screwed to the inlet port of the water pump.

3. FILL

Once this is all done, fill the tub with about 3 gallons of your favorite no-rinse sanitizer solution so that the bulkhead fitting is fully submerged. This ensures your pump will not run dry. Hook up the supplied tubing that comes with the sparging base to the outlet port on the water pump and place the lid on the tub. Make sure the pump is filled with sanitizer water as not to run it dry.

4. PUT IT TOGETHER

Now you may drill a series of holes in the lid of the tub to allow the sanitizer solution to drain back into the tub after flushing the bottles. Then place the bottle rinsing base on the lid of the tub, I affixed the rinsing base to the lid with zip ties through the newly drilled holes, so everything stays in place.

5. TEST

Plug the water pump into the remote controlled outlet and fill the bottle rack with bottles. Prior to using the bottle washer, the bottles should be free of debris and labels, ready for bottling. Place the rack of bottles onto the bottle washer. Turn on the pump and test the setup. If anything is leaking, go back and check your fittings and apply more teflon tape if needed.

6. SANITIZE

Once everything is in working order, you're ready to start sanitizing. I suggest using a 15-20 second rinse and a quick spin of each bottle to ensure good coverage inside the bottle, and with the press of a button you'll have evenly sanitized bottles in no time! BYO

This is Jeff Shoemaker's first article for Brew Your Own. *He lives in Freedom, Pennsylvania.*

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Winning Combo

Brewing buddies find their way

Sal Emma • Petersburg, New Jersey

It was an unbelievable moment. My brew partner, Terry Leary, and I had entered three beers into the annual homebrew contest at Tun Tavern in Atlantic City, New Jersey. A tire picked up a nail on the way to the judging, so I missed it. My phone buzzed around 10 p.m.

"We won!" Terry said.

"We won what?" came my reply.

"Don't you know where I am?" he asked. "We won!"

"No way."

"Way."

And that was that. The laurels were ours.

We're passionate amateurs, without professional training. We became brewers in the school of hard knocks. We each started in the mid-90s, making the typical 5-gallon (19-L) recipe. By the time we met and became friends, we'd each graduated to 10 gallons (38 L), partial-mash. We pooled our resources and started brewing together, but still producing just 20 gallons (76 L) with each brew. And at the end of every brew day, Terry would say the same thing: "We're gonna need a bigger boat." A movie quip to say, "Let's bump it up a notch. Increase the equipment size."

> "And at the end of every brew day, Terry would say the same thing: 'We're gonna need a bigger boat.'"

Photo Courtesy of Sal Emma

He was right. But it took us the better part of three years to figure it out. A challenge, because we changed everything. A two-barrel kettle, custom built. More liquor to heat, more beer to move. Hot pumps, cold pumps. A counterflow chiller. Big fermenters — and making them airtight to avoid infection. And we went "all-in." We ditched the extract syrup and started brewing all-grain.

We had some hits and misses. Each beer got better. None were terrible. But it became evident that even though we were doing everything right, something was wrong. Most of our recipes start out fairly big, around 1.060. But none would finish well. They'd peter out around 1.020 or even higher. We racked our brains as we barked up the wrong tree — post boil. We were doing everything right: chilling rapidly; aerating; pitching massive quantities of reliable yeast. Yet we couldn't get our beer to finish. With coddling, we could get it to 1.019, maybe. It was time for drastic action: we asked for help.

Friend, inventor and microbrewer Dan Listermann of Cincinnati held the key to the universe: thermometers. Dan said we were probably mashing too hot, leaving our wort short on fermentables. We put all our thermometers to the test. None read the same. We bought one we could calibrate and plotted our next conquest.

We'd made an old ale that was very tasty but not too hoppy. Decided it would be a good basis for a hoppier version. So we essentially repeated the grain bill with a lot more hops. And we were careful to mash within a degree or two from 150 °F (66 °C), reliable thermometer in hand.

The beer finished like a thoroughbred, down to 1.014 in record time, without any coaxing or additional yeast. And it was delicious. Possibly our best effort to date. It was ready when the contest deadline came around, so we took a chance. It beat its closest rival by a full point. And our Bruges Blonde, a Belgian golden, finished third. We fairly dominated.

The prize: spending a day with the Tun's brewmaster, Tim Kelly, brewing our beer on his 15-barrel Newlands system. Our beer is being served in an actual pub. And we'll pour it for brewers and beer geeks at the Garden State Craft Brewers Guild's annual Beer Festival, aboard the Battleship New Jersey. Awesome bragging rights. Tons of fun. And a gratifying apex of a journey of years, keeping our nose to the grindstone. Experience is, after all, the best teacher. BYO


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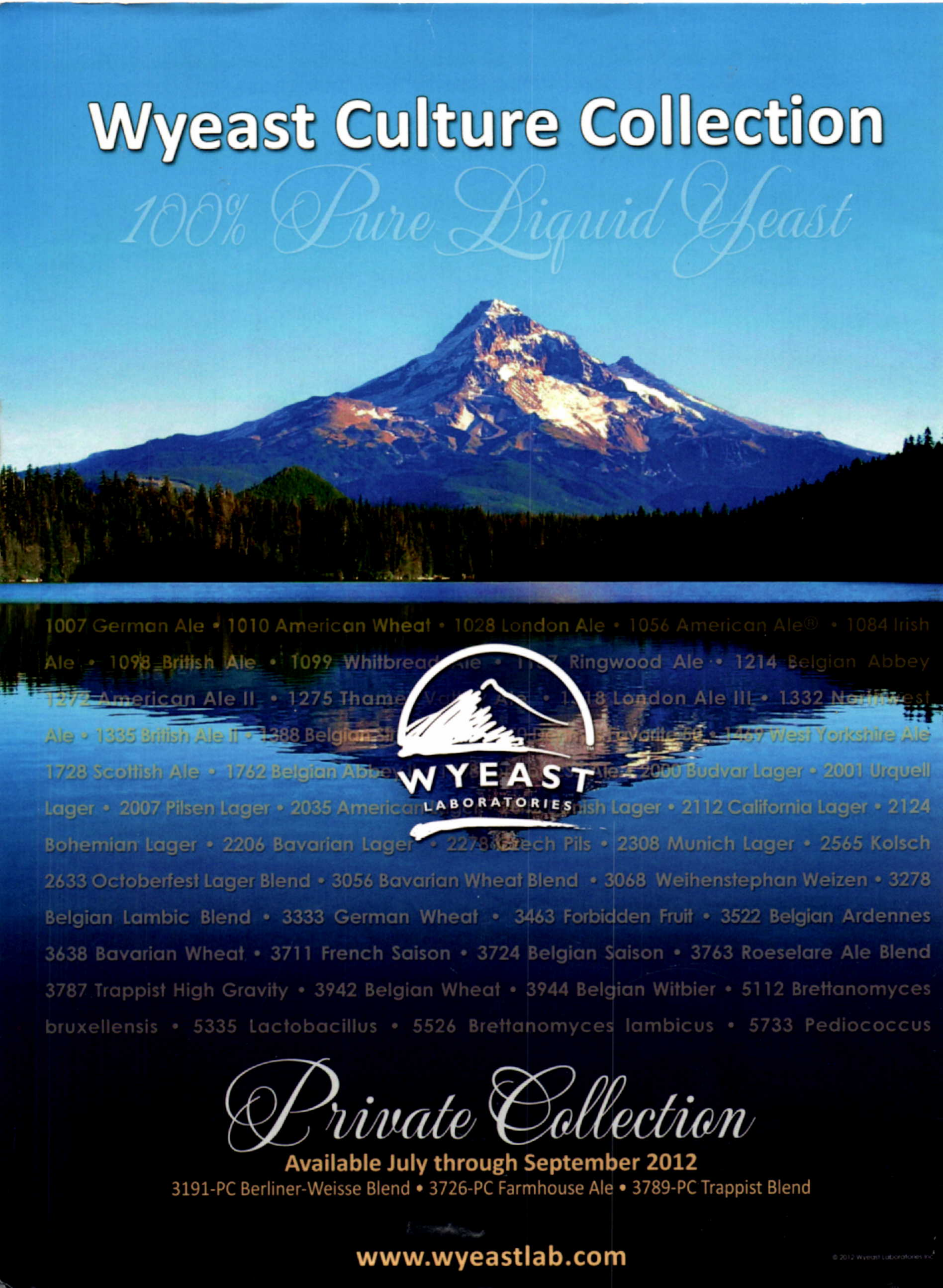

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