WORLDWIDE HOP SHORTAGE: THE IMPACT ON HOMEBREWERS AND YOUR BREWING

BrewYour Own

THE HOW-TO HOMEBREW BEER MAGAZINE

JANUARY-FEBRUARY 2008, VOL.14, NO.1

BEER & OAK

Use Barrels Like a Pro

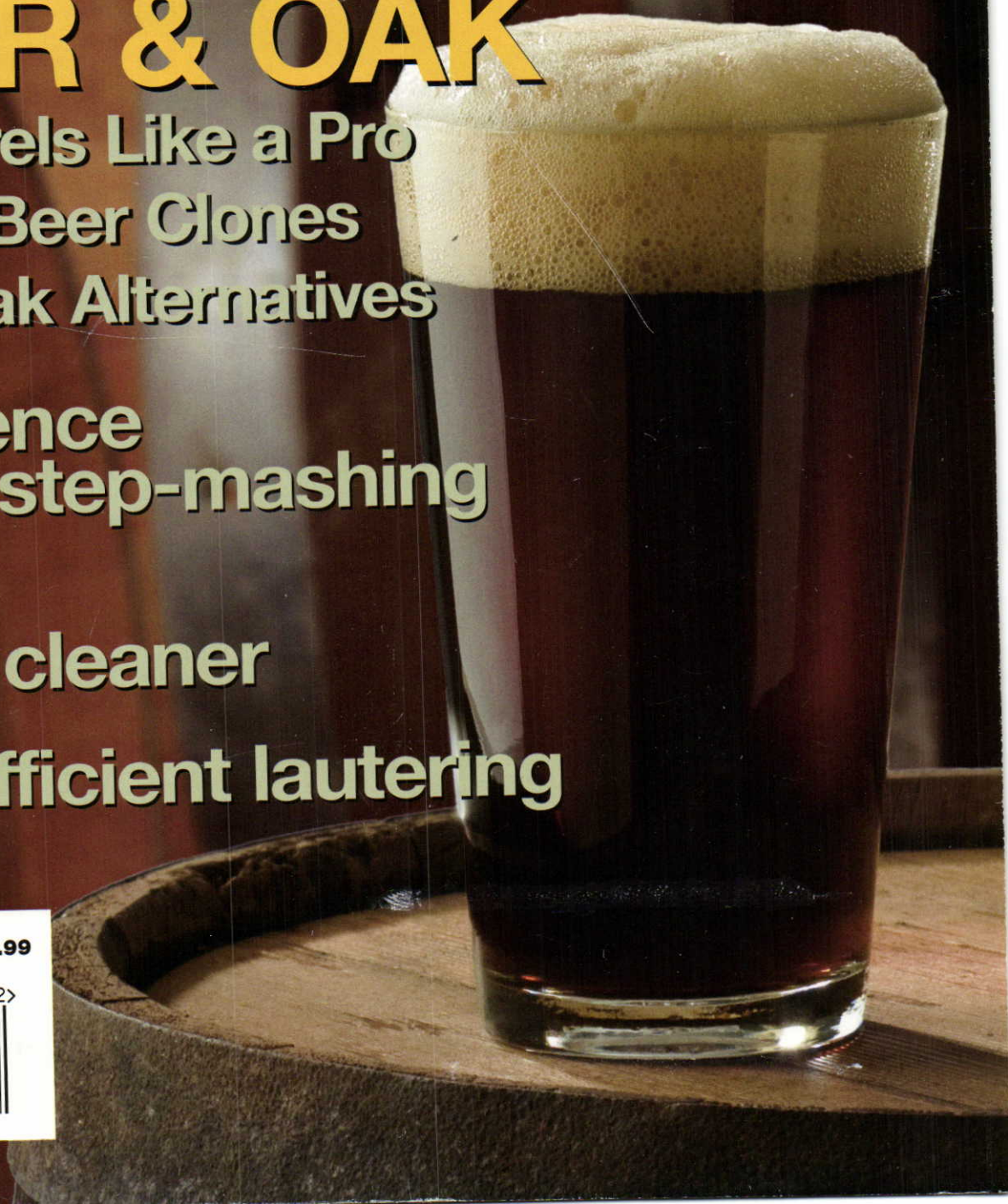
5 Wood Beer Clones

Using Oak Alternatives

the science behind step-mashing

build a carboy cleaner

more efficient lautering



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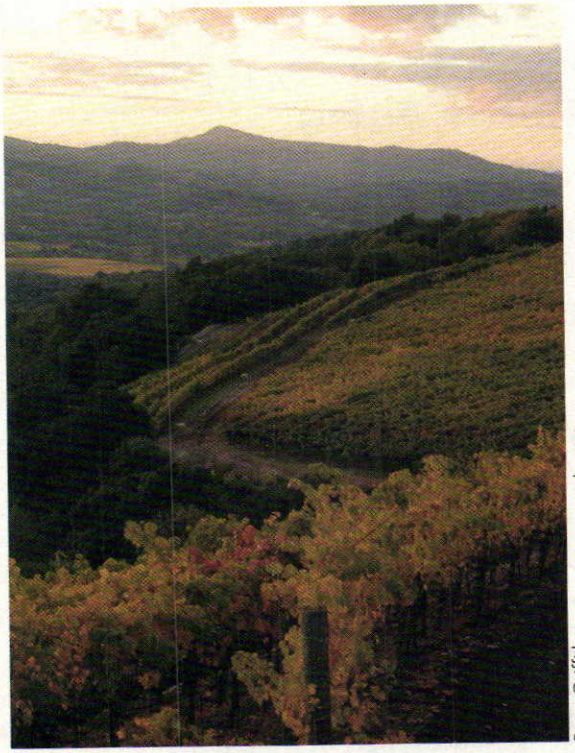

Peter Griffith www.sonomacounty.com

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Brew Your Own
THE HOW-TO HOMEBREW BEER MAGAZINE

JANUARY-FEBRUARY 2008
Volume 14 Number 1

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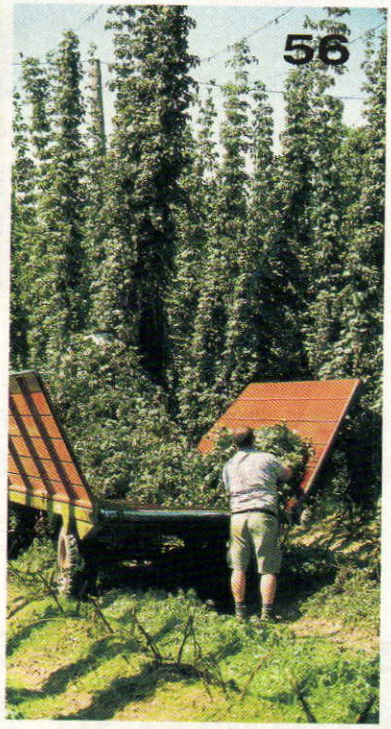

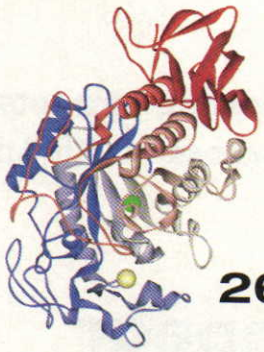

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How well do you really know your beer?

Graduate From "Beer Know-It-All" To Really Knowing It All.

What's the difference between Saaz hops and Hallertaus hops? What impact did the Bavarian purity law have on the evolution of brewing? Why is an American lager the best beer to drink when you're eating a spicy Thai dish? Beer novice or beer expert, there's still plenty to learn from ***The Beer Connoisseur*** on **herestobeer.com**. Educating you on such topics as the brewing process, beer and food pairings, the ingredients that go into beer, and the role of each ingredient in determining a beer's flavor, ***The Beer Connoisseur*** wants you to understand and appreciate beer like you never thought possible. Give it a try and find out for yourself why to know beer is to love beer.

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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.

Brew Your Own
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How to reach us

Editorial and Advertising Office
Brew Your Own
5515 Main Street
Manchester Center, VT 05255

Tel: (802) 362-3981
Fax: (802) 362-2377
E-Mail: BYO@byo.com

Advertising Contact
Kiev Rattee
kiev@byo.com

Editorial Contact
Chris Colby
chris@byo.com

Subscriptions Only
Brew Your Own
P.O. Box 469121
Escondido, CA 92046

Tel: (800) 900-7594
M-F 8:30-5:00 PST
E-mail: byo@pcspublink.com
Fax: (760) 738-4805

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Cover Photo: Charles A. Parker

Reiterated Mashing

I read your article about reiterated mashing (December 2007) and I cannot wait to try it! I am interested in how your findings, including your reported increased mash efficiency in subsequent mashes, relate to the concept of substrate inhibition on enzymatic reactions.

I'm curious about how the interactions between pH, amino acid buffering, time, temperature, substrate and end product inhibition all relate to each other in that complex soup we call a mash.

(Sorry, I'm a bit of a geek.)

Andrew Strom
via email

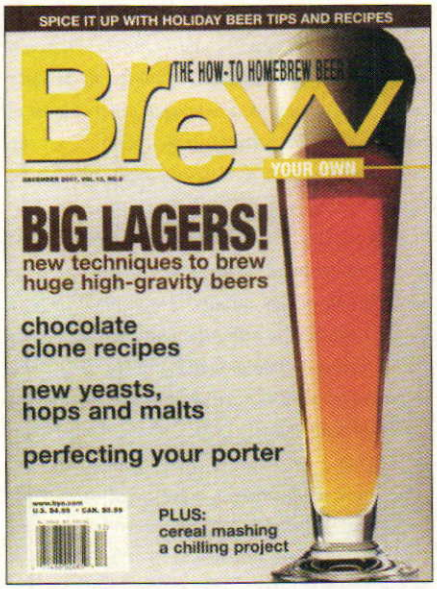
Article author and BYO Editor Chris Colby responds: "Glad you are interested in reiterated mashing and don't ever apologize for being a geek. The world needs more beer geeks!

"I plan to brew a couple more reiterated mash beers this year and pay closer attention to the pH and a couple other variables. If I find out anything worthwhile, I'll probably write about it in my blog (at byo.com).

"I don't think that getting better mash efficiency in the second mash is a general feature of reiterated mashing. It only happened once and I'm guessing it had more to do with the fact that my everyday mash efficiency isn't that great. (My mash pH may have changed a little bit in a favorable direction for the second mash or maybe I just stirred it hard enough to make a difference.) On average, the efficiencies for the second and third mashes declined. In my last — and best-run — reiterated mash brewday, I got 68% extract efficiency for the first mash, 64% for the second mash and 59% for the third.

"Briggs, Hough, Stevens and Young, in 'Malting and Brewing Science: Volume I Malt and Sweet Wort,' do mention end product inhibition with regards to mashing, saying, 'In thick mashes the rate of saccharification is retarded, probably because the accumulating sugars competitively inhibit the hydrolytic enzymes, and so wort fermentabilities are reduced when short mashing times are used.' In the third mash of a reiterated mash program, the density of wort is greater than in a regular infusion mash. However, in the article, I recommended resting for at least two hours and stirring well — which should keep the starch, sugar and enzymes mixed and lower the severity of end product inhibition, if it is occurring.

"As for amino acid buffering, oddly enough, I just wrote an article on that (in mashing in general, not in reiterated mashes specifically). It should appear in one of the next couple issues of BYO.



"There may be some interesting mash chemistry going on in a reiterated mash, but — when doing my test batches for the article — I mostly focused on developing a solid how-to procedure that would work well. Hope you like reiterated mashing and I hope that any brewers who try it write me and tell me how it went."

Recipe Amounts

I like that you go to the bother to post all three types of recipes, all-grain, partial mash and extract. My question to you has to do with the partial mash recipe formulation. Why do you list base grain quantities to the nearest whole pound but list the liquid malt extract (LME) or dried malt extract (DME) in pounds and ounces? This is common in most of the partial mash recipes and a good portion of the ones listed in the October Issue, specifically in the article titled "Partial Mash Permutations."

Like most home brewers, I buy LME and DME as packaged LME in 3.3-lb. (1.5-kg) cans or DME in increments of 1- or 3- lb. bags, but when it comes to the grain I buy it in bulk by the pound or ounce at the quantity needed. It would seem to make more sense to list extracts in the standard packed weight then adjust the base grains to balance out the recipe to meet the SRM and OG of the recipe.

It doesn't make sense to waste or store LME in partial quantities. DME is slightly different — it's easier to handle, but I don't like storing it in partial-pound amounts. If I start-

Betsy Parks, assistant editor of *Brew Your Own*, has enjoyed tasting (er, researching) many different kinds of barrel-aged beers for this issue's wood beer stories. Betsy studied to be a chef before deciding to be a journalist, and joined the team at BYO in February 2007. She lives near the ski slopes of Stratton Mountain, Vermont where she is perfecting the art of stacking perfect rows of cord wood with her boyfriend, two cats and a pair of foster turtles. Read her story on page 36 to see what advice barrel-aging U.S. brewers have to share with the homebrewing community.

John Palmer is the well-known author of the homebrewing text, "How to Brew" (2006, Brewers Publications) and co-author of the recently-released "Brewing Classic Styles: 80 Winning Recipes Anyone Can Brew" (2007, Brewers Publications), cowritten by *BYO*'s "Style Profile" columnist, Jamil Zainasheff.

In this issue, John makes his debut as our new "Advanced Brewing" columnist. Turn to page 65 to read his take on lautering efficiency.

Dave Green, BYO's advertising sales coordinator, was first introduced to homebrewing at Colby College with buddies experimenting in the chemistry lab. After college, he landed a job as Assistant Brewmaster at Brickhouse Brewery, a brewpub in Patchogue, New York.

Dave has since moved to southern Vermont where he taught chemistry and environmental science at the Stratton Mountain School in Stratton, Vermont before coming to BYO as an editorial intern. Read Dave's feature about step mashing on page 26.

ed priming with DME, it might be more practical, but I usually opt for corn sugar from priming.

John Douglas
Des Moines, Iowa

The most important goal for BYO recipes is that they make good beer. Secondary goals may be to meet certain style guidelines, to mimic a specific commercial beer or fit within a certain brewing procedure — for example, countertop partial mashing. It is not possible to do this and limit the amounts of ingredients to only whole cans of liquid malt extract, whole pounds of dried malt extract or specialty grains (or hops dispensed only in 1.0 oz. (28 g) units).

In addition, some BYO recipes are scaled down from recipes for larger volumes of beer and, because of this, some of the ingredient amounts seem odd. For example, if a 15-gallon (57-L) recipe called for 1.0 lb. (0.45 kg) of chocolate malt, the 5-gallon (19-L) recipe would require 0.33 lbs. (0.15 kg) — roughly 5.3 ounces. If an ingredient amount seems odd or inconvenient to measure out, you can always round it off to the nearest convenient unit. For example, if you added 5 oz. (142 g) of chocolate malt to the previous hypothetical 5-gallon (19-L) brew instead of 5.3 oz. (150 g), the difference would be minor. However, we don't round ingredient amounts off because some brewers may wish to brew a larger volume of beer or — in the case of a clone recipe — get the ingredient amounts as close to exactly right as he or she can manage.

In the case of countertop partial mash recipes, these are formulated starting with the 4.0 lbs. (1.8 kg) of malted grains. Dried malt extract (DME) is added to bring the recipe up to roughly half of its target original specific gravity (OG). The remaining half of the required extract is supplied by liquid malt extract (LME), which is added late in the boil.

Some homebrewers have local homebrew shops that sell bulk LME from barrels and they can request a specific amount. For homebrewers buying cans of extract, opened cans can be stored for a few weeks in your refrigerator and used for later recipes or making yeast starters. (A splash of vodka on top of the extract is sometimes recommended to suppress mold growth.)

Alternately, you can convert the amount of LME in any countertop partial mash recipe to DME and use that instead. (It may foam a bit when you add it, but using DME as your late extract addition won't negatively affect the quality of your beer in any way.) Multiply the amount of LME by 0.8 to calculate the right amount of DME to substitute.

X Didn't Mark the Spot

In John Palmer's article, "BSI: Brew Scene Investigation" (October 2007), two of the "X"s in the "Profiling the Perps" chart got shifted over one space. One "X" should have indicated that Brettanomyces, not Acetobacter, forms an opaque, white pellicle. The second "X" should have indicated that Acetobacter, not Lactobacillus, formed a thin film and a translucent pellicle. If you see any of these shifty perps, do confront them — preferably with a bottle of Star San or iodophor.

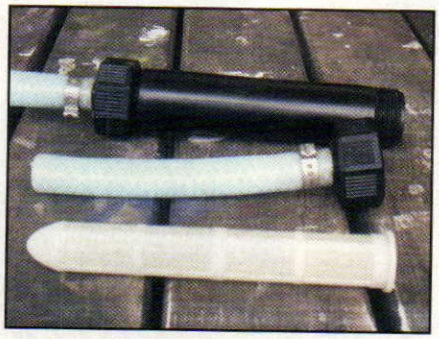
In addition, asterisks near some of "X"s should have indicated that Brettanomyces produces acid, vinegar-like smells and sour flavors only in the presence of oxygen. Likewise, Acetobacter requires oxygen to produce its off odors and flavors. The whereabouts of these asterisks is unknown, and BYO is sorry for any confusion their absence may have caused.

homebrew NATION

BYO

reader GADGET Inline Filter

Ken Jermey • Lyndoch, South Australia



Ken's handy inline filter is inexpensive to make and easy to assemble.

Mark Prior and Ken at the State Amateur Brewers Show Of South Australia.

I dry hop most of my beers with pellets and I was finding that some of the hop debris was finding its way into the kegs and bottles. So I needed a way to get rid of them — but not pay a fortune with cartridges. I also wanted it to be simple.

It took less than five minutes to construct and cost less than $10.00 to make (although you can buy inexpensive premade models in boating and RV catalogs).

All you need to make your own is an in-line irrigation filter and one meter of 13 mm — ½" rain water hose. Cut a 150 mm piece off and connect it to the inlet. Attach the remainder to the bottom. This will ensure that the hose will be long enough to reach the bottom of the keg/bottling bucket so that no aeration will occur when in use. Sterilize the filter with boiling water prior to use, and when you're finished, pull it apart to clean. For more info, find me at www.aussiehomebrewer.com.

byo.com BREW POLL

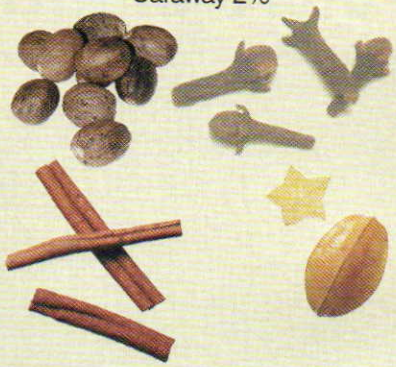
What is your favorite brewing spice?

Coriander 48% • Cinnamon 19%

Clove 10% • Nutmeg 9% •

Allspice 7% • Anise 5%

Caraway 2%



Check out the latest poll question and vote today at byo.com

reader RECIPE Gary Foster • Concord, California

One of the first craft beers I fell in love with was Anchor Steam. This is my homage to Fritz Maytag's wonderful creation. It's a bit more complex and flavorful (in my opinion) but is a straight up California common with attitude. This uses all late addition hops for a really rich and flavorful Northern Brewer hop presence. Brew it like I wrote it and I know you'll love it. I guarantee it or your money back.

Spotted Dog (California Common)
(5 gallons/19 L, all-grain)

OG = 1.050 FG = 1.011
IBU = 37 SRM = 12 ABV = 4.5%

Ingredients

8 lbs. (3.6 kg) domestic, Great Western 2-row pale malt
9 oz. (255 g) crystal malt 60 °L
6 oz. (170 g) Victory malt
3 oz. (85 g) pale chocolate malt (200 °L)
6 oz. (170 g) wheat malt
22.5 AAU Northern Brewer hop pellets (2.5 oz./71 g of 9.0% alpha acids) at 10 mins.
9 AAU Northern Brewer hop pellets (1 oz./28 g of 9.0% alpha acids) at 5 mins.
9 AAU Northern Brewer hop pellets (1 oz./28 g of 9.0% alpha acids) at 1 min.
White Labs WLP810 (San Francisco Lager) yeast

Step-by-Step

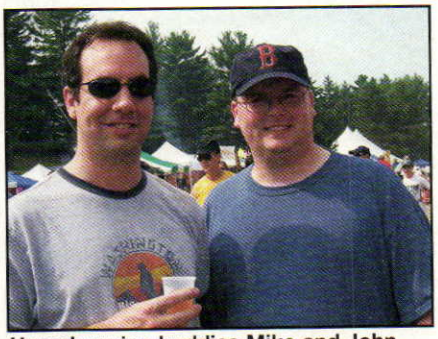
Mash at 154 °F (68 °C) for 60 minutes. Sparge to collect 6 gallons (23 L). Boil for 60 minutes. Add first hop addition with 10 minutes left in the boil. Add whirlfloc at 5 minutes along with second hop addition. Add final hop addition at 1 minute (yes, there is no 60 minute hop addition, this is not a typo).

Chill quickly to below 70 °F (21 °C). Pitch a 2 L yeast starter and ferment at 65 °F (18 °C) for approximately two weeks (leave it on the yeast this extra time to help clean things up). Crash cool to 50 °F (10 °C) a few days prior to kegging or bottling to settle out the yeast. Keg or bottle and lager at 34 °F (1 °C) for 1 month. You will not need to dry hop this beer, the hop aroma and flavor will be quite enough.

brewers' PROFILE

Mike Warren and John Krochune

Chelmsford and Malden, Massachusetts



Homebrewing buddies Mike and John are The Brew Dudes.

Mike Warren and John Krochune are longtime friends with a passion for well-crafted beer.

Right after college, Mike caught the bug to brew his own and has been brewing with the same starter kit for the last ten years. After many tastings and confidence-building discussions ("If you can boil water, you can brew beer!" Mike would say), John started brewing two years ago.

Mike is an all-grain brewer and has recently started focusing on consistency by making a handful of styles regularly — including ordinary bitter, which he has brewed over and over since he loves the flavor profile and easy drinkability.

Using a converted keg for a kettle and batch sparging with a simple cooler, he has honed in on how different variables in the mash, boil strength, and hopping rates affect the final product. His background as a bench biochemist has given him the training to build a consistent process from which he can structure solid brewing methods and formulate some interesting brewing experiments.

As a fairly new brewer, John has moved from brewing kits to formulating his own recipes. He has brewed a wide range of styles from a chocolate cherry porter to cream ale. Most of his beers are malt extract brews, but he tried his first partial mash brew earlier this year and it turned out OK.

John recently moved off of his stovetop and purchased an outdoor propane burner setup to brew using his seven-gallon kettle. John enjoyed the do-it-yourself nature of homebrewing and started to read everything he could about it, partially to catch up with Mike.

Mike lent him the "The Complete Joy of Homebrewing" and "The Brewmaster's Bible" and he found plenty of interactive information on the Web: forums, chat rooms, online calculators, brewing podcasts, great publications (like BYO) and blogs. In the process, it struck both of them that never before has the common hobbyist had such easy access to direct answers through these mediums by seasoned and recognized veterans of the hobby, including Jamil Zainasheff, John Palmer, or Charlie Papazian, so they decided to contribute.

Their own blog, Brew Dudes (http://www.brew-dudes.com), was created to share their experiences with the homebrewing community. With access to a world wide audience, they try to provide a contrasting view of the experienced all-grainer and the developing partial-mash/extract brewer through style profiles, brew logs, equipment discussions, and generally relating their enthusiasm about homebrewing.

In the next few months, they have plans to post videos of homebrewing topics since new technology has made it easier to publish this format online.

John and Mike think it certainly is a great time to be a homebrewer, and with the wide array of tools available to connect with the brewing community, the urge to reach out and be a part of it all is irresistible.

WE WANT YOU

Do you have a system or a homemade gadget that will make our readers drool? How about a killer recipe or tip? Want to profile your club? Email a description and photos to **edit@byo.com** and experience fame among 100,000+ homebrewers!

If we publish your article, recipe, photos, club news or tip in Homebrew Nation, you'll get a cool ½ Liter German Stein (courtesy of White Labs) and a *BYO* Euro sticker.

homebrew systems that make you DROOL

Mike Foldy • Racine, Wisconsin

Broken Wrench BREWERY

My brewery is named the Broken Wrench Brewery. It is an all electric HERMS (Heat exchange recirculaing mash) system.

The sparge tank is powered by a 240-volt 3000 watt heating element, which has a ½" copper coil in the tank that is used to heat the mash.

The mash tank has a false bottom and recirculates the mash through the copper coil or through the bypass valve.

The boil kettle has two 240-volt 3000 watt heating elements. The whole system is controlled by a multi-channel temperature controller. It controls the heat in the sparge tank and boil kettle and controls the mash temperature by opening and closing the two solenoid valves.

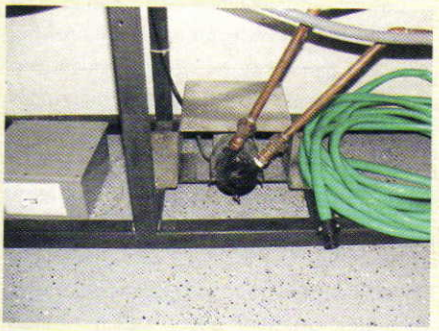
The system uses a magentic drive pump and a counterflow wort chiller. This allows me to brew year-round in my basement.

I built the system myself and did all the welding and fabrication on my own. I enjoyed building it, but I enjoy brewing with it even more!

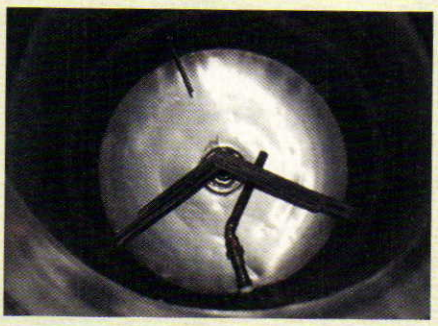
My HERMS brew system consists of three converted kegs, a magnetic pump, and is powered by three 240 volt heating elements.

A view of the control panel that has the multi channel temperature controller and on/off switches for the heating elements and pump.

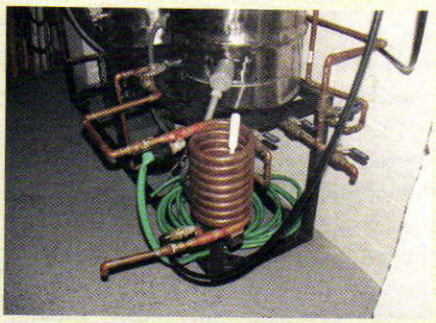
This is the inside view of the mash tun showing the hinged false bottom and the sparge arm.



This is a view of the magnetic drive pump and also my homemade magnetic stir plate.



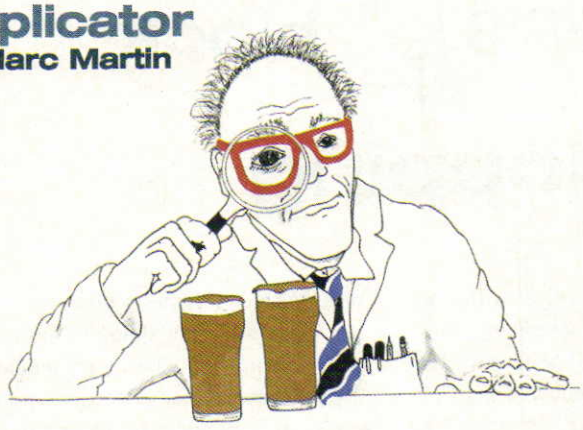
This is the inside view of the boil kettle showing the two 3000 watt heating elements and the thermocouple that is used to control the heat.



Here is the counterflow chiller and the valve manifold that controls the flow of the sweet wort.

replicator

by **Marc Martin**



Dear Replicator,

While on a trip attending a wedding, we stopped at the New Holland Brewery in Holland, Michigan for dinner and to listen to a local blues band. Of the brewpubs we visited while traveling, this was among our favorites. Their food is almost as memorable as their beers, which are quite unique and well crafted. The best was Dragon's Milk, a barrel-aged strong ale from their high gravity series of seasonal beers. It is quite rich and malty with hints of vanilla, oak and perhaps licorice. As their slogan states, they are truly brewers of "Art in Fermented Form." Could you help me recreate this masterpiece?

Sonny Christian
Fenton, Michigan

While eastern Michigan and Detroit are well known for big cars with lots of horsepower, one of western Michigan's claims to fame is big, malty beers with high gravity. At the heart of this notoriety is the New Holland Brewing Company, which currently offer six beers with starting gravities of 1.072 or higher.

The brewery opened in 1996 as a small local brewpub. Their offering of great beers provided for rapid growth and their size now classifies them as a regional brewery, with distribution in several states in the Great Lakes area.

Brewmaster John Haggerty began his career as an assistant brewer at Seattle's Big Time Brewing Company. He completed brewer's training in Germany. An offer to be the brewer at Great Dane Brewing in Madison, Wisconsin brought him to the central states and he has been Brewmaster at New Holland since 2002.

John told me that Dragon's Milk is one of their best selling big beers and has been in their lineup for several years. One half batch of this beer is aged in bourbon barrels for 90 days and then blended with the other half, which is aged in stainless. He feels that it combines the best attributes of a sweet stout and an old ale.

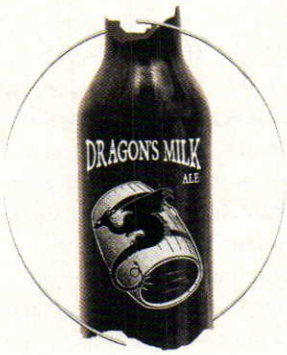
In English noble houses, four types of beers were served, from the last, weak runnings for the peasants to the richest, strong ales for the noblemen. These potent, heavy ales were known as "Dragon's Milk" some say for the feeling in your head the next morning as if you "had been bitten by a dragon." A noble request for a fine strong ale that is perfect for these cold months. Now Sonny, you can "Brew Your Own" Dragon's Milk and be master of the castle.

For more information about New Holland visit their Web site, www.newhollandbrew.com, or call (616)-355-6422.

New Holland Brewing Company Dragon's Milk

(5 gallons/19 L.
extract with grains)

OG = 1.080 FG = 1.018
IBU = 27 SRM = 28 ABV = 8.1 %



Ingredients

6.6 lbs. (3 kg) Briess light, unhopped, liquid malt extract
2 lbs. (0.9 kg.) Briess light dried malt extract
1.5 lbs. (0.68 kg) Munich malt
0.5 lb. (0.23 kg) crystal malt (80 °L)
0.5 lb. (0.23 kg) crystal malt (120 °L)
0.5 lb. (0.23 kg) flaked oats
10 oz. (0.3 kg) chocolate malt
0.25 lb. (0.1 g) wheat malt
1 oz. (28 g) oak chips
4 oz. (113 g) Jim Beam or similar Bourbon whiskey
9 AAU Columbus pellet hops (60 min.) (1 oz./ 28 g of 9% alpha acid)
1.13 AAU Northern Brewer pellet hops (10 min.) (.25 oz./ 7 g of 4.5% alpha acid)
½ tsp. yeast nutrient (last 15 minutes)
White Labs WLP001 (American Ale) or Wyeast 1056 (American Ale) yeast
0.75 cup (150 g) of corn sugar for priming (if bottling)

Step by Step

Steep the crushed grain and flaked oats in 2 gallons (7.6 L) of water at 154 °F (68 °C) for 30 minutes. Remove grains from the wort and rinse with 2 quarts (1.9 L) of hot water. Add the liquid and dried malt extracts and bring to a boil. While boiling, add the hops as per the hopping schedule. Now add the wort to 2 gallons (7.6 L) of cold water into the sanitized fermenter and top it 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. Soak the oak chips in the Bourbon overnight. Transfer the wort to a carboy, avoiding any splashing to prevent aerating the beer and add the soaked oak chips. Let the beer condition for one week and then bottle or keg. Allow to carbonate two weeks and enjoy your Dragon's Milk strong ale.

All-grain option:

This is a single step infusion mash. Replace the malt syrup and dried extract with 7.5 lbs. (3.4 kg) 2-row pale malt. Mix the crushed grain and flaked oats with 3.5 gallons (13 L) of 172 °F (78 °C) water to stabilize at 156 °F (69 °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 0.75 oz. (21 g) to allow for the higher utilization factor of a full wort boil. The remaining recipe and procedures are the same as the extract with grain recipe.

Homebrew CALENDAR

January 11

Big Beers, Belgians & Barleywines Homebrew Competition
Vail, Colorado

The annual festival where the snifter is king. This year's event features a new experimental brewing seminar with Sam Calagione (Dogfish Head), Adam Avery (Avery), Will Meyers (Cambridge) and Peter Bouckaert (New Belgium). For more information and deadlines, visit www.BigBeersFestival.com.

January 26

Upper Mississippi Mash-Out
St. Paul, Minnesota

Organized by the Minnesota Home Brewers Association, the Mashout is a qualifying event for the High Plains Brewer of the Year award, the Midwest Homebrewer of the Year competition and the Masters Championship of Amateur Brewing. Don't miss the Mash-Out Banquet, featuring Kris England's 40-gallon all-grain re-brewing of last year's Best Of Show beer. More information online at www.mnbrewers.com/mashout/beerbanquet.htm.

February 8

International Mead Festival Home Meadmaker Competition
Lakewood, Colorado

The yearly gathering of the world's best meadmakers. Judging for the home meadmaking competition will occur February 8 and 9. No winners will be announced until the festival awards, so attend the fest to see if you won in person. For more information, visit http://www.meadfest.com/.

February 23.

War of the Worts
North Wales, Pennsylvania

A stop on the Delaware Valley Homebrewer of the Year trail, organized by the Keystone Hops Homebrew Club. Deadlines, dropoff locations, online registration forms and more are available at http://www.keystonehops.org.

BEGINNER'S block

Dry Hopping

by Betsy Parks

As you experiment with new recipes and ingredients, there are several minor changes that any brewer can play around with to put their own stamp on a beer, such as altering fermentation temperatures, changing the yeast or experimenting with the specialty malts. One good example of this is trying dry hopping, which is an easy way to develop more hop aroma without adding more bitterness.

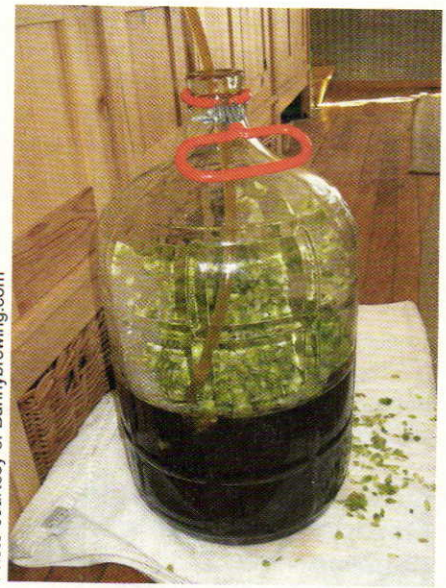


Photo courtesy of Bunnybrewing.com

You've probably tasted a few of the many commercial examples of dry hopped beer like Sierra Nevada's Celebration Ale, Brooklyn Brewery's East India Pale Ale, Magic Hat's Fat Angel or Liberation Ale from Live Oak Brewing. Many brewers use some kind of dry hopping method to add more of a certain hop flavor and aroma and to preserve more volatile hop oils that are normally boiled out of the wort.

The definition of dry hopping is adding hops to your wort after the boil, when it's been cooled. This is different from other hop additions, even finish hopping or using a hopback, because the hops aren't exposed to heat, and therefore do not cook. Without heat, the hop alpha acids do not isomerize and hence do not add bitterness like hops added to hot wort which contribute to bittering.

There are a few different ways to dry hop, depending on the variety and form of hops you plan to use. Selecting a hop variety for dry hopping is subjective, however, it is common to use aroma hops that have a low to medium alpha acid rating such as Cascades, E.K. Golding, Saaz, Glacier or Willamette (for a list of hop varieties and characteristics, visit byo.com/referenceguide/hops/). You can also always experiment with high alpha acid varieties like Chinook or Simcoe as well. There are no hard and fast rules.

Choose a form of hops that you will feel comfortable handling for your brewing setup. Loose hops, plugs and pellets are all easy to add to a carboy, and if you're using a fermenter with a larger opening you can put your hops in a sanitized grain bag and steep them like tea. Hop plugs are especially easy to use as they are already measured in half ounces and are condensed into a solid form. A good rule of thumb is to use around a half to two ounces of hops for a five-gallon (19-L) batch, depending on the variety.

Once you've chosen your hops, you can add them to your cooled wort. Some brewers like to add the hops to the primary fermenter. If you choose to add them at this point, you need to account for some aroma loss from the release of CO_2 by adding more hops than you might think you need.

Most brewers add their hops to the secondary fermenter, which avoids aroma loss problems. Plus, beer in the secondary has finished fermenting and has a lower pH, so there is less of a risk of contamination from anything on the hops (which is a low risk either way).

Steep your hops for a week or two if you're using ale temperatures, and two to three weeks at lager temperatures. Keep tasting your beer throughout the process until you find the flavor you want. Then, rack your beer away from the hops or remove the hop bag and you're ready to start bottling or kegging.

Out in the Open

Expert advice on open fermentation

by Betsy Parks

Before the days of airlocks and cylindroconicals, open fermenters were the only way to go. These days, however, despite all the modern methods, some brewers believe that the old way is still the best way. Take some advice from these U.S. brewers about this time-honored technique.

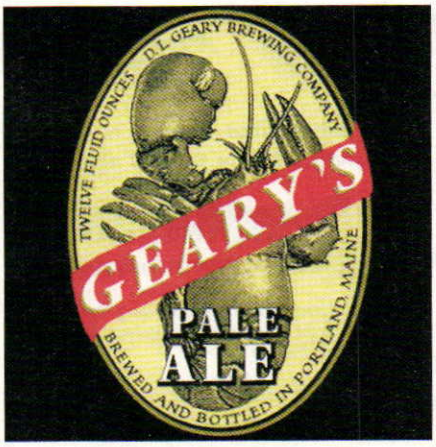
OLLIE LAGOMARSINO is one of the five main brewers at Anchor Brewing Company in San Francisco, California. Anchor Steam, Anchor's flagship beer, has been brewed with open fermenters since the 1800's and open fermentation the only kind of brewing Ollie has ever known since he started working on the production line at the brewery in 1995, eventually moving his way up to become a brewer.

At Anchor, open fermentation is all about tradition. In the 1800's, steam beer was brewed by open fermenters without refrigeration. When Fritz Maytag bought the brewery, he felt that continuing open fermentation was the right thing to do.

Our primary fermenters are very shallow pans that allow the heat to dissipate faster. In the old days, to cool the boiled wort down, brewers would pump it into huge vats on the roof of the building called brewships, which would use the cool San Francisco air to cool them down, which of course wasn't very sanitary. I personally think that is how Anchor Steam got its name — from the steam coming off of the roof.

Although we don't have to make Anchor Steam the way that we do, I don't see that there's many pitfalls to making it that way except for capturing the CO_2 during primary fermentation for carbonation. In our case, however, the beer is carbonated with natural kräusening.

As for open fermentations at home, I've never homebrewed, so I really can't say if I think it's possible, but I think it's feasible if you are careful about your brewing environment. At Anchor, we pump positive fed air into the rooms with the open fermenters to prevent any yeast contamination. If you brew a lot, mingling yeasts may be a problem, so like us you should keep all your yeasts separated. For example, we keep our ale yeast in a different part of the brewery than our lager yeast. We also wash our yeasts with acid periodically to prevent different strains from getting involved.



DAVID GEARY and his wife Karen founded Portland, Maine's D.L. Geary Brewing Company, one of the first craft breweries in New England, in 1983. Before opening the brewery, he traveled and worked extensively in England and Scotland to train and research brewing techniques, eventually compiling his experiences to develop the recipe for Geary's Pale Ale in the Yorkshireman style.

The major benefit of open fermentation, for us, is yeast management. Whereas a closed fermentation in a cylindroconical fermenter might yield six or so generations of yeast, we have done about 5,000 generations in our Yorkshire round-style open fermenters. With this style of fermentation, the yeast is constantly cleansing itself at the top of the tank, turning over things like hops residue, which drops to the bottom while the healthy yeast linger at the top. In a cylindroconical, the yeast you harvest is at the bottom along with the residue.

There are some drawbacks to open fermentation, but if you have the right yeasts you can overcome a lot of common misconceptions about airborne yeasts, bacteria and contaminants like fruit flies. At D.L. Geary, not much can compete with our healthy yeast strain. The pH is very low and unfavorable to bacteria, and the layer of CO_2 on the top is a very effective biological lid — even fruit flies know not to go where they can't breathe.

If your yeast isn't vibrant enough, I don't think you would want to open ferment. We use a combination of a fast starter and a strong flocculator, which are very dense. Anything otherwise might expose the beer to air. Our primary fermentation lasts around three days. After that we chill the beer down in the fermenters with glycol-filled coils and allow the beer to continue to condition in the fermenters for another five to six days. Around this time the yeast forms an extremely dense lid, which protects the beer underneath.

For homebrewing, I've heard of fermenting in a large stock pot with a lid, which is probably the way to go. I dare say, however, that most yeasts available to homebrewers, especially dry yeasts, may not have the right stuff to be successful, especially when a lot of homebrewers are doing open fermentations in cellars with mold and such. Also, yeast management is, in my opinion, one of the biggest benefits on a commercial scale, but at the homebrewing level I don't think it makes much of a difference.

STEVE DRESLER is the Brewmaster at Sierra Nevada in Chico, California, which is home to a few Yorkshire square-style open fermenters. He has been with the brewery since 1983 when he parlayed an educational background in biology, chemistry and homebrewing into a professional brewing career.

When I started at Sierra Nevada, we only had open fermentation in our cellar, 5-barrel (170-gal./645-L) batches. The brewery started with open fermentation because it was deemed as the most traditional way to do ale fermentation in open squares. I do feel that the ester notes from open fermentation are exceptional, and there is very little stress put on the yeast by CO_2 saturation and hydrostatic pressures that you get in larger cylindroconical fermenters. We still have four 100-barrel (3,400-gal./12,900-L) fermenters at the brewery and use them all the time.

Also, when we were doing open fermentation only, or as a greater percentage of our production, I could run my yeast for many more generations without propagating because there is less stress on the yeast during fermentation.

The pitfalls are, of course, that you need to have a very clean fermentation environment (you should anyway), and watch your micro closely. We have sterile filtered air going into our fermenter room at a higher flow rate than the CO_2 evacuation to try and cause a positive displacement situation.

Also with open fermenters you do need to have a secondary fermenter to transfer the beer into. This is an additional cost and takes up more real estate than doing the entire fermentation in a single unitank. Open fermenters also do not lend themselves to automatic Clean In Place (CIP) processes and have to be manually cleaned, which takes more time and labor.

After primary fermentation, the beer needs to be moved into the secondary tank. This should be done when there is still a small amount of extract left in the beer so that at the end of fermentation the yeast can take up any oxygen that the beer comes in contact with during the transfer. It is nice to purge or at least blanket the secondary fermenter with CO_2 prior to moving the beer. This is also a perfect time to dry hop the beer if that is a desired effect.

I suppose open fermentation would be fine at home, but it should be attempted in a closed environment such as a cooler or temperature controlled box that can be properly sanitized.

Web extra:

Ron Jeffries of Jolly Pumpkin Brewing Company also "opens" up online at:
byo.com/departments/1691.html

Bitter Bottle Battle

Oxygen safety, filtering and overhopping

"Help Me, Mr. Wizard"

by Ashton Lewis

Bottle bitterness

After recently trying a new beer on draft at a local bar, I liked it so much that I decided to buy a 6-pack at the grocery store. I noticed that the bottled version tasted considerably different. There was much more bitterness and I've noticed this with other brands of beer. Why is it that draft beer seems smoother and less bitter than bottled beer? For a homebrewer, is it better to go with a kegging system to achieve this same smoothness or are there some tricks to the bottling process to help the beer keep a smoother finish?

Dan Schipman
Greensboro, North Carolina

I think there are a few reasons why draft and bottled beer taste different and some of the reasons may recolor your view of draft beer. Some breweries actually have different variations of their beers for draft and bottle. I do not have real good information on how prevalent this is, but the examples I am aware of have two commonalities: the draft beer has a lower bitterness and lower carbonation compared to the bottled beer. Sierra Nevada Pale Ale draft beer is different from its bottled cousin in that the draft form is a little darker and has a lower original gravity compared to the bottled version. Both beers are excellent. I assume that their draft Pale Ale is intended to be more of a session beer and the difference in the recipe makes it more quaffable. So this could explain your observation.

Other factors that make draft beer taste different from the bottled can make a brewer an unhappy camper. Some bars put their beers on "beer gas," also called mixed gas, to "smooth" out beer flavor. An unintended outcome of this practice is that these beers lose their carbonation and deviate from the brewery specification. This really irks me because if a brewer decides they want to serve their draft hefeweizen at three volumes of carbon dioxide, the bar owner or distributor has no business doing something that changes the character of the beer.

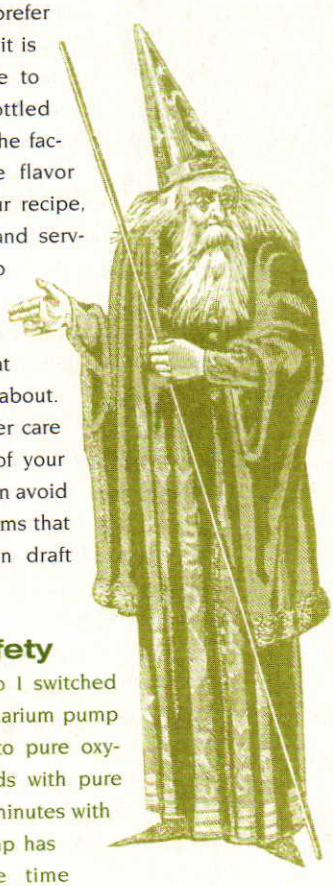
In an effort to lower operating costs, some bars use dreadful contraptions called air blenders. This cheap way of making mixed gas creates a mixture of carbon dioxide and air, which replaces nitrogen with the more affordable compressed air. The use of air blenders flatten kegs over time. They also pump oxygen into the keg to oxidize the beer. Sometimes the air compressor hooked to the blender introduces a bit of microbiological wildlife and whatever funky smells are next to its intake into the mix of carbon dioxide, nitrogen, oxygen. In short, air blenders can change the flavor of kegged beer in a variety of different and disappointing ways.

The use of mixed gas and air blenders make bar owners really happy because they reduce beer carbonation, making the beer easier to pour. This practice reduces beer loss caused by the sloppy bartenders slinging pints behind bars scattered across this great land. If I sound a bit harsh towards bar owners and bartenders it's because that is my intent! The reason that beer advocacy and travel magazines make such a big deal about great draft beer bars is because of the astounding number of really awful draft bars.

Another interesting factoid about draft beer is the flexible line linking the keg to the tap. These little buggers can turn into veritable small intestines. In other words, with their relatively large surface to volume ratio and their tendency to become covered in a microbiological film when neglected, draft lines can turn into long, thin bioreactors that change the flavor of beer as it flows from keg to tap. Neglected taps can also become totally funkified with microbiological growth. This can become especially pronounced with unfiltered beers as the nooks and crannies of the beer tap can quite literally become coated with a visible film of living yeast.

The key to draft beer is really quite simple. Carbon dioxide pressure and beer storage temperature should be matched to the carbonation level of the typical draft beer (usually somewhere around 2.5 volumes of carbon dioxide), and draft lines need to be routinely cleaned. In well-run draft bars, the flavor of draft beer should be within the expectations of the brewery and any difference between a draft and bottled beer should be minimal unless the beer has different draft and bottle specifications.

You mention that you perceive draft beer to taste smoother than bottled beer. This may come from the difference in pouring techniques between the two. It is often the case with draft beer that a noticeable amount of carbon dioxide is "knocked" out of the beer during pouring. In contrast, bottles are easier to gently pour and the amount of carbon dioxide loss is much less. Since carbonation level influences perceived bitterness, any differences in carbon dioxide content between draft and bottle may also lead to apparent differences in bitterness.



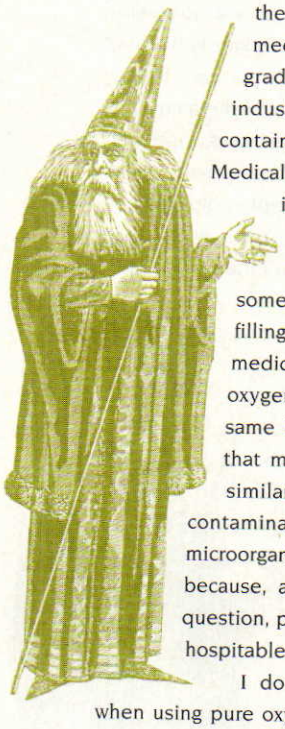
As a brewer I prefer draft beer because it is less labor intensive to produce than bottled beer. Recognizing the factors that influence flavor you can adjust your recipe, carbonation level and serving temperature to produce the beer that you want, which is really what homebrewing is all about. And with the proper care and maintenance of your draft system you can avoid many of the problems that readily arise when draft neglect occurs!

Oxygen safety

A few batches ago I switched from using my aquarium pump aeration method to pure oxygen. Thirty seconds with pure oxygen versus 30 minutes with the aquarium pump has been a welcome time saver. I am using a stainless steel wand with an air stone connected to a red 1.4 oz. metal canister of welding oxygen I purchased at a hardware store. In my research before going to this pure oxygen system, I found very little information about the safety of using these welding oxygen canisters. I found one posting on the Web saying that using this,

"non food grade," oxygen is safe because concentrated oxygen kills any possible contamination. Could you tell me if these welding oxygen canisters are safe to use for wort aeration and/or is there a better alternative for pure oxygen?

Bruce Wilder
Brattleboro, Vermont



The short answer to your question is that welding grade oxygen is probably OK for homebrewing. I know that the only difference between medical grade and welding grade oxygen at my local industrial gas supply is the container the gas goes in. Medical grade oxygen must go into containers that are only used for that grade and there are probably some special inspections and filling procedures used for the medical grade stuff. The actual oxygen gas comes from the same bulk tank. My guess is that most gas suppliers use a similar procedure. As far as contaminants from oxygen go, microorganisms are not a concern because, as you mention in your question, pure oxygen is not a very hospitable environment.

I do suggest using caution when using pure oxygen to oxygenate wort. The problem you face is that the solubility of oxygen in wort is much higher when pure oxygen is used instead of air. Most brewing texts cite the ideal level of oxygen in wort prior to fermentation at around 8 ppm or 8 mg/L. Levels higher than this can cause oxidative damage to yeast cells. When using pure oxygen, wort oxygen levels of about 30 ppm are possible, making over-aerating a legitimate concern. One way to meter the flow of oxygen into wort is to use a gas flow meter. Gas rotameters are common and relatively inexpensive devices that measure the flow of gas.

If you have a flow meter, you can use it to meter gas flow and determine the amount of gas required given a few assumptions. Let's say you want to add 8 mg/L of oxygen to your 20-liter batch, you can see that you will need 160 mg of oxygen (Note to metric-phobes: get over it! The metric system is so much easier than our units when doing these types of calculations. No metric to English conversion is offered because chemistry simply cannot be addressed without using the metric system). 160 mg is equivalent to 0.005 moles of oxygen (0.16 grams/32 grams of oxygen per mole = 0.005 moles). If you multiply 0.005 moles by 22.4 l/mole you see that 0.112 liters of oxygen are required to supply the 160 mg required to yield a concentration of 8 ppm in your 20 liters of wort.

I said there are a few assumptions required for this calculation. The first assumption is that all of the oxygen injected in the wort goes into solution. This is not a bad assumption if the oxygen is bubbled from the bottom of the fermenter and the bubbles are really small. A wand with drilled holes (rather than a gas stone) would produce larger gas bubbles which have a reduced tendency to dissolve into the wort. This would be evident as bubbles break the surface of the wort. Assuming 100% transfer is not a bad assumption as long as you use a stone and keep the oxygen flow slow during aeration. The second assumption is that the ideal gas law is valid enough for brewing and that one mole of oxygen is similar enough to an ideal gas that the 22.4 liters/mole (at atmospheric pressure) conversion is believable. In my opinion, the ideal gas law is certainly good enough for brewing. If you are a chemistry guru fell free to use your favorite equation of state.

If you want to buy a gas rotameter look for one that is scaled in liters per minutes (not cubic feet per minute) with a range between 0-1 liter/minute (lpm) and 0.1 subdivisions. In this example, running the gas flow at 0.2 liters per minute for 30 seconds will introduce about 0.1 liters of oxygen.

Some brewers attempt to replace a gas flow meter with a gas pressure gauge. Without getting into details, I do not recommend using pressure as an indication of flow because it simply does not work well. Unless you know that 10 psi gas pressure delivered to your stone gives some known flow rate you are guessing. The bottom line is that to use oxygen for brewing you really should have a flow meter.

Once you get some experience in introducing oxygen into your wort you can begin making adjustments. If you believe that less than 100% of the gas is going into solution, you can make small adjustments to compensate for the loss. Without measuring the oxygen concentration in your wort this is certainly a guess, but it can be a reasonable one. If you approximate that you are getting 90% of the oxygen injected into your wort, simply divide 0.112 by 0.90 and increase the oxygen volume to 0.124 liters. By using a flow meter you can make small changes with the confidence that accompanies knowing your flow.

We use air for aeration at Springfield Brewing Company. Dry compressed air comes into our aeration panel, flows through a sterile filter, then to a rotameter flow meter before the in-line injection point. Whether using oxygen or air, gas flow meters are handy gizmos to have around the brewery!

Further filtering debate

I found Mr. Wizard's reply to Jared Foote's filtration question in the May-June '07 issue informative but inconclusive. I've filtered homebrewed beer with a dual plate filter for several years and I can say that, for the most part, using a coarse filter (anywhere from 5 to 7 microns) will filter beer to brilliance, removing not only yeast but even chill haze. This flies in the face of all the published information I've ever seen, but the results are what they are — most of my filtered beers are brilliant to near-brilliant. A small but perceptible amount of flavor and body are removed using coarse pads; using 3 micron or finer pads will severely strip flavor, aroma and body, and a 0.5 micron pad would render beer into water, as Mr. Foote now knows — he will be much happier if he tries 5 microns. Tips for success: chill the beer for 24 hours before filtering; dump the first quart or two to purge air and avoid oxidation; pressurize with only 0.5 to 2 psi and take 30 to 60 minutes for 5 gallons. My filtered beers have won at the national level.

John Peed
via email

In my response to Jared Foote's question, I stated that a 2 micron sheet filter can be used to produce clear beer. Not all filter pads are the same, but in my experience the 2 micron filter sheets we use at Springfield Brewing Company do not severely strip flavor, aroma and body from our beers. I have also found that we need the 2 micron sheet to produce the desired clarity. We have also won awards for our filtered beers at the national level, which in my opinion is irrelevant when it comes to evaluating filtration technique. What is important is that the goals of filtration are accomplished with-

out negatively affecting the beer. If you can create brilliant beer using a 5–7 micron pad, that's great! I agree that using the coarsest pad for the job is good advice because, as I failed to state in my original response, filtration does remove some flavor from beer.

Your advice about chilling the beer before filtration is also very sound as this practice causes the formation of chill haze that is removed during filtration. A general rule for chilling beer prior to filtration is that the beer should be colder during filtration than during storage or serving. Most brewers try to filter at a near-freezing temperature to prevent chill haze from forming after filtration. I have had some minor chill haze problems if the beer is not held long enough at the cold pre-filter temperature and always keep the beer really cold for 48 hours before filtration.

Some brewers use a variety of fining and chill-proofing aids that can successfully be used to produce almost brilliant beer without filtration. For example, beers that have been initially fined with isinglass and treated with silica gel and/or PVPP can be filtered bright using coarser pads. One key factor when it comes to clarity is malt since most of the proteins and polyphenols that cause chill haze come from malt. We occasionally use a German Pilsner malt which gives us chill haze problems that we don't have with domestic 2-row malt. My point is that there are several factors that influence beer clarity other than filter pore size.

Brewers who filter on a regular basis typically take into consideration what filtration removes from their beers and compensate for these losses in their formulations. Hop bitterness and aroma can be bumped up to offset losses across the filter and the same can be done with color and body through adjustments to the grain bill. Like most of the techniques used in brewing, there are many ways to filter beer and the most important thing to keep in mind is how any technique influences the finished beer. At the end of the day, all of our efforts as brewers are evaluated by what is in the glass!

Bittering dilemma

I just finished a brown ale that I let ferment for two weeks at 65 °F (18 °C). Then I bottle conditioned it for another two weeks. When I chilled the beer for a first taste it was way too bitter. I entered the recipe in beertools.com and the IBU was around 40. Way too bitter. I put the whole batch in the refrigerator at 32 °F (0 °C) to try to lager the bitterness out with no luck. Should I throw out the batch and start over or put some type of non-fermentable sugar such as dextrin or lactose into a fermenter, ferment the beer all over for a week and then bottle again? Or is there any other way to sweeten a beer that has already been carbonated?

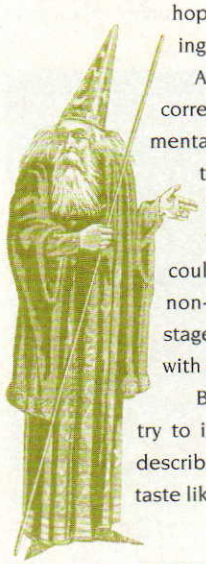
Jesse
via email

It seems as though many of the questions I get address problems after they have occurred and it is an unfortunate truth that most brewing skills come from learning from our mistakes.

Lagering a bitter beer in the bottle will not do much to reduce a beer's bitterness. Nor do I suggest methods to reprocess an unsatisfying beer that has already been bottled as the likelihood for success is not too great. Adding non-fermentables to the beer

and fermenting for a week will not serve any purpose and anything that you do that involves removing the beer from the bottle will most likely result in increased oxidation.

The time to address this sort of problem ideally should occur before brewing. If you had calculated the bitterness prior to brewing you may have known that a 40 IBU brown ale was something you were not going to like and you could have scaled down the hopping to a more appealing bitterness level.



Another opportunity for correction occurs after fermentation. If you had tasted the beer prior to racking and discovered it was too bitter you could have added some non-fermentables at that stage or decided to blend it with a less bitter batch.

Before I brew a beer I try to imagine what the beer described in my recipe will taste like. I look at the calculated bitterness, the various malts, and the aroma hop additions and do a mental analysis on the finished beer. Although this is an abstract exercise it works pretty well if you have enough brews under your belt to know what various ingredients do to beer flavor.

I also like to taste beer during fermentation. Some flavor defects can be corrected if you catch them prior to bottling. And then again, there are some flavor defects that cannot be corrected and I would rather identify candidates for the drain before going to all the time and effort of discovering a real loser after it's time to drink it!

There are a few things that you might want to do with this beer. You may find that it tastes pretty good if you blend it with another beer. My graduate professor was known to blend Budweiser with Bigfoot to produce an odd combination that he found satisfying. You can try blending your too bitter brown with another homebrew or pick up something else from the store to tone it down with.

If you like fruit beers you might find that adding some raspberry syrup or raspberry liqueur to this beer makes a decent raspberry brown. You could also use it for cooking, although bitter beers often do not work very well in certain recipes. The best thing to take away from this beer is a good lesson in problem avoidance!

Brew Your Own Technical Editor Ashton Lewis has been answering homebrew questions as his alter ego Mr. Wizard for the last 12 years. A selection of his Wizard columns have been collected in "The Homebrewer's Answer Book," just released, available online at brewyourownstore.com.

Do you have a homebrewing question for Ashton? Send inquiries to *Brew Your Own*, 5515 Main Street, Manchester Center, VT 05255 or send your e-mail to wiz@byo.com. If you submit your question by e-mail, please include your full name and hometown. In every issue, the Wizard will select a few questions for publication. Unfortunately, he can't respond personally. Sorry!

American Blonde Ale

The easy drinking, balanced beer

by Jamil Zainasheff

Oh where have all of the American blonde ales gone? Searching aisle after aisle of the Great American Beer Festival, I don't see nearly the number that would have been present in years past. Or is this just my imagination? It seems everywhere I look, breweries are pouring "special" beers. Is it that few breweries consider their American-style blonde ale special anymore? Sure, it is still a popular style amongst beer drinkers, and a style that many pubs feel they must have available to please the average beer consumer, but now it elicits little excitement from most beer geeks. What a shame, because a well-crafted blonde ale, though not complex, can be a wonderful beer. Not every beer needs to have several different character malts, exotic fruits, and aging in a barrel to be special. A really well made beer is special by itself.

Photo by Charles A. Parker/Images Plus

BLONDE ALE by the numbers

OG:	1.038–1.054 (9.5–13.3 °P)
FG:	1.008–1.013 (2.1–3.3 °P)
SRM:	3–6
IBU:	15–28
ABV:	3.8–5.5%

Of course, on the festival floor I see a number of beers that are pale in color and labeled as "blonde." Everything from bocks to Belgians. And to some extent, commercial beer names do help define a style. I recall a conversation many years ago where a group of beer judges were discussing which commercial beers with "blonde" in their name were actually of the American blonde ale style. A few people only approved of a couple of the beers named. They had in their minds a very narrow range of characteristics, low esters, low hops, low bitterness, and low maltiness. They wanted them all to be clean, simple and balanced beers. Other people accepted a broader definition, allowing low to moderate levels for every component from bittering to esters. Like most issues, I found myself somewhere in the middle. My take on the vast majority of beer styles is that there is quite a bit of leeway in them. Sure, there are a few key aspects of each style that makes them unique and worth naming beers as belonging to that style, but if a beer is a little more hoppy or a little bit darker or has a little more of this or that, in most cases it can still be considered a good example. A beer out on the edges of a style can be as good or better of an example as a beer smack dab in the middle.

Yet you can't just call any beer a blonde ale. For example, calling a dark lager "blonde ale" just doesn't make sense, no matter what fancy name you give it. In many cases, the commercial brewers are just coming up with creative names and identifying the color of their beer. They're not saying that the beer matches a particular style as defined by the BJCP. The BJCP blonde ale style is a bit of a catchall, including beers that are lower alcohol, lower hopped versions of American pale ales, and higher hopped versions of the Kölsch style. They are all pale beers with a relatively balanced and restrained approach. Many folks think of American pub-style blonde ale as in the middle of this description and that is my focus for the rest of this article.

RECIPE

Blondinebier
(5 gallons/19 L, all-grain)

OG = 1.049 (12.2 °P)
FG = 1.011 (2.8 °P)
IBU = 20 SRM = 5 ABV = 5.0%

Ingredients

10 lb. (4.53 kg) Great Western North American 2-row malt (2 °L)
0.50 lb. (227 g) Great Western crystal malt (15 °L)
4.1 AAU Willamette hops (60 min) (0.82 oz./23 g of 5% alpha acids) or substitute with Willamette, Glacier, U.S. Fuggle, U.S. Tettnang or Styrian Golding hops
Wyeast 1056 (American Ale), White Labs WLP001 (California Ale) or Fermentis Safale US-05 yeast

Step by Step

Mill the grains and dough-in targeting a mash of around 1.5 quarts of water to 1 pound of grain (a liquor-to-grist ratio of about 3:1 by weight) and a temperature of 152 °F (67 °C). Hold the mash at 152 °F (67 °C) until enzymatic conversion is complete. Infuse the mash with near boiling water while stirring or with a recirculating mash system raise the temperature to mash out at 168 °F (76 °C). Sparge slowly with 170 °F (77 °C) water, collecting wort until the pre-boil kettle volume is around 6.5 gallons (25 L) and the gravity is 1.038 (9.5 °P).

The total wort boil time is 90 minutes. Add the bittering hops with 60 minutes remaining in the boil. Add Irish moss or other kettle finings with 15 minutes left in the boil. Chill the wort to 67 °F (19 °C) and aerate thor-

recipe continued from page 19

oughly. The proper pitch rate is 9 grams of properly rehydrated dry yeast, two packages of liquid yeast or one package of liquid yeast in a 1.4 quart (1.3 L) 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.

Blondinebier
(5 gallons/19 L, extract plus grains)

OG = 1.049 (12.1 °P)
FG = 1.011 (2.8 °P)
IBU = 20 SRM = 5 ABV = 5.0%

Ingredients

6.3 lb. (2.85 kg) Alexander's North American light liquid malt extract (2 °L), or substitute 5.1 lbs. (2.3 kg) fresh, light dried malt extract
0.50 lb. (227 g) Great Western crystal malt (15 °L)
4.1 AAU Willamette hops (60 min) (0.82 oz./23 g of 5% alpha acids) or substitute with Willamette, Glacier, U.S. Fuggle, U.S. Tettnang, or Styrian Golding hops
Wyeast 1056 (American Ale), White Labs WLP001 (California Ale) or Fermentis Safale US-05 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 0.5 gallons (~2 L) of water at roughly 170 °F (77 °C) for about 30 minutes. Lift the grain bag out of the steeping liquid and rinse with warm water. Allow the bags to drip into the kettle for a few minutes while you add the malt extract. Do not squeeze the bags. Add enough water to the steeping liquor and malt extract to make a pre-boil volume of 5.9 gallons (22.3 L) and a gravity of 1.042 (10.4 °P). Stir thoroughly to help dissolve the extract and bring to a boil.

Once the wort is boiling, add the bittering hops. The total wort boil time is one hour after adding the bittering hops. During that time add the Irish moss or other kettle finings at 15 minutes before shut-down.

Chill the wort to 67 °F (19 °C) and aerate thoroughly. The proper pitch rate is 9 grams of properly rehydrated dry yeast, 2 packages of liquid yeast or 1 package of liquid yeast in a 1.3 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.

Style profile

Blonde ale should always be a smooth, easy to drink beer with a clean fermentation profile and just a touch of malt character. Held to the light, it is light yellow to deep gold in color and usually brilliant in clarity. I prefer my blonde ale without fruitiness. A little fruitiness is acceptable, but it should be no more than a hint. Hop character is generally low to moderate, as is the alcohol level (3.8 to 5.5% ABV). A very slight residual sweetness should be offset with just enough hop bitterness to keep things balanced. It should never be heavy nor should it be overly dry or thin. It should have a slightly dry or slightly sweet finish and a medium body. Balanced and easy drinking is the key. It is a very approachable beer for people new to craft beer.

Blonde ale recipes are usually simple, with a nice balance between simple malt flavors, bittering and a clean fermentation character, with all aspects of the beer in harmony. The fermentation character is clean and subtle, and the hop and malt character should be low key as well. You can find recipes out there with all sorts of additional grains and sugars, but a simple malt bill is best for this style. Choose high quality malt or malt extract and let the fine flavors of the base malt shine through via a clean fermentation. Most brewpubs make this as an ale, but it can also be done as a lager at slightly warmer than normal lager fermentation temperatures. If you want to add some late hop additions, keep them restrained and use only one hop variety to keep things simple and subtle.

I'm a big fan of rich malt character, but if you're targeting the traditional center of this style, you really need to go clean and simple with the base malt. North American two-row malt is the standard, giving the beer that clean, subtle background malt character common to many fine American craft beers. If you want to push the boundary some, you can use domestic pale ale malt, for a slightly richer background malt character, giving the beer a light bready note. Again, this is the type of malt character you'll find in many fine domestic craft brews. I would avoid British pale ale malt or continental Pilsener malt, as that adds just a bit too much base malt character. Extract brewers should use a light color malt extract. All-grain brewers

can use a single infusion mash and should target a mash that will leave enough long chain sugars in the beer to help give the beer a middle of the road-type body. A temperature around 152 °F (67 °C) creates wort with a nice balance between fermentable and non-fermentable sugars.

The majority of the malt character of a blonde ale should really come from the base malt, not from specialty malts. You want the efforts of the maltster to shine through, not be masked by heavy flavors.

"Blonde ale recipes are usually simple, with a nice balance between simple malt flavors, bittering and a clean fermentation character, with all aspects of the beer in harmony."

Some folks like to use a touch of wheat, light color crystal, or some lightly toasted character malts and these can provide a welcome malt accent, but keep it simple. Try to hold yourself to no more than one specialty grain and keep the amount to no more than 10% of the grist. I prefer a touch of light colored crystal malt for a little background sweetness, at around 5% of the grain bill, but feel free to experiment with other grains of moderate color.

There is quite a bit of flexibility in the hops used for blonde ales. The bittering/malt balance can range from slightly sweet to slightly bitter, with most examples being evenly balanced. You want just enough hop bitterness to balance any residual malt sweetness, and it doesn't take much. The bitterness to starting gravity (IBU divided by OG) ratio for this style usually ranges from a modest 0.3 to a bold 0.6. If you're using a lower attenuating

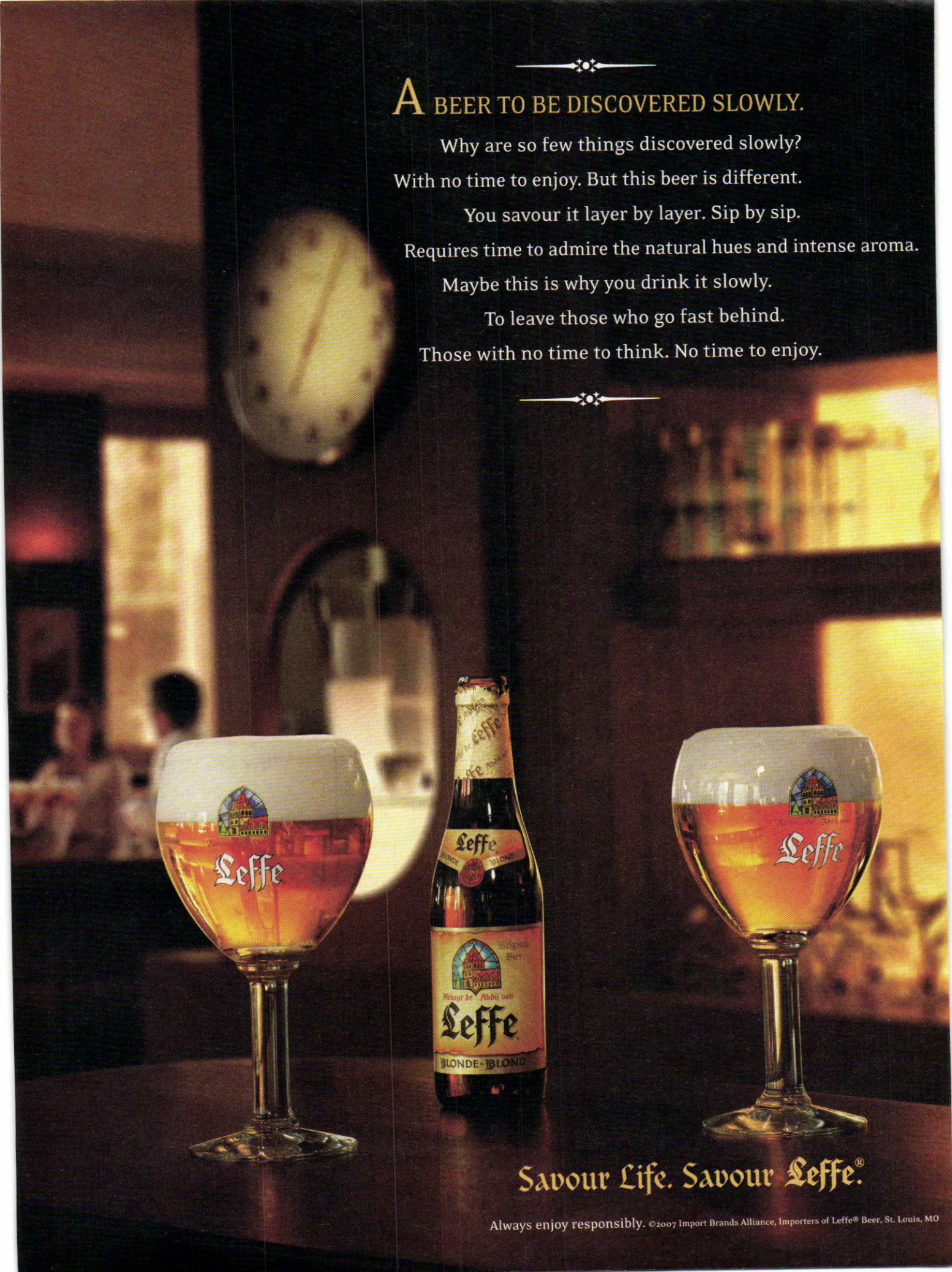
yeast or a lot of crystal malt, lean toward the higher end of the ratio. With a more attenuating yeast or fewer unfermentable sugars from specialty malts, target the lower end. Be aware that highly bitter or hoppy versions are going to be more like American-style pale ale than good blonde ale.

There isn't a lot of hop flavor in blonde ale and hop aroma is often non-existent or very low. Of course, there are examples where a little hop flavor peeks through, but it is still restrained and tends to come from fairly mellow hop varieties, such as Willamette. Even though this is an American style of beer, avoid using really pungent American hop varieties, such as Centennial, Columbus or Simcoe. Even when used only for bittering, their flavor can be tasted with such a simple malt bill. Use caution if these are not the hop flavors you're targeting.

Fermentation for blonde ale is straightforward. Like the majority of American-style ales, blonde ale most often has a clean profile, with very low to no fruity esters. A slight fruitiness can be welcome, as long as it isn't excessive. It is important to not leave too much residual sweetness in this beer, as residual sweetness tends to have a negative impact on the drinkability. I prefer to use a clean, moderately attenuating yeast, such as Wyeast 1056 (American Ale) or White Labs WLP001 (California Ale). Other good options include White Labs WLP008 (East Coast Ale), White Labs WLP051 (California Ale V), or Wyeast 1272 (American Ale II). Make certain that you oxygenate the wort and pitch an appropriate amount of clean, healthy yeast for the batch you are brewing. This will help create that clean American pub-style profile in the beer. If using Wyeast 1056 or White Labs WLP001, ferment around 67 °F (19 °C), holding the temperature steady throughout fermentation. Other yeasts may require slightly warmer or cooler temperatures, depending on the strain, but 67 °F (19 °C) is a good ballpark to start in if you're unsure. 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 estery beers. If you wish, 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.

So, even though blonde ale may not be trendy or might not seem special anymore, it never hurts to have one on hand when someone is searching for an easy-drinking pint.

Jamil Zainasheff is co-author of the book "Brewing Classic Styles," which contains more than 80 of his award-winning recipes (in both extract and all-grain versions) and covering every BJCP recognized style. He hosts the popular Jamil Show on The Brewing Network, www.thebrewingnetwork/jamil.php, where he discusses brewing tips and brewing beer styles. He writes "Style Profile" for every issue of Brew Your Own.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THE SCIENCE OF STEP-MASHING

by **Dave Green**

Step mashing is a mash program in which the mash temperature is progressively increased through a series of rests. The ubiquity of well-modified malts has virtually eliminated the need to perform a step-mash in most situations. So why should you learn more about the process and science behind step-mashing? Simple, you can produce more variety and sometimes better, more distinctive beers when following a step mash program.

Step-mashing allows brewers to manipulate the mash to get the desired wort, dry or sweet, velvety or lightly astringent. You may also find that your extract efficiency goes up slightly-to-moderately when using a step-mashing regimen. Understanding the science behind step mashing can help all-grain brewers — and even partial mash brewers — decide on an appropriate mash regimen for their beers.

Malt Modification

Malting plays a fundamental role in the brewing process. The goals of mashing are essentially an extension of the goals of malting, and what happens in the malthouse should influence your choice of a mash protocol.

The main purpose of malting is to begin germination of the barley, then toast the grain to stop the seed from sprouting. Brewers care about this because it will start two vital degradations and also produce the fundamental enzymes of mashing. During the malting process, gums (glucans) in the cell walls of the barley are broken down. Likewise, proteins are broken down. This breakdown supplies the wort with amino acids necessary for yeast health and lowers the possibility of haze or biological instability in the finished beer. Finally, malting causes the barley to produce the starch-degrading enzymes that will be employed in the mash. The degree to which gum and protein degradation has progressed is called modification. These days, most malts are fully modified. The glucans and proteins are degraded to a point that brewers only need to convert the starches in the grain to make good quality wort. Undermodified malts are those in which modification has stopped short, essentially leaving the brewer to complete those tasks in the brewhouse.

If a malt is undermodified, it will clearly say so in the name. For example, Briess makes a malt called Less Modified Pilsner Malt. Conversely, if a malt name does not mention its level of modification, it's fully modified. Seed barley is very hard. Malt modification proceeds from one end of the barley grain to the other, softening it. Another way to identify an undermodified malt is to chew it — if it has a hard, "steely" end, then it's undermodified. See Table 1 for a summary of various malt types and their levels of modification.

If you have purchased an undermodified malt — or have made your own malt at home, which usually yields unevenly modified kernels — a step mash (or decoction mash) may be your best option.

Enzymes

Enzymes are proteins that catalyze chemical reactions, allowing them to occur at a much faster rate than they would on their own. (There are also enzymes made of RNA molecules, but these don't play a direct role in mashing.)

A protein is a long, unbranched chain of amino acids, ranging from as short as about 50 amino acids long for insulin to up to over 8,000 amino acids in some of the largest proteins. In some regions of a protein, an amino acid sequence will form a "coil" (called a helix). In others, the string might double-back on itself and form what's called a sheet. The whole sequence, with its local regions of helices and sheets, folds into a 3-dimensional shape. The most common bonds that stabilize the enzyme's shape are know as Van der Waals forces, weak attractions that can easily be broken by increased temperature or changes in pH.

The shape of an enzyme determines its function. This is because the substrate for a given enzyme will fit into the enzyme's "active site." A simple analogy for enzyme action can be drawn using the video game Pac-man. If the Pac-man character was an enzyme, his mouth would be the active site, which would grip the substrate (or substrates) and catalyze a chemical reaction. For example, when an amylase enzyme breaks down a starch molecule, its active site "grips" the starch and breaks the bond between two sugar residues in the starch strand.

Unfortunately, analogies to 1980's-era video games sometimes have to be aban-

doned when the finer points of enzyme action are discussed. Contrary to what the Pacman analogy might imply, enzymes do not physically "chew" on molecules.

The protein-degrading and starch-degrading enzymes in a step mash work by a process called hydrolysis, which loosely translates as "breaking with water." For example, amylase enzyme will bind to two adjacent sugar molecules on a starch strand. When a water molecule bumps into the enzyme and substrate complex, the enzyme catalyzes a reaction between a hydrogen ion (H+) from the water molecule and one of the sugar molecules, and a second reaction between a hydroxyl ion (OH-) and the other sugar. Essentially, the bond between the two sugars is replaced with a water molecule, which splits into two parts, breaking the starch strand. Once the bond is broken, the change in the shape of the molecules in the active site causes the enzyme to release, where it is free to float around in solution until it bumps into another starch strand.

Now, if any of the bonds that stabilize an enzyme's shape are disrupted, then the enzyme will no longer function because the active site's shape changes and the substrate won't fit in it. When an enzyme's structure is disrupted by heat, we say that the enzyme is denatured. Once denatured, most enzymes — including the enzymes relevant to mashing — will not fold back into their active shape. Therefore, generally speaking, denaturing permanently deactivates an enzyme.

In the brewing literature, the optimal temperature ranges for various enzymes are given. (For a summary, see Table 2.) For advanced brewers, it is important to understand what these mean. Enzymes are simple "machines" that work solely due to their shape. In solution, if they happen to bump into their substrate(s), they catalyze a chemical reaction. As an enzyme solution is heated, the rate of reaction increases as the time it takes for enzymes to randomly bump into substrate molecules is decreased because the individual molecules are moving faster through the solution. Enzymes are active at all temperatures between the freezing point of a solution and the temperature at which the enzyme denatures. When the temperature range for a given enzyme is stated in the brewing literature, it is the range of temperatures that result in good brewhouse performance for that enzyme. It does not mean that enzyme is inactive outside of that range. All brewing enzymes are active below their stated range. However, at lower temperatures, they are working more slowly. The top end of an enzyme's range is determined by the enzyme's activity and denaturation point. Heating a step mash over the top end of an enzyme's range does not cause that enzyme to stop working instantly. It takes time for enzymes to denature. In some cases, enzymes will actually denature within their stated range. For example, at 149 °F (65 °C), beta-amylase is denatured within 40–60 minutes and alpha-amylase activity will cease after 2 hours at 153 °F (67 °C). The point is that, by changing mash temperatures, you are not cleanly switching enzymes on and off. Due to their simple mechanism of action, your control over them is much more "squishy."

Still, there are four factors that determine the speed of an enzyme-catalyzed reaction — the enzyme's concentration, the substrate concentration, the tempera-

table 1

Grain Type	Glucan Content	Cell Wall Degradation	Large Protein Degradation
Undermodified	Moderate	Moderate	Slight
Lager/Pilsner	Low	High	Moderate
Pale Ale	Very Low	Almost Fully	Almost Fully
Unmalted Wheat, Rye & Oats	High	None	None
Malted Wheat, Rye & Oats	Moderate	Moderate	Moderate

table 2

Enzyme	Optimal Temp. Range	Maximize the Enzyme	Denatures
Phytase	86–128 °F (30–53 °C)	95 °F (35 °C)	~140 °F (60 °C)
Beta-Glucanase	95–131 °F (35–55 °C)	113 °F (45 °C)	~140 °F (60 °C)
Peptidase	113–128 °F (45–53 °C)	122 °F (50 °C)	~145 °F (63 °C)
Proteinase	122–138 °F (50–59 °C)	136 °F (58 °C)	~155 °F (68 °C)
Beta-amylase	130–150 °F (54–66 °C)	148 °F (64 °C)	~160 °F (71 °C)
Alpha-amylase	150–160 °F (66–71 °C)	158 °F (70 °C)	~170 °F (77 °C)

A representation of beta-amylase that shows its 3-D structure.

1,4 beta-glucanase is the primary gum-degrading enzyme.

ture of the mixture and its pH — and all four of these can be manipulated in a step mash to alter your wort's qualities.

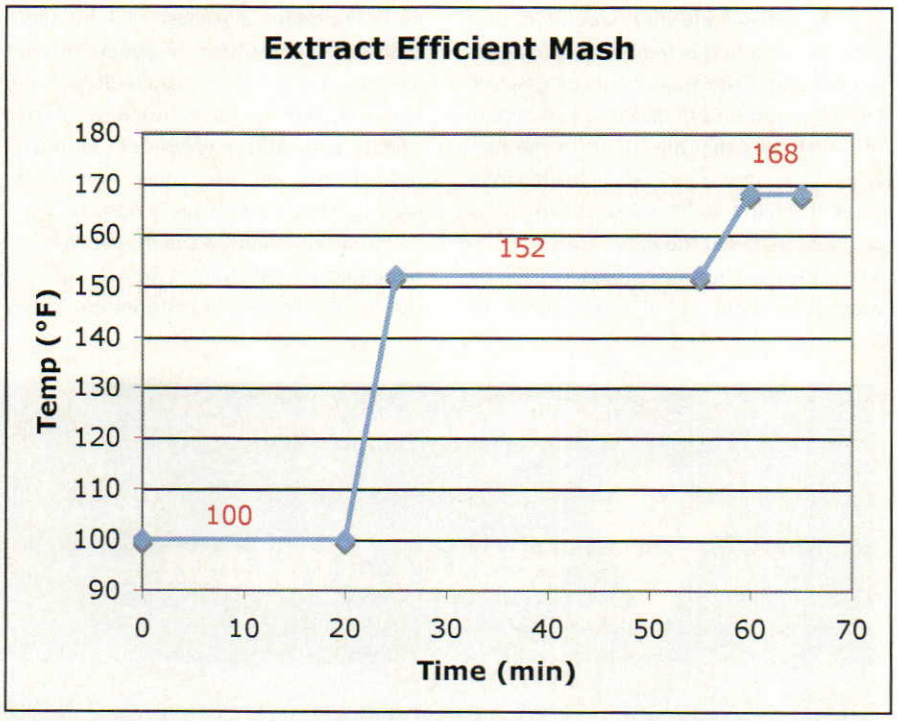
The Acid Rest

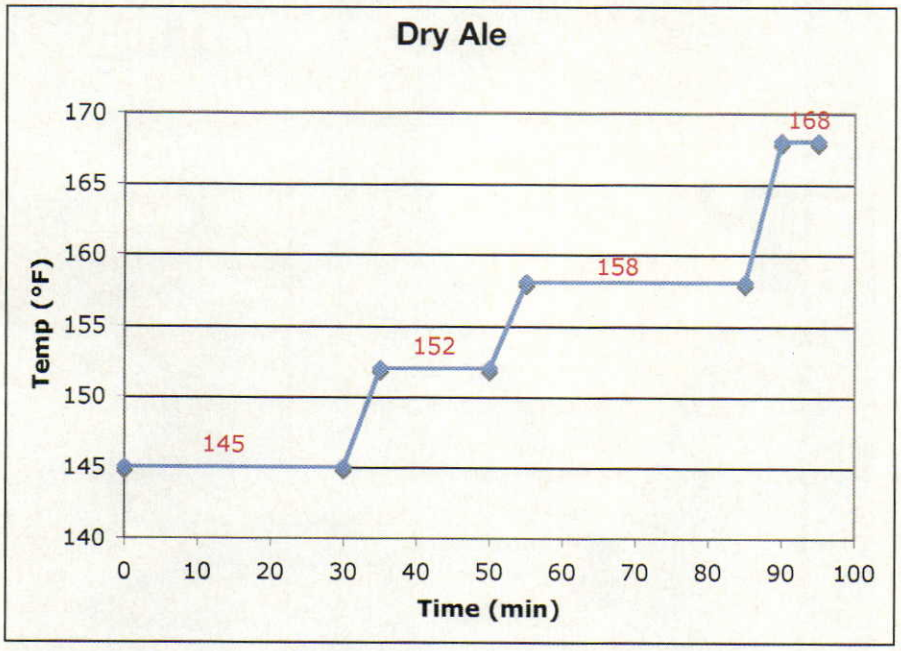
The acid rest is the first rest you might schedule after dough-in in any full step mash or decoction mashing regimen. The acid rest has two functions; to lower the pH of the mash to an appropriate range and to break down the dreaded glucans that can gum up a mash. The typical range for an acid rest is between 95–113 °F (35–45 °C). At this temperature, the enzyme phytase breaks down a molecule called phytin and releases phytic acid, which lowers mash pH.

Phytase is very susceptible to heat and most of these enzymes will be destroyed during extended malting. So phytase will only be present in very lightly-kilned malts. Therefore it will only really benefit a mash made up of undermodified malts in soft water with little buffering capability — a rather small niche. Usually, this situation is addressed by simply adding acid to the strike water. Another reason that acid rests are not widely used is that it takes at least an hour to bring about any meaningful change in mash pH.

The second and more important purpose of a rest in this temperature range is to take care of the majority of glucans, also known as gums. Beta-glucans are a form of carbohydrates that are found in the protein layer surrounding the starch molecules in grains and beta-glucanase is an enzyme that will degrade these molecules. Various glucanases are active all the way up to about 140 °F (60 °C), but the most important glucanase, 1,4 beta-glucanase has an optimal temperature right around 113 °F (45 °C). Beta-glucans are found in highest concentrations in rye, wheat, oats and undermodified malts. Beta-glucans are also known to lead to haze in beer if not properly degraded.

In a fully-modified malt, the level of beta-glucans should not be a problem, but if you experience lautering problems





or haze with your favorite malt, try a 15-minute rest in the acid rest temperature range.

The Protein Rest

A rest in the temperature range between 113–138 °F (44–59 °C) has traditionally been called a protein rest. These days, many brewing scientists do not think that much protein degradation occurs during mashing and this is part of the reason that it is left to the maltster. However, it's worth reviewing the possible enzyme actions that may occur in this range.

There are two specific types of enzymes that were thought to be active in this range — proteinase and peptidase enzymes, collectively known as the proteolytic enzymes.

Proteinase is an enzyme that works on longer-chained proteins turning them into medium length chains. Peptidase enzymes chop up the moderate to short chains and break them down to their component form. Conveniently, these two enzyme groups have slightly different optimal temperature ranges, so you can hypothetically favor one or the other.

Brewers do not want a lot of longer chain proteins in their wort. A high level of big proteins can lead to haze and instability. However, brewers do want medium length protein chains because they are beneficial for a beer's body and for foam retention. The optimal range for peptidase is between 113–128 °F (45–53 °C) while the optimal range for proteinase is 131–137 °F (55–58 °C). A 15–30 minute hold in the proteinase range was thought to diminish haze, but not negatively impact foam or body.

One important point to note is that the low temperature rests have been found to be more effective with thick mashes. Therefore you may want to mash-in when utilizing these low temperature rests between 0.8–1.0 qts./lb. (1.7–2.1 L/kg). You can then thin the mash with boiling water when raising the temperature to the saccharification rest(s).

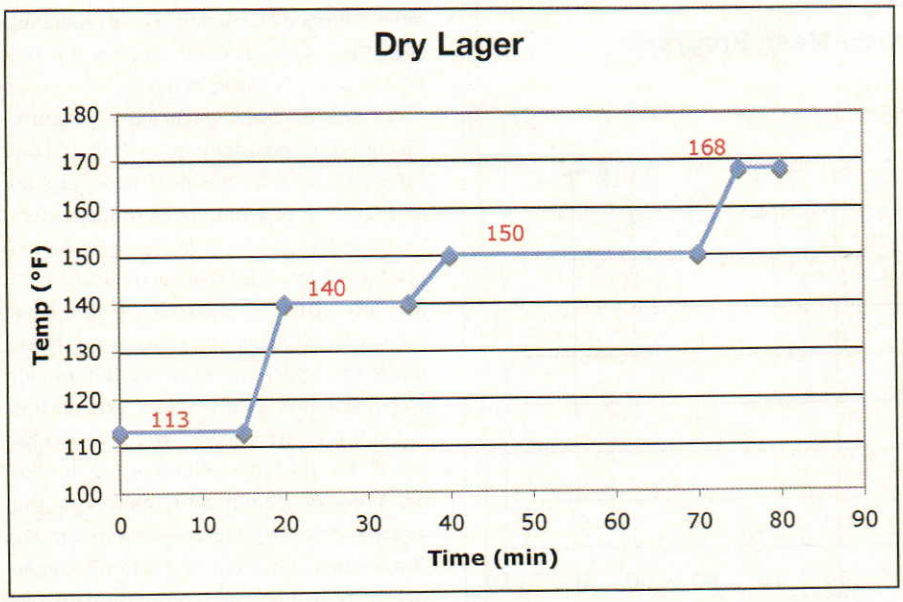
Some beta-glucanase activity also occurs in the protein rest range and some brewers perform a "protein rest" for this reason. Unless you have a very good reason — for example, if you know you have a high-protein malt on your hands — avoiding a rest in the 113–128 °F (45–53 °C) range is probably prudent as you will potentially avoid any problems with head retention. When brewing with under-modified malt, you should rest in the 131–137 °F (55–58 °C) range — at a minimum, it will break down some gums.

Whether or not meaningful amounts of protein degradation are occurring in this range, a rest here does affect the quality of your wort. For example, the time and stirring that goes on in a step mash may promote better extraction efficiencies — especially for homebrewers not used to stirring their mashes or those who typically get marginal extraction rates.

Starch Conversion

The only required rest in any mash program is a rest in the starch conversion, or saccharification, range. When mashing fully-modified malts, a single rest in this range is a very popular option.

Starch conversion is performed by two separate enzymes, which attack starch chains in different manners. The two enzymes are collectively referred to as the diastatic enzymes. The typical starch conversion rest occurs between 142–



162 °F (61–71 °C). (Sometimes you will see a smaller subset of this range stated, for example 150–158 °F (66–70 °C). Remember that enzyme action is not an all-or-nothing thing and allow for the fact that any boundary to any temperature range in brewing is somewhat arbitrary.)

Beta-amylase attacks the ends of starch molecules and "snips" off the final two sugar residues, producing maltose. One noteworthy aspect to this is that starch molecules can be very long. If you want beta-amylase as your primary starch converter, then your mash will need a long rest in its optimal range. A 1–2 hour rest in the 140–145 °F (60–63 °C) range is, in fact, one way for brewers produce a highly-fermentable wort for drier beers.

Alpha-amylase is the second enzyme that is used for starch conversion. The optimal temperature range of alpha-amylase is around 155–162 °F (68–72 °C), although it is still active to a lesser degree at lower temperatures. Alpha-amylase attacks starch molecules at random points along their chains. It is bulky enough that it is not able to attack the starch molecules around branching points. A rest in the high end of the alpha range will result in a less fermentable wort, resulting in a sweeter, more full-bodied beer. In particular, a short (20 minute) rest at 158–162 °F (70–72 °C), in a relatively thick mash (around 1.0 qt./lb. or ~2 L/kg) will produce a very thick, full-bodied beer.

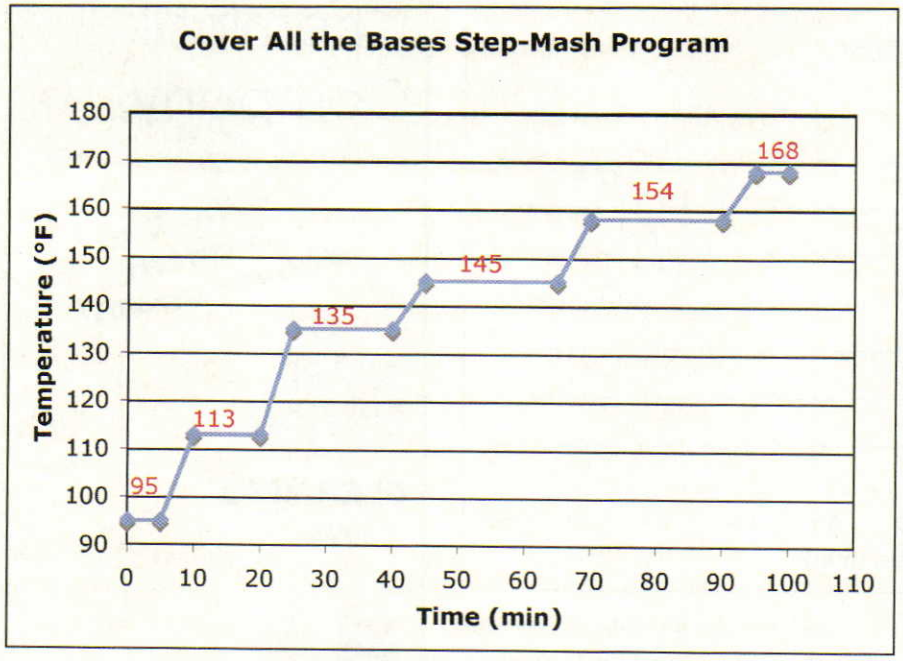
This is particularly true for beers brewed with low-enzyme malts, such as British pale ale malts.

Alpha-amylase is usually used in conjunction with beta-amylase to produce moderate to full-bodied beers. The basic idea is that the "random" action of alpha amylase opens up new ends for beta–amylase to work on. Working together in the 150–152 °F (66–67 °C) range, these enzymes will produce a moderately fermentable wort and this is a popular range for single-infusion mashes among homebrewers. Increasing this temperature up to 154 °F (68 °C) will result in a more full-bodied beer, but not so "thick" as to be overly sweet or cloying.

Typical resting time is 60 minutes, but with many malts, conversion occurs much more quickly than this. For a moderate to full-bodied beer, you can begin running off the wort as soon as an iodine test shows a negative result (no color change, indicating that the test is not detecting appreciable amounts of starch.)

Alpha-amylase is less active and less stable in worts with low levels of calcium ions. This instability is increased in thin mashes and mashes in which the pH is above the recommended range.

For any beer that is supposed to be full-bodied, a mash out — a 5-minute rest at 168–170 °F (76–77 °C) — is recommended. Also, ensure that your grain bed temperature stays at this temperature during sparging by heating your sparge water to the appropriate temperature — which is dependent on the heat loss of your system during lautering. This will ensure that amylase enzyme activity is decreased, due to denaturation of the enzymes. As



such, your wort fermentability will not increase appreciably during wort collection due to continued enzymatic action.

Performing a mash-out also increases wort viscosity and makes lautering easier.

Step Up to the Plate

The figures on pages 30-32 show some suggested step mash programs for various types of beer. Most homebrew texts also list various combinations of steps. (For the most common decoction mash programs, see the "Techniques" column in the December 2006 issue of BYO.)

When deciding on a mash program, you need to consider your malt type, your beer style and its desired characteristics and sometimes even your brewing setup. Keep in mind that a more complicated mash program does not necessarily result in better beer. Conversely, if you have been experiencing poor lautering, haze, low extract efficiency or worts that are not as fermentable as you would like, adding the appropriate rest to your mash may solve the problem. When using undermodified or homemade malt, you will need to do a step mash — at a minimum, you should hold in the protein rest range before boosting the temperature to the starch conversion range. The more undermodified or variably modified your malt is, the more an involved step mash will improve yield and wort quality.

Dave Green is the resident ski bum and Advertising Coordinator for Brew Your Own.

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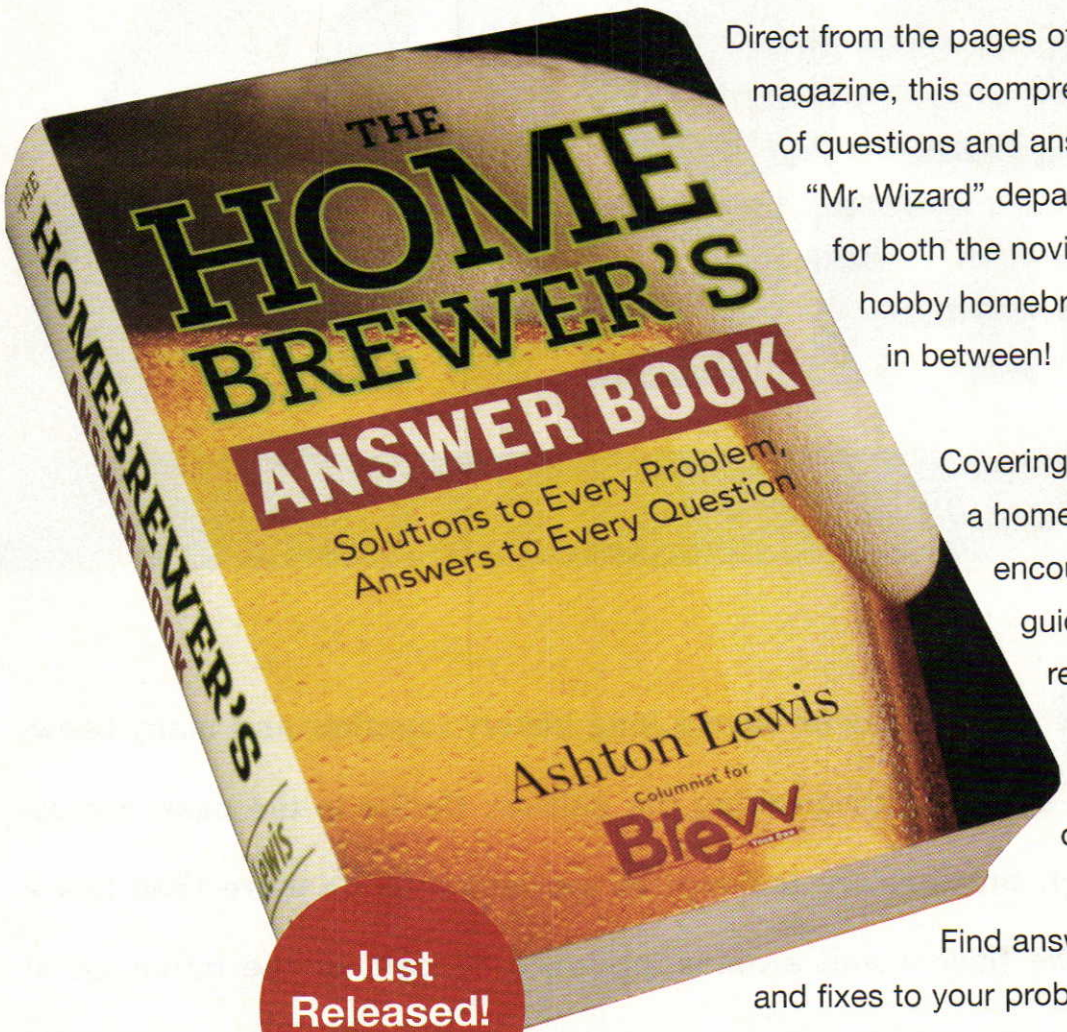

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the whys and whats of wood-aging beer

WOOD BREWS

Wood and beer have a long history together and many brewers are rediscovering the pairing. Unlike in the past, however, brewers are looking for the barrel to be more than just a storage vessel. The flavors and aromas imparted by oak, or the influence of microorganisms living in the wood, are meant to be part of the sensory profile of some beers. If you are interested in wood-aged brews, check out our round-table discussion among professional brewers who practice barrel aging, "wood beer" clones, tips on maintaining barrels and ways to add oak to your beer without buying and maintaining a barrel.

our **GUIDE** to getting your **OAK** on

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by **Betsy Parks**

PROFESSIONAL BARREL AGING

Thinking of trying your own barrel-aged homebrew? Before you begin, let these six professional brewers explain how they mix beer and oak.

What styles of beers do you like to age in wood and why?

RON JEFFRIES, Jolly Pumpkin Brewing Company
We age all of our beers in oak. We enjoy looking for the influence of the wild yeast and souring bacteria on all different styles.

VINNIE CILURZO, Russian River Brewing Company
I prefer blonde ales, both lower in ABV and in the 7% range. They tend to dry out a little better which I really like in barrel beers. But, with that said, we just recently did the 20th Anniversary Ale for the Toronado Pub in San Francisco. Dave Keene, the owner, gave me three guidelines: dark, barrel aged and funky. I ended up brewing five different beers and then Dave and I did the final blend. It ended up being a sour, Belgian-style dark strong ale. It was AWESOME. In fact, I thought it was one of the best barrel beers we've ever done.

STEVE BREEZLEY, Avery Brewing Company
Here at Avery we've generally focused on our "big" beers – our varieties that are over 9% ABV. These have ranged from our 10% ABV Belgian-style quadrupel (The Reverend) to our 12% ABV Imperial Stout (The Czar) to The Beast, a 16% ABV Belgian Grand Cru of sorts. We have a lot of interest in these beers to begin with, so it's natural that barrel-aged versions become much sought after.

SCOTT VACCARO, Captain Lawrence Brewing Company
I don't particularly look to age certain styles of beer in the barrels. I look for beers that I think will benefit from the flavors of the wood or whatever was held in the barrel previously. As a general rule, strong, dark beers tend to have flavors that integrate the best with the oaky flavors, but many other styles will work as well.

JOHN EGAN, Stone Brewing Company
It all depends on what types of barrels are being used and what you're going for with them. Aging beers like our Stone Old Guardian Barley Wine, Stone Imperial Russian Stout, and Double Bastard Ale do very well in bourbon barrels, adding depth and complexity to an already outstanding beer. Lots of vanilla, bourbon, coconut, and alcohol come through.

Brandy barrels are very similar to bourbon, but seem to impart less of an oak or bourbon character. They seem a little more neutral, as many brandy barrels are retired wine or bourbon barrels that have been stripped of a lot of the oak character by being filled numerous times. Our Stone Smoked Porter, Stone Pale Ale, and Double Bastard Ale have all spent some time in brandy barrels (separately, of course!) and come out tasty.

This last spring we were fortunate enough to get our hands on some red wine barrels which we filled with our '07 Vertical Epic Ale. This is a Belgian-style beer that has done well in the wine barrels for the last few months. I'm looking forward to tasting this one in about a year or so.

ERIC WALLACE, Left Hand Brewing Company
I recommend barleywine and imperial stout. Big, ageable beers benefit the most from wood aging.

Did you decide to age beers in wood to experiment or to be traditional?

RON JEFFRIES, Jolly Pumpkin Brewing Company
It is really a mix of both. Brewers originally aged beer in oak, and it is very traditional, but now it seems like most people have moved away from oak and into stainless steel, so I feel that our move back to the barrels is also experimental. I think of it as a revivalist tradition.

"Strong, dark ales tend to have flavors that integrate the best with the oaky flavors . . ."

VINNIE CILURZO, Russian River Brewing Company
When I started doing barrel-aged beers, I wanted to take my favorite component in a lambic, which is *Brettanomyces*, and use that in local wine barrels in a strong blonde Belgian-style ale. This beer ended up being Temptation. Although customers tend to like and hype the Supplication more, I like the Temptation for its straightforward *Brett* character. Over time, some *Lacto* and *Pedio* have infused in the beer, but it is minimal. So, it was both experimental and traditional.

STEVE BREEZLEY, Avery Brewing Company
We definitely do it to experiment. We really don't do anything traditional here at Avery. The coolest things we've done in barrels were experiments with *Brettanomyces* and different yeast strains in different barrels.

SCOTT VACCARO, Captain Lawrence Brewing Company
I am always looking to add my own twist on a traditional method of aging beer. All beer was aged in wood at one point, some for the flavors, some out of necessity, and some to achieve new and acidic flavors. The experimentation comes when you use a type of barrel that has not been used before or you take a beer that typically would not be aged in wood and add it to a barrel.

JOHN EGAN, Stone Brewing Company
A little bit of tradition, but mostly experimental. It's really cool and a lot of fun to see how beers develop over time in barrels and how much they change.

ERIC WALLACE, Left Hand Brewing Company
For our beers, barrel aging is both traditional and experimental.

How long do you age your beers and why?

RON JEFFRIES, Jolly Pumpkin Brewing Company
We age for varying times depending on the beer and maturation period. The longer the beer is in the barrel the more sour it will become. We age anywhere from two weeks to many years.

VINNIE CILURZO, Russian River Brewing Company
We go a minimum of 12 months and as long as 24 months for Beatification. There is no real formula for the time a beer must sit in a barrel with the bugs and critters, but, it is those very bugs and critters that will tell you when the beer is ready to be pulled out. It takes at least six months for the *Brett* to show any signs of the work it has been doing, and the *Lacto & Pedio* are not much faster, depending on the strain. We go 12 to 15 months for Temptation and Supplication and longer on Beatification, which is spontaneously fermented.

It is just a slow process regardless of how you look at it. Sometimes we develop some acid character from the bacterias pretty early on, but it is usually pretty sharp then, and in time it tends to mellow out and meld with the *Brett*.

STEVE BREEZLEY, Avery Brewing Company
It definitely depends on the beer. When we are using *Bretts* or lambic blends, it's usually about achieving a flavor profile from the yeasts and bacteria. With other beers it's about acquiring the character of the barrel, which in our experience varies greatly with the type of barrel used.

SCOTT VACCARO, Captain Lawrence Brewing Company
I always tell people the same thing — until the beer is ready. Some of our beers age for over a year, and some only a month or two. It really comes down to what type of flavors you want and the intensity that you want to get out of the barrel. A freshly-emptied bourbon barrel will give you flavors really quickly, while a sour beer may need to sit in the wood for a few years.

JOHN EGAN, Stone Brewing Company
With the big beers, we let them hang out in the barrels for at least six to 12 months. The Belgian-style beers in barrels may go for a little longer, depending on whether they are "funkified" or not. Lower alcohol beers might age in the barrel for anywhere from three to six months on average.

ERIC WALLACE, Left Hand Brewing Company
We age for around six to nine months in order to pick up enough wood to make a difference in the beer.

Do you prefer unused barrels or those from spirits or wine for your beers? What type of oak do you prefer and why?

RON JEFFRIES, Jolly Pumpkin Brewing Company
The majority of our barrels are used spirit barrels, but we like to find barrels that other brewers have already used for extracting the spirit flavors. We're looking for more of a clean note, rather than the spirit. We actually have a lot of barrels from Firestone Walker Brewing Company in Paso Robles, California. New barrels are expensive, so there is that factor, but we also like the used barrels because we are looking for a home for wild yeast. Chances are, there may be something already in a used barrel when we get it. We use many barrels with all different kinds of

oak — German, Austrian, U.S. and French — and they are all different and unique. But we don't age our beers in specific barrels for certain oak characteristics like you would for wine. Once the barrels are reused, the oak flavors imparted on the beer tend to become neutral.

VINNIE CILURZO, Russian River Brewing Company

We use 100% used wine barrels. A part of the Temptation and Supplication is infusing the wine flavors from the barrel into the beer, then there is the minor amount of oak that gets contributed, plus all the flavor of the beer and the funk that has been added.

I've never used a new barrel, but one of these days I plan to get a larger barrel and try it out. I don't personally like spirit barrels, as the liquor that was once in the barrel tends to overpower the funk that we are trying to have come through in the beer's personality.

We tend to use French oak, but we are about to start a new beer called Consecration, which will be aged in used, 100% American oak Cabernet Sauvignon barrels. There is a belief among brewers that French oak is better because it is more porous, so the bugs and critters can stay impregnated in the oak longer and more easily. This may be true, but it will also aid in the barrel more easily picking up *Acetobacter* over time — this is something that I don't like. A little *Acetobacter* adds some nice character to the beer, but it can overrun a beer as well.

STEVE BREEZLEY, Avery Brewing Company

So far we have preferred used wine barrels. We like the character that the previous contents add to our different beers.

SCOTT VACCARO, Captain Lawrence Brewing Company

The choice all depends on the beer you are making. Some styles require the flavor of the spirit that was in the barrel previously and some beers are only aged in the barrel to acquire flavors from the microbes living in the wood. As a general rule, we age our sour beers in wine barrels as opposed to barrels that held spirits such as bourbon or rum, but that is not always the case.

"There is a belief among brewers that French oak is better because it is more porous . . ."

JOHN EGAN, **Stone Brewing Company**
I have only had the opportunity to use barrels that have previously contained spirits or wine. I would imagine unused barrels to be intensely woody and take some blending to make the aged beer palatable. I like French oak and American oak equally. They have different qualities that can be used for different beers.

It's nice to be able to play around with the two types and see which one works best for the type of beer you're working with. American oak tends to be a bit more intense and rough at times, while French oak has a softer, less intense woodiness with some nice vanilla undertones.

ERIC WALLACE, **Left Hand Brewing Company**
French oak barrels used once for red wine is our normal method, but we are always experimenting with new stuff like bourbon barrels and my personal favorite, brandy.

Do you age your beer in wood with the intent to blend?

RON JEFFRIES, **Jolly Pumpkin Brewing Company**
We blend a lot. For example, La Roja is a Flanders-style ale blended from beer in barrels ranging in age from two to ten months. Luciernaga, our pale ale, is actually two separate beers we make specifically to blend at bottling. And Perseguidor, our sour blend, is actually a number of different beers that are blended together and matured up to six months in the barrel. Many of our seasonal ales, like Noel de Calabaza, are also blended.

VINNIE CILURZO, **Russian River Brewing Company**
In many cases, blending only happens if the final beer needs it. If we can bottle it unblended, we will. With Beatification, it will always be blended now because we bottle multiple vintages, just like a Belgian-style Lambic Gueuze. We also always keep some sour, acid beer around if we need to acidify a beer at blending.

STEVE BREEZLEY, **Avery Brewing Company**
We are just beginning to produce enough barrel stuff to begin blending.

SCOTT VACCARO, **Captain Lawrence Brewing Company**
Some beers get blended out of necessity. You need to evaluate each beer on its own merits then decide whether it needs to be blended or it can stand alone.

JOHN EGAN, **Stone Brewing Company**
For the majority of the time, no. I like to fill at least two barrels with the same beer at once so that when it's time to rack them to another tank for carbonation I have enough beer to make it worth the effort. This makes the beer more desirable as well, because it's such a limited quantity. There could be some blending in the future, however.

Do you have any experience using oak alternatives instead of barrels?

RON JEFFRIES, **Jolly Pumpkin Brewing Company**
I don't have any experience with oak alternatives, and I don't think I plan to try them. I feel that there's really no comparison to barrel aging. Certainly it is possible to make some fantastic beers with the alternatives, but that's just not the same as the revivalist style of brewing that we do here.

VINNIE CILURZO, **Russian River Brewing Company**
Back when I had Blind Pig Brewing Company in Temecula, California, we actually added oak chips to every batch of Blind Pig IPA. We also added them to our Double IPA and Barleywine. Natalie (my wife) and I now own the trademark for Blind Pig again and we make Blind Pig IPA. When people ask me what the difference is between the recipe from now and then, I always forget to say that we don't use the oak chips now.

We recently made Batch 23 Damnation, which was a supped-up version of Damnation, our Belgian-style strong golden ale. We took it up to 11% ABV, changed the base malt, changed the hops around, and aged it on oak chips. The oak came though nicely and the beer was so well received that I think I will make this beer the same way for every 23rd bottling of Damnation.

STEVE BREEZLEY, **Avery Brewing Company**
In our 15% ABV Samael's Oak Aged Strong Ale we use a blend of different oak chips in the conditioning tank with great results. When we started brewing this beer (and to this day) we did not have the barrel capacity to produce the 700 or so odd cases that are ordered annually.

JOHN EGAN, **Stone Brewing Company**
Yes, quite a bit actually. I have used oak chips, some very fine oak dust, and I've got some infusion spirals to try out soon as well. Oak alternatives are a great option for the homebrewer, as barrels can be quite pricey.

ERIC WALLACE, **Left Hand Brewing Company**
We have experimented with oak chips for some of our beers.

At what point do you think it's best to introduce your beer to the wood?

RON JEFFRIES, Jolly Pumpkin Brewing Company
I really hesitate to say "best" about anything, because it depends on what you are looking for in the finished beer. Firestone Walker actually ferments some in the oak, for example, but we put our beer in the barrels after primary fermentation.

VINNIE CILURZO, Russian River Brewing Company
For most of our barrel beers, we will finish a beer with either fining or filtration and then put it in wood. I like putting fairly clean beer into the barrel. With that said, though, now that Beatification is spontaneously fermented, it stays in the barrel for 24 months and we don't take it out until it is ready to bottle. So, it is sort of a mixed bag for us. There are no real rules.

STEVE BREEZLEY, Avery Brewing Company
We have experimented with full fermentation in the barrel to aging filtered, finished beer. Most of our stuff has been fermented but is very young when we transfer it to oak. Having some yeast present obviously helps the beer age, so we try to achieve a reasonable cell count before racking.

SCOTT VACCARO, Captain Lawrence Brewing Company
The best time to introduce the beer is after primary fermentation is complete.

JOHN EGAN, Stone Brewing Company
It depends on the beer and what you're looking to get out of the wood/beer aging. Most of the time I'll rack the beer into the barrels after fermentation is complete and the beer is chilled and fairly bright. Other times, I'll introduce the beer towards the end of fermentation and place an airlock on the barrel to let it finish its fermentation in the barrel.

ERIC WALLACE, Left Hand Brewing Company
I think after fermentation is the best.

Do you reuse barrels after you've aged a batch?

RON JEFFRIES, Jolly Pumpkin Brewing Company

Reusing barrels is the way that we are able to build up the wild yeast populations, which is why we use the barrels.

VINNIE CILURZO, Russian River Brewing Company
We have sort of our own barrel program, which goes like this: for Temptation, Supplication and soon Consecration, all of those beers are aged in specific barrels with a specific wine type in them. Because we intend to pull some of the wine flavor from the barrel, it is important for us to bring in fresh barrels every year. With these three beers, we tend to call out 40% of the barrels each year and bring in 40% new barrels (that is, new to us). Then, we take the old barrels that have absolutely no oak or wine left in them and move them over to the Beatification, which we want to have no oak or wine flavor. With Beatification, we are only using the wood to harbor the funk.

In our new brewery we are building right now, I'm having trouble getting white wine barrels, and for some reason I have been overrun with Pinot Noir barrels from all of my winemaker friends. So, as it looks, in late 2009, we'll have lots of Supplication and very little Temptation. Once we use up the barrels over the following few years, a lot of these barrels will be turned into Beatification barrels.

STEVE BREEZLEY, Avery Brewing Company
Yes. We especially like some of our wine barrels that have developed certain sour producing bacteria and we use that to our advantage aging some of our wacky "Belgiany" stuff.

SCOTT VACCARO, Captain Lawrence Brewing Company
Sometimes we reuse barrels, but usually for sour beers only.

JOHN EGAN, Stone Brewing Company
I like to use the barrels several times and make notes on how much oak character is still left. Most often I will rack the beer out of a barrel and refill it with another beer on the same day. Even if barrels are spent of any oak character, they can still be put to good use. You can add oak alternatives, funky wild yeasts — or use them in your garden for decoration.

ERIC WALLACE, Left Hand Brewing Company
We use our barrels a few times – until wood flavor dissipates.

What advice can you give a homebrewer who would use a small barrel or oak chips to achieve similar aging results?

RON JEFFRIES, Jolly Pumpkin Brewing Company
With the emergence of more barrel-aged styles, we get this question a lot. I have two pieces of advice. First, these types of barrels can leak or seep, which can look like amber oozing out. You don't really know if the barrel is going to leak or not, so I recommend storing the aging beer in a

place that you can clean, and not, say, in a closet. Second, the oak in smaller barrels is much thinner so the oxygen diffusion is much different. This will likely cause more rapid maturation, so you really need to keep an eye on it. One thing we've learned from our larger barrels is that when the beer is ready to bottle, you better get it out of there.

VINNIE CILURZO, Russian River Brewing Company
The problem with a small oak barrel is that you get too much oxygen diffusion because the oak staves are thinner than, say, a 60-gallon (227-L) wine barrel. A Belgian friend of mine who makes lambic beer just emailed about barrels but he wanted larger used wine barrels, something like 100 or 120 gallons (379 or 454 L). This is because there is less oxygen diffusion as the barrel gets larger.

For the homebrewer, he or she needs to watch the O_2 uptake and consider only aging in the small barrel for a maybe six months. Then maybe move to a keg or a carboy to finish.

I love the idea of using oak chips to move the funk from one batch to another. For those that heard me speak at the AHA conference in Denver or at the NorCal Homebrewers Fest, I have my "dime bag of oak chips" with some bugs and critters from Russian River. It is a concept.

STEVE BREEZLEY, Avery Brewing Company
A few oak chips go a long way, so be careful. I know some people have soaked oak chips in whiskey to disinfect and potentially add flavor, but I haven't heard of anybody doing that with wine, which on the small scale would be fun.

Oak chips are also a great idea if you are mixing in any bugs to the equation, because if you get *Brettanomyces* or other critters in any small barrels, they're probably there for good.

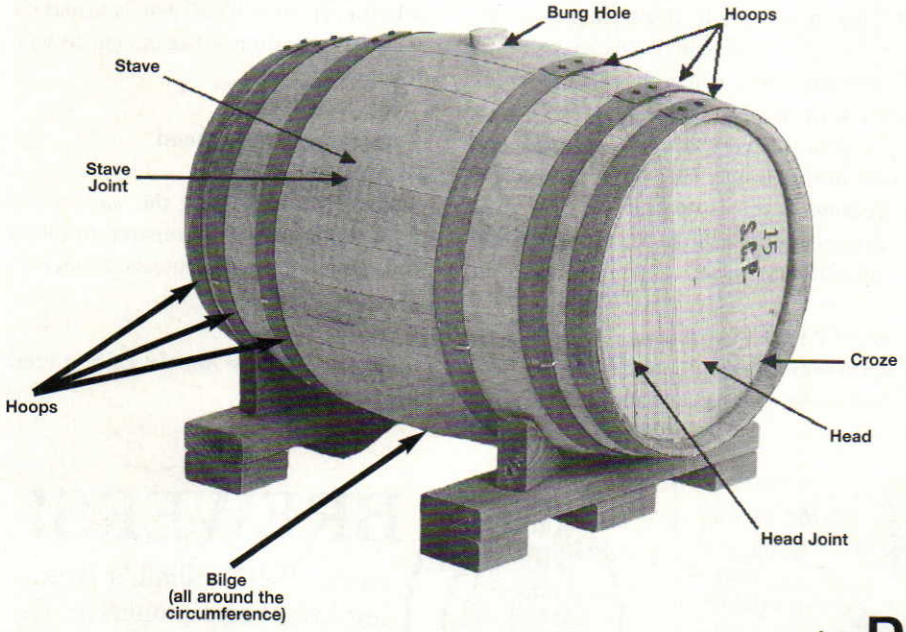
SCOTT VACCARO, Captain Lawrence Brewing Company
You need to have a second batch of the same beer ready to blend with the oak-aged beer, just in case the intensity of the barrel is too much. Start with a small amount of chips and work your way up until you get the desired amount of flavor. It may take a few batches, but the results will be worth it.

JOHN EGAN, Stone Brewing Company
Go easy at first! Experiment, have fun, and be patient. Don't rush the wood aging. Let it do its thing, taste it every once in awhile, and when you feel it's ready to keg or bottle, go for it. It's all sensorial and it's your beer, so when it tastes right to you, drink it!

ERIC WALLACE, Left Hand Brewing Company
Go for it! Taste it along the way so you don't overdo it, or be prepared to blend the aged batch with unoaked beer to reach a nice balance.

Betsy Parks is the Assistant Editor of Brew Your Own *magazine.*

KEEPING IT CLEAN



Barrel maintenance for those who don't know their bilge from their bung hole.

by **Daniel Pambianchi**

Beer and barrels just seem to go together — at least in some drinking songs. However, in modern breweries, beer is usually found in stainless steel vessels. These days, why would you store beer in a vessel with a potential for sanitation issues, that slowly lets in oxygen as the beer is aged and can't hold pressure? There are a couple possible answers to this question. Some brewers age their beer in bourbon barrels to impart a mixed oak and whiskey flavor to their beers. (See the October 2006 issue of BYO for more on using bourbon barrels.) Others brew sour beers and the "bugs" in the wood and oxygen permeability might be just what they are looking for. Finally, some brewers may simply be looking to add a little oak character to a regular (non-sour) beer. This article will explain how to maintain a new, "clean" barrel for oak-aging your beer.

Buying a Barrel

When you first buy a barrel, new or used, thoroughly inspect the interior and exterior of the barrel for any potential problems. Visually inspect the interior by inserting a small light source through the bung hole. Look for any obvious wood defects, wide joint gaps, or excessively charred wood resulting from over-toasting. Toasted wood should have a smooth finish with a uniform brownish color. Charred wood will look damaged and can be easily detected because it has a very dark brown, almost black, color.

On the exterior, ensure that stave and head joints are narrow and tight, hoops are properly fastened, and the bung hole is tapered and not damaged.

New Barrel Maintenance

To minimize maintenance, wait to buy new barrels until you are ready to use them. Otherwise, store empty barrels in a cool and humid area, 55 °F (13 °C) and 65–75 percent humidity, respectively, and away from dampness, to minimize shrinkage.

Protect empty barrels from spoilage organisms by burning sulfur inside the barrels to replace the air with sulfur dioxide (SO_2) gas. Barrels can be stored empty for an indefinite amount of time when properly preserved with sulfur. Once a month, gently sniff the inside of each barrel to determine if any SO_2 gas is still present. If detected, simply replace the bung; otherwise, burn more sulfur. Be sure to work in a well-ventilated area and avoid inhaling SO_2 gas.

A "sulfur bung" for burning sulfur sticks or discs can be used for this purpose. This device — which can be found at most winemaking shops — is used to hold burning sulfur and prevent sulfur deposits from falling into the barrel. Deposits left in the barrel

will interact with beer during aging, causing hydrogen sulfide (H_2S) to form.

To prepare an empty barrel for storage, thoroughly rinse the interior with water and let it drain completely. No puddling of water should remain in the bilge; otherwise, it will cause sulfur dioxide gas to hydrate and form into sulfurous acid.

Light a piece of sulfur stick and deposit it in the metal container at the bottom of the sulfur bung. If using a sulfur disc, place it on the hook over the metal container, and light it. Insert the burning sulfur attachment in the barrel and seat the wooden bung in the hole. The sulfur will burn completely in a few minutes to fill the barrel with gas. Remove the sulfur bung and quickly insert a wooden bung to prevent gas from escaping.

Do not attempt to sanitize a used bourbon barrel in this manner. Alcohol vapors and open flame are a bad combination.

New Barrel Preparation

A new barrel must be swelled with clean water before transferring beer into it; otherwise, it will leak. If beer leaks through stave or head joints, or the croze, there may be considerable loss. There may also be premature oxidation of the beer as air enters the barrel. Eventually, if untreated, mold will form on the exterior surface and will penetrate through the joints to contaminate the beer. By swelling barrels, all joints will tighten to eliminate any possibility of beer seepage and prevent spoilage problems.

You can swell a new barrel using a hot-water treatment or using an overnight water-soaking treatment. First, let all the SO_2 gas out and thoroughly rinse the inside of the barrel with lukewarm water.

The hot-water treatment method is very effective and requires little water. Pour approximately a 20 percent volume of very hot, steamy, clean tap water into the barrel. For example, use three gallons (11 L) of hot water for a 15-gallon (57-L) barrel. Bung the barrel and slosh it around to soak the entire interior surface. The vapor pressure and hot water significantly accelerate barrel swelling and "plug" any seepage through joints. Continue sloshing the barrel until there is no more leakage. Then place it upright and let the head area soak until there is no more leakage. Repeat with the other head area. When done, let the water drain completely and let the barrel dry and cool down before transferring beer into it. If the barrel does not stop leaking within one hour of pouring the hot water, proceed with an overnight treatment.

The overnight treatment should fix any leakage unless the barrel is defective. However, it will leach out some of the oak flavor owing to the longer soak period. This is fine for new barrels because you may want to reduce the amount of oak that will be imparted to that first batch of beer.

Fill the barrel to the top with cool water and let it soak overnight. Initially, the barrel may leak but it should stop after a few hours or a day. The soak period should never exceed 24–36 hours with the same water to avoid mold developing and penetrating the barrel. If there is still leakage, refill the barrel and repeat until leakage stops. If leakage does not stop after four to five days, the barrel is defective and should be returned to your supplier. When leakage has stopped, drain the water out of the barrel by placing it in the bung-down position. Let the barrel stand for an hour or two and then fill it immediately with beer.

The barrel's exterior surface requires no special preparation, although you should inspect it regularly for any mold.

Used Barrel Maintenance

Used barrels must also be properly stored and maintained; however, since these previously contained beer or another liquid, a different maintenance program is recommended.

If used barrels are to be stored empty, rinse them several times with clean water, and drain. If left empty, the barrel wood will dry and shrink over time, and will therefore require to be swelled again when transferring beer into it. An effective alternative is to fill and store barrels with a sulfur-citric holding solution. This holding solution will promote sanitation, keep the barrels swelled and smelling sweet. It is not recommended for new barrels, barrels less than one year old or barrels previously holding spirits such as bourbon since precious oak or other flavors would be stripped.

The holding solution is prepared using 1 tsp of citric acid and 1.5 tsp of potassium metabisulfite for each gallon (4 L) of barrel volume. Dissolve these in one gallon of hot water. Fill the barrel two-thirds with water, add the holding solution, top up the barrel with cool water, and bung the barrel. Top up the barrel with a holding solution once a month to replace lost solution. The barrel can be stored indefinitely without the risk of spoilage. During storage, rotate the barrel 45° in either direction every time you top up to keep the bung area soaked. This will prevent the bung area from drying out and protect it from spoilage organism growth. The sulfur-citric holding solution will etch a concrete floor. Rinse the floor with water to prevent this.

Used barrels require no special preparation beyond a simple water rinse, if desired, when transferring beer out and in immediately. If the barrel has been stored with a holding solution, drain the barrel and rinse it thoroughly with clean water before transferring beer into it.

Barrel "Bugs"

Sanitation can be a problem with oak barrels. *Penicillium* mold — a blue-green fungus — is the most common spoilage problem and can be very difficult to eradicate. Typically, it will grow through joints or around the bung hole in barrels that have not been properly swelled. The "usual suspects" may also inhabit the wood in a barrel. These include *Acetobacter* (especially in barrels that are not topped up regularly), *Brettanomyces* (which can subsist on the wood cellulose sugars in new barrels), *Lactobacillis* and *Pediococcus*.

To treat any of the above spoilage problems, prepare an alkaline solution by dissolving either sodium carbonate or sodium percarbonate in water at a rate of 1 tsp per gallon (or use 1 g/L) for mild spoilage problems or up to a maximum of 3 tsp for more serious problems. Fill the barrel two-thirds of the way with water, add the solution to the barrel and then top up with water.

Let the barrel soak overnight, empty it and neutralize any remaining alkaline residues using a citric acid solution. Prepare the citric acid solution by dissolving citric acid powder in one gallon of water. Use 1 tsp of powder for each gallon of barrel volume. For example, dissolve 15 tsp. for a 15-gallon (57 L) barrel.

Armed with these techniques, you'll be able to "roll out the barrel" whenever you wish to wood-age a beer.

by **Glenn BurnSilver**

The idea of putting beer into wooden barrels is nothing new. The practice has been chronicled as far back as the mid-1400s in Europe. Beer was traditionally made and stored in wood barrels because there was not a better storage solution. However, much of the time, the inside of the barrel was lined with pitch, so the beer would not interact with the wood (or the microbes living in it.)

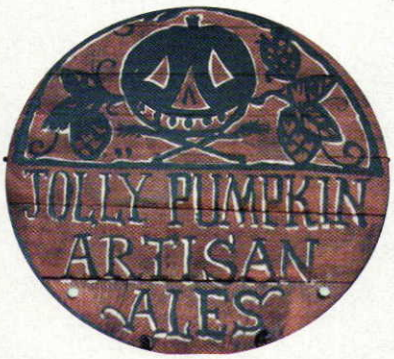
Today, things are heading full circle as the barrel concept is again gaining in popularity. Microbrewers are exploring the Old World methods of brewing. This is not to say such methods ever disappeared. Numerous breweries in Belgium, such as Rodenbach, have been brewing this way for hundreds of years.

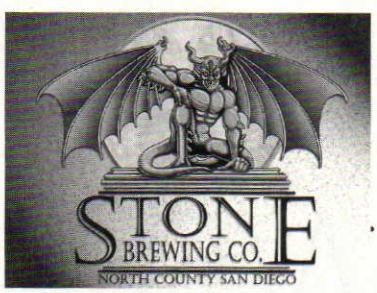
In the United States, a wood barrel revolution is just getting underway. These days, when superior beer storage materials — such as stainless steel — exist, barrel aging is chosen specifically for the possibility of wood flavors being imparted to the beer, the influence of wood-borne microorganisms or factors such as the slight oxygen ingress over time. (Or, for all three.) And of course, when microbreweries open up their creative taps, homebrewers

WOOD BEER CLONES

five barrel-aged brews

an old practice made new again





always follow. (And vice versa.) *Brew Your Own* tracked down five commercial microbrewers that have embraced the use of barrels and picked their brains for some choice recipes and tips for successful barrel aging.

The first thing all agree on is creating a solid base beer. As noted by the variety of recipes presented here, anything from IPAs, porters and stouts to barley wine can be aged in barrels. And of course, barrel aging is the method of choice for sour beers.

Whether you should ferment in the barrels or fill with finished beer is a matter of debate. Vinnie Cilurzo at Russian River Brewing, Zac Triemert of Upstream Brewing and Ron Jeffries Jolly Pumpkin Artisan Ales all ferment some of their creations in the barrels. On the other hand, Lauren Salazar at New Belgium Brewery — home to La Folie and two other barrel-aged beers — believes it's important that the beer is truly finished and filtered or fined to remove any yeast that could continue the fermentation process in the barrel.

"You want a really clear beer to go into the barrel. Finished product — always!" she says. "You want to age in the barrel with a minimum of additional fermentation."

"It is a pain to rack barrels, so we tend to try and get the beer as yeast free as possible," Ro Guenzel, a brewer at Left Hand Brewing adds. "I have heard of breweries fermenting in the barrel, but I think this would be very messy and not really effective."

But before the beer goes into the barrel, you have to decide which type of barrel is right for the final flavors you hope to achieve. Barrels can be bought new or used. Some brewers have recently begun experimenting with Chardonnay barrels, while used Pinot Noir and Cabernet Sauvignon barrels have been employed for years. Whisky and bourbon barrels are also used frequently. Each time a barrel is used, some of the wood flavors and aromas are removed. A barrel that has been used multiple times is sometimes referred to as "neutral" because it will no longer confer any oak character. It may still be useful, however, if you want to age your beer in a container that will "breathe." Conversely, if a strongly flavored product — such as bourbon — has been aged in the barrel, this flavor will be imparted to the beer aged in that barrel. The origin of the barrel wood is also important. French, Hungarian and American oaks all offer different flavor and aroma components.

"We want to make sure that the beer will be complemented by the oak, not overwhelmed," Mitch Steel of Stone Brewing says. "From our perspective, the age of the barrel, how many uses it's been through, and what was aged in it previously are all important considerations."

One difficulty the homebrewer faces is the need for smaller barrels. Standard wine barrels hold 55 gallons (208 L). Smaller barrels are easy to find, but their higher surface-to-volume ratio means that beer can get "over-oaked," especially when the barrel is new. But, if you are lucky enough to find small used wine or bourbon barrels,

the beer most likely can age longer and pick up more subtle aspects.

Once the beer is in the barrel it's important not to rack beer until it is finished. The beer needs to sit in the same barrel for its entire barrel-aging period. It's also important not to peek into the barrel too often. Steele says at Stone beers are checked once a quarter, which works fine since most of these brewers state their creations age from 10 months to several years. That won't be the case with smaller barrels, and especially newer barrels that can flavor a beer more quickly and will need to be checked a little more frequently.

Sour Beers

When making a sour beer, the microorganisms in the wood — especially *Brettanomyces* — and the slow "breathing" of the barrel contribute to the character of the beer. Because of this, however, you may want to have some beer on hand for keeping the barrel topped up over the long aging process.

"Patience is an important component, not only waiting long enough to let the bugs and critters do their thing, but also not getting into the barrel every day getting a sample will make a better beer," Cilurzo says. "The pellicle that floats on the top of the beer shouldn't be disturbed if at all possible."

"Let happy bugs be," Salazar agrees.

And always remember, once you've used a barrel to make a sour beer, every beer you put in it will become sour.

While brewing with barrels today won't be as rudimentary as it was hundreds of years ago, the process and feeling really isn't all that different. For many brewers, that is part of the finished product.

"Barrels are one of the last great pieces of ancient brewing equipment we use today," Salazar says with a touch of nostalgia that complements her love of brewing. "It's easy to get swept back in time when everything was simpler, when we respected beer and enjoyed every moment, every sip. It just feels right."

And if everything goes as planned, every moment will be enjoyed; every singe barrel-aged sip.

Glenn BurnSilver is a frequent contributor to Brew Your Own.

Barrel-Aged Clone Recipes

Temptation clone (Russian River Brewing Company)

(5 gallons/19 L, all-grain)

OG =1.064

FG = 1.012 (going into the barrel)

IBU = 28 SRM = 4 ABV = 6.7%

"When we fill the used Chardonnay barrels, we only add Brettanomyces *in with the beer as we are filling the barrels. The acidity comes from the bacteria that are floating around our barrel room. We add no* Lactobacillus *or* Pediococcus *to the beer because our barrel room is so alive with this stuff. When we make the final blend post barrel aging, we then blend in some Beatification to bring the acidity up if necessary. To achieve the acidity as a home-brewer, you'll need to add some* Lacto *and* Pedio."

— Vinnie Cilurzo

Ingredients

12 lb. 6 oz. (5.6 kg) 2-row pale or Pils malt

10 oz. (0.28 kg) wheat malt

3.8 AAU Styrian Golding hops (90 min) (0.76 oz./22 g of 5% alpha acids)

4.5 AAU Sterling hops (30 min) (0.56 oz./16 g of 8% alpha acids)

4.5 AAU Sterling hops (0 min) (0.56 oz./16 g of 8% alpha acids)

Wyeast 1214 (Belgian Ale) or White Labs WLP550 (Belgian Ale) yeast

Wyeast 5112 (*Brettanomyces bruxellensis*) or White Labs WLP650 (*Brettanomyces bruxellensis*) yeast

Wyeast 5335 (*Lactobacillus*) or White Labs WLP677 (*Lactobacillus*) bacteria

Wyeast 5733 (*Pediococcus*) bacteria

1 cup corn sugar (for priming)

Step by Step

Mash at 154 °F (68 °C). Boil for 90 minutes. Ferment at ale temperatures. Fine beer post fermentation. Add a 1 pint *Brettanomyces bruxellensis* starter. At Russian River, we get the *Lacto* and *Pedio* from the air or blending post barrel aging. For homebrewing purposes, add a 0.5 pint (240 mL) *Lactobacillus* starter and a 0.5 pint (240 mL) *Pediococcus* starter. You can also try to culture them from a bottle of Temptation. Age for 12–15 months. Bottle condition or force carbonate. Remember that if you are bottle conditioning, you'll need to add more sugar than normal, probably 1 cup of sugar per 5 gallons (19 L). This is because the beer has lost all of its CO_2 during the barrel aging. It is as still as wine when it comes out of the barrel.

Extract option

Reduce Pilsner malt to 1.38 lb. (0.62 kg). Add 2.5 lb. (1.1 kg) Briess Light dried malt extract and 4 lb. 12 oz. (2.2 kg) Coopers Light liquid malt extract. Steep grains in 3 qts. (~3 L) of water at 154 °F (68 °C) for 45 minutes. Rinse with 1.5 qts. (~1.5 L) of water at 170 °F (77 °C). Add water to make 3 gallons (11 L), add dried malt extract and bring to a boil. Boil for 60 minutes, stirring in liquid malt extract for final 15 minutes of boil.

La Roja clone (Jolly Pumpkin Brewing Company)

(5 gallons/19 L, all-grain)

OG = 1.062 FG = will vary

IBU = 25 SRM = 21 ABV = around 7%

"This one of our signature beers, if you will. It is loosely based in the Flanders sour red tradition."

— Ron Jeffries

Ingredients

8 lb. 5 oz. (3.8 kg) blend of Pils and pale malts

1.0 lb. (0.45 kg) malted wheat

1 lb. 4 oz. (0.57 kg) Munich malt (10 °L)

13 oz. (0.37 kg) crystal malt (120 °L)

0.50 oz. (14 g) black malt

1 lb. 2 oz. (0.51 kg) dextrose (added to kettle)

4 AAU Hallertau hops or other noble hop (60 min) (1.0 oz./28 g of 4% alpha acids)

4 AAU Hallertau hops or other noble hop (30 min) (1.0 oz./28 g of 4% alpha acids)

Wyeast 3763 (Roeselare Ale) blend

1 cup corn sugar (for priming)

Step by Step

Mash at 154 °F (68 °C). Boil for 60 minutes. Ferment at ale temperatures, then rack to barrel for aging.

Extract option

Omit pale and Pilsner malts. Add 1.0 lb. (0.45 kg) Muntons Light dried malt extract and 4 lb. 14 oz. (2.2 kg) Muntons Light liquid malt extract. Steep grains in 4.6 qts. (4.4 L) of water at 154 °F (68 °C) for 45 minutes. Rinse with 2.3 qts. (~2.2 L) of water at 170 °F (77 °C). Add water to make 3 gallons (11 L), add dried malt extract and bring to a boil. Boil for 60 minutes, stirring in liquid malt extract for final 15 minutes of boil.

Darth Porter clone (Stone Brewing Company)

(5 gallons/19 L, all-grain)

OG = 1.076 FG = 1.019

IBU = 63 SRM = 51 ABV = 7.3%

"Don't be afraid to use a barrel that has already been through many uses. There is more to the barrel aging process than extracting wood and bourbon, brandy or wine flavors."

— Mitch Steele

Ingredients

13 lb. 10 oz. (6.2 kg) Pilsner malt

12 oz. (0.34 kg) chocolate malt

8.0 oz. (0.23 kg) Caramunich® malt

8.0 oz. (0.23 kg) crystal malt (90 °L)

4.0 oz. (0.11 kg) black patent malt (or Carafa® malt)

13.5 AAU Perle hops (60 mins) (1.5 oz./43 g of 9% alpha acids)

6.5 AAU Hallertau hops (30 mins) (1.0 oz./28 g of 6.5% alpha acids)

0.5 oz. (15 g) Hallertau hops (15 mins)

Wyeast 2206 (Bavarian Lager yeast) or White Labs WLP820 (Octoberfest/Märzen Lager) yeast

1 cup corn sugar (for priming)

Step by Step

Mash at 154 °F (68 °C). Boil wort for 60 minutes. Ferment at ale temperatures, then rack to barrel and age six months to a year (or more). Pull samples from all of your barrels every few months and taste them.

Extract option

Omit Pilsner malt and add 3.25 lb. (1.5 kg) Briess Light dried malt extract and 5.75 lb. (2.6 kg) Weyermann Pilsner liquid malt extract. Steep grains in 3 qts. (~3 L) of water at 154 °F (68 °C) for

45 minutes. Rinse with 1.5 qts. (~1.5 L) of water at 170 °F (77 °C). Add water to make 3 gallons (11 L), add dried malt extract and bring to a boil. Boil for 60 minutes, stirring in liquid malt extract for final 15 minutes of boil.

Grand Cru clone (Upstream Brewing Company)

(5 gallons/19 L, all-grain)

OG = 1.087 FG = will vary

IBU = 30 SRM = 6 ABV = around 9.0%

What's the secret to making a good barrel aged beer? "Good wood, great beer, a little imagination and lots of patience."

—Zac Triemert

Ingredients

13 lbs. (5.9 kg) Weyermann Pils malt

2.5 lbs. (1.1 kg) Weyermann Wheat malt

11 oz. (0.32 kg) Belgian sugar

11 oz. (0.32 kg) honey

5 AAU Liberty hops (60 mins)
(1 oz./28 g of 5% alpha acids)

4 AAU Saaz hops (30 mins)
(1 oz./28 g of 4% alpha acids)

1 oz. (28 g) Saaz hops (0 mins)

White Labs WLP500 (Trappist Ale) or Wyeast 3787 (Belgian Trappist Ale) yeast

1 cup corn sugar (for priming)

Step by Step

Mash at 149 °F (65 °C) for 75 min. Boil for 100 minutes. Ferment at ale temperatures. After primary fermentation, diacetyl rest for two days, then cool and filter. After filtration, add the beer to a well-used 5-gallon (19-L) barrel with 50 g *Brettanomyces anomalus* (or substitute White Labs WLP645 (*Brettanomyces claussenii*) bacteria) and 50 g boiled malt extract. Let the beer mature for a year or more depending on your individual taste. However, please note that a new 5-gallon (19-L) oak cask will not work for this application. New wood and high surface area to volume ratio will significantly overoak the beer.

Extract option

Omit Pilsner malt. Add 2 lb. 4 oz. (1.0 kg) Briess Light dried malt extract and 6 lb. 10 oz. (3.0 kg) Weyermann Pilsner liquid malt extract. Steep grains in 3.8 qts. (3.6 L) of water at 149 °F (65 °C) for 45 minutes. Rinse with 1.9 qts. (1.8 L) of water at 170 °F (77 °C). Add water to make 3 gallons (11 L), add dried malt extract and bring to a boil. Boil for 60 minutes, stirring in liquid malt extract for final 15 minutes of boil.

La Folie clone (New Belgium Brewing Company)

(5 gallons/19 L, all-grain)

OG = 1.062 FG = 1.015 (or lower)

IBU = 20 SRM = 17 ABV = 6.0%

"Never turn your back on (the barrels). They like to change on you and right when you think

you know what one will do, it does the exact opposite."

—Lauren Salazar

Ingredients

9.75 lbs. (4.4 kg) 2-row pale malt
1 lb. 5 oz. (0.60 kg) Munich malt
1 lb. 5 oz. (0.60 kg) crystal malt (60 °L)
10 oz. (0.28 kg) unmalted wheat
5.7 AAU Cantillion Iris hops (60 mins) (or any neutral hop) (1.9 oz./54 g at 3% alpha acids)
Wyeast 1056 (American Ale), White Labs WLP001 (California Ale), Fermentis Safale US-05 or Danstar Nottingham yeast
Wyeast 3278 (Lambic blend) or White Labs WLP655 (Belgian Sour Mix 1) blend
1 cup corn sugar (for priming)

Step by Step

Mash at 154 °F (68 °C). Boil for 60 minutes. Ferment with neutral ale yeast at 75 °F (24 °C), then rack to barrel and add sour blend. Aging time is totally up to the barrel. This is where years of tasting and blending come in handy. If you want to blend, try ~ 20% of a sweeter (younger) barrel, ~30% of a nice mild sour barrel and ~50% of a well established "tour gripper" with nice oak notes (cherries, horse blanket, etc). (Young usually means ~ 1 year, mid range ~2 years and grippers are 3+ years.) But there are no rules here. Do whatever works for you.

Extract option

Omit 2-row pale malt. Add 1 lb. 14 oz. (0.85 kg) dried malt extract and 4 lb. 10 oz. liquid malt extract. Steep in 4.8 qts. (4.6 L) of water at 154 °F (68 °C) for 45 minutes. Rinse with 2.4 qts. (2.3 L) of water at 170 °F (77 °C). Add water to make 3 gallons (11 L), add dried malt extract and bring to a boil. Boil for 60 minutes, stirring in LME at end of boil.

Poor Man's Barrel Option:

Don't have the budget (or room) for a barrel? Try this "poor man's" method of emulating some of the aspects of barrel aging. Conduct your primary fermentation in a bucket or ferment the beer with ale yeast, then rack it to a bucket — adding any "bugs" that may be called for. Buckets are more permeable to oxygen than barrels are, so let the beer condition in the bucket for only about 3 months, then rack it to a carboy for the remaining conditioning time. Two weeks before racking, take 3.0 oz. (85 g) of oak cubes (French oak, medium toast) and soak them in wine. Use Chardonnay for the Temptation clone, Pinot Noir for La Roja, Cabernet Sauvignon for Darth Porter and Burgundy or Meritage for Grand Cru and La Folie. Change wine every 3 days to lessen the intensity of the new oak. Add cubes when beer is racked to carboy.

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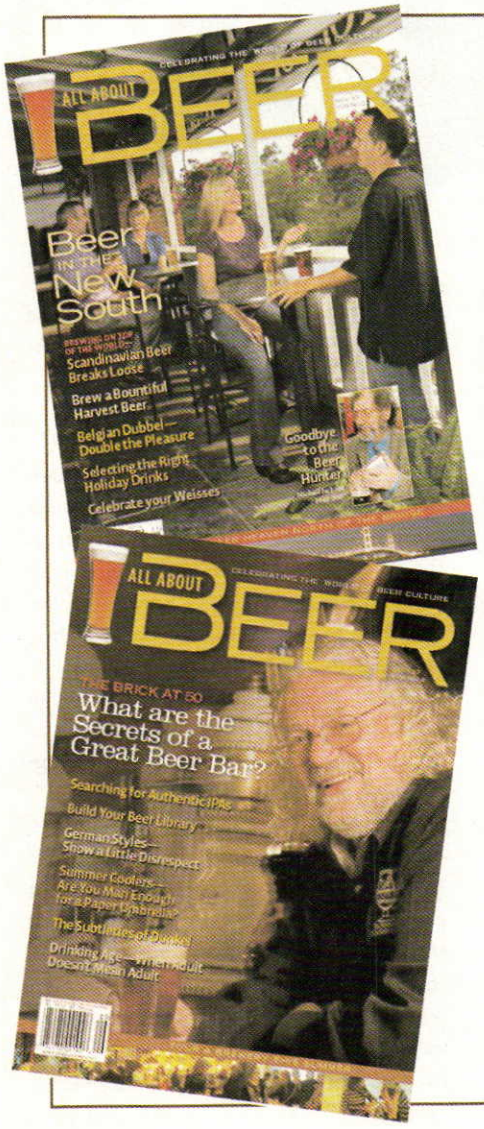

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CELEBRATING THE WORLD OF BEER CULTURE

Photo courtesy of Northern Brewer

oak alternatives

by **James Alexander**

Oak barrels are great, but they're not for everyone. They're expensive, they take up a lot of room and they need to either be constantly filled and topped up with beer or undergo periodical maintenance to keep them usable. For the serious wood-beer brewer, these aren't going to be an obstacle; but what if you'd like to experiment with wood and beer, but aren't sure if you want it to become a big "thing." If so, try these alternatives for easy, affordable oaking of your brew.

Oak Essence and Powder

Two easy ways to get oak character in your beers are to add oak essence or oak powder. These options quickly impart their flavors. Oak essence, such as Sinatin 17, is a liquid and only needs to be stirred in. Oak powder can be stirred into beer, and once it has settled, all the oak character will be extracted. (The quick extraction is due to the high surface area to volume nature of powder.) In both cases, the package will give dosage recommendations for wine and this usually amounts to a couple ounces per 5 gallons (19 L). Generally, you will want to add less for beer than for wine, but the amount is really up to you. With both these options, you can add a small amount in secondary, taste the beer and add more if desired. Although these options are very quick, the quality of oak character derived from them is variable. Most homebrewers who use alternative oaking methods use chips, cubes or larger pieces of wood.

Oak Chips

Oak chips are an old standby for winemakers and a good option for brewers looking to impart some oak character to their beer. They are available in French oak, which gives a "refined" oak character, and American oak, which has a slightly more aggressive edge to it. They are also available at different levels of toast. In beer, you can add from 0.5 oz. (14 g) to 2.5 oz. (71 g) to your beer. Full extraction occurs in about two weeks.

Oak Cubes

Many winemakers, who have had a lot of experience with oak, feel oak cubes are a step up from chips. Oak contains volatile compounds that evaporate from chips and powder because of their higher surface to volume ratio. To confirm this for yourself, cut a piece of oak and smell the freshly-

oak lternatives

cut surface. Compare it to the older surfaces. Chips and sawdust have lost virtually all of what you smell from the freshly cut surface long before you buy them. In addition, powder often causes beer to foam and in some cases takes a while to settle completely.

Oak cubes are available in American, Hungarian and French oak at various levels of toast. Research has shown that wine penetrates about 6 mm into the oak staves of a barrel, and we would expect beer to do the same. Light toast is a surface treatment with no measurable depth; medium toasting penetrates 2 mm into the wood and heavy toasting reaches 3–4 mm in depth. Oak cubes are about 6 mm on each side, providing enough depth for heavy toasting and ensuring full flavor extraction. The toasting is intentionally varied over the surface to provide a broader spectrum of flavors.

The amount of cubes to add to a 5-gallon (19-L) batch of beer is the same as with chips, but the extraction of oak character is slower. You will need to age your beer for 4–6 weeks to get the most from the cubes. This obviously allows for the option of periodically sampling your beer and racking away from the cubes when you reach an amount of oak that is pleasing to you.

Staves and Spirals

Most home winemaking shops will carry powder, chips and cubes. Some may also carry staves or "infusion spirals." Staves are just the sides of a barrel and spirals are specially-cut pieces of wood. Spirals provide a surface-to-volume ratio that is less than cubes, but much greater than than a full barrel.

If you use a whole stave or spiral in a 5-gallon (19-L) batch of beer, you will add considerably more wood (by weight) to your beer. Your control over the level of oaking will come from the contact time with the beer. It takes about 20 weeks to fully extract the desired oak characteristics from a spiral, and longer still for a stave. Of course, these can be used for shorter amounts of time to oak several batches of beer sequentially. With each reuse, the oak character will get less intense and will take longer to extract. The "full-on" oak character from a fresh piece of wood will stand up nicely to big, fully-flavored beers, but a subtle hint of oak from a well-used piece of oak may be just the thing for some session beers.

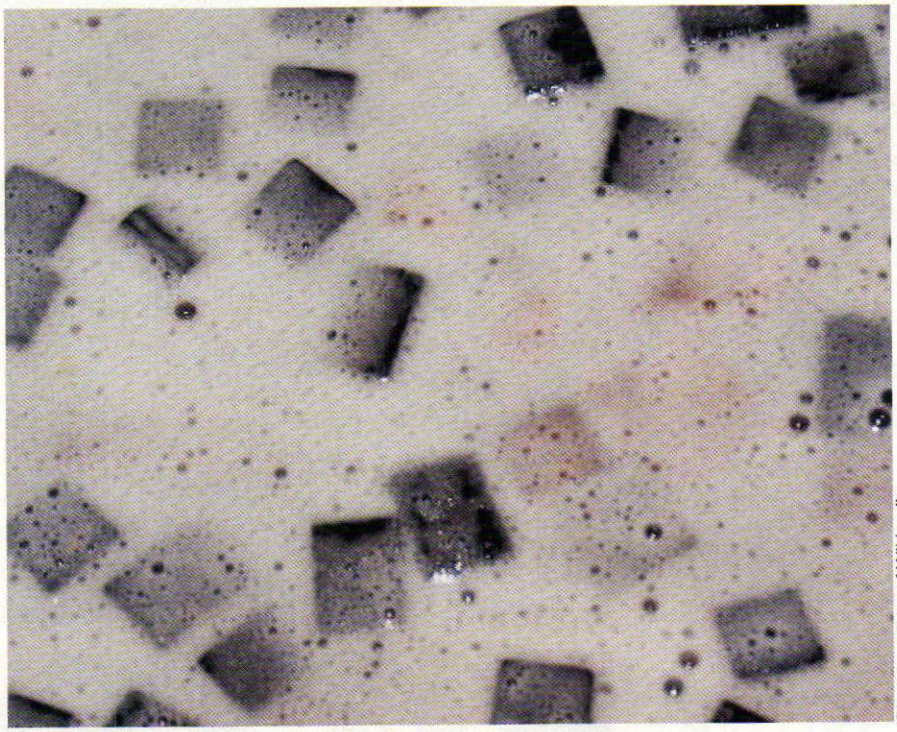

Photo courtesy of Wikipedia

Oak cubes, 6 mm on their sides, are a good compromise between chips and bigger chunks of wood (or barrels). Extraction time occurs in weeks, not months, but they are not generally reused, as staves or spirals can be.

Lumber for Your Lager?

It is important that you do not use oak lumber in your beer. Lumber has additives to reduce cracking and warping during the drying process that you don't want in your beer. Shop for your oak at a home winemaking shop, not Home Depot.

Sanitation

When brewing a fruit beer, homebrewers are divided over whether the fruit should be sanitized. And, this argument plays out exactly the same way when talking about oak. If you're brave — and don't want to miss out on any of the delicate oak aromas — just add the wood directly to the beer after primary. If not, soak your oak in 160–170 °F (71–77 °C) water for 15 minutes to sanitize it. You can save the "wood water" to touch up the batch, if needed.

Some brewers also soak their oak alternatives in spirits like bourbon or whiskey to simulate the flavor effect of using a used spirit barrel. If you want to try this method, soak your oak pieces in just enough spirits to cover the cubes (Ziplock baggies are an easy method). Soak for anywhere from 48 hours to two weeks for most common usage. The amount of time you soak is relative to how much flavor you will pick up: less than 24 hours won't yield much flavor, while more than two weeks is probably unnecessary, and likely won't pick up additional flavor.

by Chris Colby

THE BITTER END

The GREAT 2008 HOP SHORTAGE or Dude, Where's My Hops?

By now, you've probably noticed that many of your favorite hop varieties are gone from the shelves of your local homebrew shop. Depending on where you live, you may have also seen price increases in craft beer. If you belong to a homebrew club or read the online brewing forums, you have likely heard that there will be a worldwide hop shortage in 2008. What's going on? At this point, there are still a lot of unanswered questions, but here's the Cliffs Notes version: Due to an unusual confluence of events, hop availability in 2007 fell below the level of demand. Hop prices are going up — way up. Beer prices are also going up. Some hop varieties will be in short supply and others will be unavailable. How will this affect us as homebrewers? Read on.

How the Hop Market Works

To understand the current situation, you need to understand a little about the worldwide hop market. Hop farmers grow some hops under contact with hop merchants or breweries. Under contract, the buyer is assured the delivery of hops (barring crop failure) and the farmer is guaranteed an agreed-upon price for his crop. Additionally, some hops are sold on the open market. The farmer grows them in the hope that there will be enough demand to sell them at a decent price. This year, the US crop of aroma hops did well, although the high-alpha hops came in a little below expectations. Still, the US produced roughly the same amount of hops in 2007 as it produced in 2006. (In fact, US acreage was up by about 5% and total US production was up about 2%.) Yet, we are now faced with a serious shortage of hops — how is that possible?

Think Globally, Hop Locally

"The first thing you need to understand about the hop market is that it's global," says Ralph Olson of HopUnion. The United States exports about 60% of the hops grown here each year. Conversely, we also import a lot of hops. Each year, about 50% of the worldwide hop crop gets converted into hop extract — a liquid alpha acid product. Although hop extract doesn't get used much in craft breweries, and is almost unheard of at the homebrew level, global giants — such as SABMiller, Heineken, Modelo and Brahma — rely heavily on extract. So, what happens on hop farms, in hop markets and in breweries overseas affects the availability of hops here in the United States and Canada.

"The Perfect Storm"

Hops aren't the only commodity with a global market, so how did things get so bad so fast? The story of the 2008 hop crisis starts way back in 1992. Back then — when Jay Leno was taking over for Johnny Carson on the Tonight Show, the movie "Wayne's World" was in theaters and the video game Mortal Kombat made its debut in arcades — worldwide hop acreage hit its all-time maximum at 236,067 acres. Bumper crops led to a great excess of hops, much of which was converted to hop extract, which is stable for years when stored correctly. In the intervening years, this excess was slowly drained away. Often, cans of extract were sold at below cost, because it costs money to keep things warehoused. Farmers continued to grow hops, of course, and these hops continued to be turned into extract. However, each year's new extract was just "thrown on the pile," so to speak.

As this was all happening, hop prices stayed low. In fact, in many years, it cost more to grow hops than they could be sold for, and farmers took a loss. With hops and extract being cheap on the open mar-

MALT PRICES ALSO UP

If you talked to a barley farmer in North Dakota this spring, you may have thought that things would be great for maltsters and brewers this year. North Dakota grew 60% more barley (6-row) than in 2006 and the barley had a low protein content and a high percentage of plump kernels (both of which are good things in malting barley). Unfortunately, this was one of the lone highlights of the year, malt-wise. Overall, barley harvests were down and malt prices are up dramatically.

Like the hop industry, the malt industry is global. And in fact, the story of this year's increasing malt prices shares a lot of similarities with the current hop crisis.

Every year, farmers harvest their grains and sell them at market. At the end of the year, however, some grains are usually left over. The size of these "ending stocks" influences the availability of that grain the next year. Over the past several years, the size of barley ending stocks has decreased. A poor barley harvest in 2006 meant that 2006's ending stocks were the lowest since the 1970's.

Barley is grown in both the Northern Hemisphere - especially in Europe and North America — and the Southern

Continued on page 61

ket, fewer growing contracts were initiated or maintained.

Predictably, farmers began converting hop acreage to more profitable crops or selling their land to developers, especially overseas. By 2006, worldwide hop acreage was down to 113,417 acres.

Some of the reduction in hop acreage was due to higher alpha varieties being introduced and hop products with better utilization being developed. However, low prices were the main culprit. The decrease in hop acreage wasn't planned in any way, it was just a response of individual farmers to market conditions. Sean McGree of Brewers Supply says, "Farmers didn't have any scientific way to calculate how many acres would be needed each year. They were just pulling acres out the ground because of low pricing. It's a classic story of supply and demand."

This year, unusual weather in Europe caused their 2007 hop crop to fall far below expectations. Germany's crop was OK, but the harvests in Czechoslovakia and Slovenia fell 30% below expectations. (Go to YouTube and type in "Slovenia" and "hops" to see a hop farm devastated by a hail storm just prior to harvest.) England's harvest was average, but — although classic varieties such as Kent Golding and Fuggles are popular among homebrewers — hop acreage in the UK has fallen so low (under 2,500 acres) that they no longer have much impact on the global hop trade. While all this was happening, the pool of excess hop extract finally dried up. Olson describes the interaction of events as "the perfect storm."

Why didn't someone see this coming? Well, some folks did. I heard Olson speak about the decrease in hop acreage at the 2006 Dixie Cup (the homebrew conference thrown by Houston's Foam Rangers). But nobody knew when — exactly — the problem was going to come to a head. Why? Because nobody knew how much hop product was in storage worldwide. The glut of hops and extract was all in private hands in warehouses and breweries worldwide. Sharing the details of your inventory is never a good business strategy, so nobody knew when the feast would turn to famine. "As late as March of this year (2007), I had no idea that things would get so bad so fast," says Sean McGree of Brewers Supply. "Nobody had any idea how much was inventory."

As this is being written, the 2007 harvest is in and being processed. Those with contracts to US growers are getting their hops. In Europe, some contracts are going unfulfilled due to poor yields. The rest of the hops on open market are a hot commodity. (Sorry, *were* a hot commodity, they're gone now.) Prices on the open market skyrocketed when people realized that supply would not meet demand. Hops that sold for $2–3 a pound last year ended up selling for up to $26 a pound. And, since the Euro is currently strong versus the US dollar, European brewers had had an economic advantage over their US counterparts. European brewers ponied up the dough and bought up much of the hops on the open market. Some estimates put the hop deficit at 10–15% percent below demand.

"Kiss Cascades Goodbye."

Chris Graham
MoreBeer!

Just as nobody knew exactly when the hop crunch would hit, nobody currently knows the full extent of the problem. Hop dealers and brewers are scrambling to secure hops. Craft brewers that have never known a time when hops weren't available in excess are now wondering about the future of their breweries. The lack of information has led to some serious anxiety, and even some panic, among professional brewers. Others seem to feel that something will occur to make things better. At a minimum, when the 2007 crop gets divvied up and shipped, people will at least know where they stand in terms of hop inventory.

Growers, hop dealers and brewers are all looking for a solution to the problem. New acreage is currently being planted, but it takes 2 years in the US, and 3–4 years in Europe, before new hop acreage will produce harvestable yields. About 5,000 acres were planted in 2007 and potentially another 15,000 acres will be planted in 2008, but getting farmers to convert land to hop acreage can be difficult. Planting new hop acreage requires that the farmer invest in trellises and forego at least a year of producing something they can sell. In addition, a brand new hop farm would additionally require the purchase of the harvesting machines and ovens for drying hops, and these cost millions. And finally, hops are a single use product. If brewers don't buy them, there is no secondary market. As such, most growers want long-term contracts (at least 4–5 years) before they plant new acreage.

The Crystal Ball

Looking forward, most people think 2009 will be worse than 2008 — although, obviously, there are many variables that will affect hop availability. The big variables are, of course, the worldwide demand for beer and growing conditions in 2008. Sometime after 2009, market forces should start bringing the hop crisis under control. (Of course, this could just set up another bubble and we could go through this all again in 10 years. In the long-term, hop prices have shown cycles over time.)

One big wild card in the future hop outlook is China. China's economy is growing quickly, and with it its demand for beer. China grows a lot of hops, but not enough to meet their own needs — and they recently converted some of their acreage to cotton and flax. So, China imports hops and the vast majority of Chinese hops aren't sold outside of China.

If China decided to greatly increase its hop acreage — and look at a map, they have the land — it could easily flood the market with hops in a few years. (And even if the varieties they grow aren't known to us, it could still be converted to extract.) On the other hand, if the Chinese demand for beer increases, but its hop

acreage doesn't grow apace, China could increasingly be buying hops from the US and Europe.

Wait, It Gets Worse

News of a multi-year hop shortage is bad. However, it gets worse. From the standpoint of homebrewers and lovers of craft beer, there is a crisis within a crisis. Many of the hop varieties we most prize as homebrewers are getting squeezed out by varieties that produce higher yields and higher alpha levels. If a buyer is buying hops for extract, he pays the farmer according to the amount of alpha acids the crop provides. Many of the classic aroma hops have not only lower alpha acid levels, but yield less per acre. For example, Hallertau hops yield about 1,000 pounds an acre, with an average alpha acid level around 4%. In contrast, Columbus yields about 3,000 pounds per acre, at an average alpha around 13% — almost 10 times as much alpha acids per acre. To give another example, at current prices, a grower could make $8,500 per acre growing Columbus compared to only $5,200 per acre for Cascade.

So, even as new acreage is being planted, "aroma acreage" is being ripped out and replaced with "alpha acreage." "Aroma hops are in serious jeopardy," says McGree, "aroma acreage is down 12–15% even though craft beer is growing at the rate of 10–12% a year."

At some point, demand for craft beer may cause the prices for aroma hops to increase to the point that planting more aroma acreage will be a financially viable option for farmers. However, in the short term, growers will be focusing on "growing alpha acids." Hop merchants such as Olson and McGree are working to try to convince growers to retain as much aroma acreage as possible and to plant new aroma acreage wherever possible, but it will take strong multi-year contracts to convince farmers to buck the high-alpha trend.

What Does This Mean to Craft Brewers?

So what does this mean for our favorite craft brewers? Brewers with hop contracts for US hops will be OK for the years their contracts cover. For example, Vinnie Cilurzo of Russian River Brewing says, "The hop shortage did not affect us this year.

I've been contracted for some time and in fact, when I heard early in 2007 that there could be a shortage, I purchased any extra varieties that we use that I could get my hands on from last year's crop. We have everything we need and won't have to reformulate anything. As for increased pricing, we have already increased our beer pricing due not only to the hop prices going up, but, also due to malt prices going up." (See the sidebar on page 57 for a rundown on the malt situation.) Ashton Lewis, Staff Master Brewer and Process Engineer for Paul Mueller Company — and also BYO's Mr. Wizard — elaborates, "The current situation with hops totally blows! [Current hop pricing] adds between $8.50 to $17.00 per barrel of beers with assertive hopping. In percentage terms, that's an increase in the cost of raw materials between about 50–100% when you also figure in the increase in malt prices."

Brewers without contracts — mostly small craft brewers and brewpubs — will face significant hardship. Some brewers will have to reformulate their beers, even those brewed with a "signature" hop. Peter Ausenhus, brewer at Worth Brewing in Northwood, Iowa says he will not be getting any of the varieties he has been brewing with and will have to reformulate all of his beers. Ausenhus brews 10 gallons (38 L) at a time on a Sabco Brew-Magic system and his plans to expand to a 7–10 barrel brewery will have to be put on hold. It could be worse. Cilurzo says, "I got a call the other day from a friend saying that he would have to stop brewing at his brewery in January as he wouldn't have any more hops at that point."

Brian Peters, brewer for Billy's Brew and Que in Austin, Texas, says that reformulating recipes is not as big of a deal for brewpub brewers as it is for craft brewers. Peters says, "I wasn't the last guy in the world to find out about the hop crisis, but I think I was second to last. Luckily, none of the beers I brew is 'branded.' Every time I brew an IPA, I give it a different name. As long as my customers have something good to drink, they'll be happy."

End Of The IIPA?

One thing many beer fans have been speculating about is the end of the imperial IPA, the hop bombs that have been very popular in the past few years. As the reasoning goes, higher hop and malt prices will quickly make these beers go the way of the dinosaur, leaving beer lovers to sit around drinking Scottish 60/- or other low-gravity, lightly-hopped ales.

In the short term, this is not likely to happen. Although many brewpubs will quit brewing their biggest, hoppiest beers, microbrewers with branded IIPAs and other aggressively hopped brews are not likely to quit producing them as long as they sell. Certainly, it is reasonable to assume that many breweries may roll out some lighter, less hoppy offerings in an attempt to produce a less expensive product. However, IPAs and imperial IPAs will still be available — at least for awhile.

What Does This Mean to Homebrewers?

As a homebrewer, you are probably wondering what this will mean to you. To be honest, even after hours of interviewing hop merchants, brewers and homebrew shop owners, I'm still wondering the same thing. Although some aspects of this situation are well-documented, some key information is still lacking from the big picture. As such, making any concrete statements about the future is impossible. However, the best consensus picture shows less selection and higher prices for hops over the next few years.

One thing homebrewers need to know is that homebrew shops are at the end of the hop supply chain. Craft brewers who seem huge to us are a drop in the bucket to the global brewing industry; comparatively, we are the amoebas dissolved within that drop. The upside to this position is we don't need a ton of hops to get by.

A Green Xmas . . . and a Hoppy New Year?

When this issue lands in your mailbox or homebrew shop, it will be right in the middle of the holiday season. And, if you stop by your local homebrew shop, you will find — hops! The 2007 hop crop will be mostly processed and distributed by December and all signs point to a "green Christmas." None of the homebrew shop owners I spoke to expected to be out of hops, nor had they heard of any shop that would be. However, almost all of the shops I spoke with did expect to be carrying fewer varieties — in some cases less than half of the varieties they carried in 2006. My local shop stocked 49 varieties in 2007. In 2008, they have only lined up 21. Many of our favorite varieties will be gone, but a few new strains will show up. Dave Turbenson of Midwest Supplies says that "the price of a moderately-hopped batch of 5-gallon (19-L) batch of homebrew will increase by a couple bucks."

Which varieties will be missing? That's a great question. The exact lineup of hops at your local shop will depend on where they get their hops from, when they found out about the crisis, how much time their hop buyer spent on the phone, if they are on good terms with a local micro that has a long-term contract and many other variables. However, some general trends can be expected.

"C" You Later, C-hops

"You can quote me on this," says Chris Graham of MoreBeer!, "Kiss Cascades goodbye." Almost every shop owner I spoke to — with a couple exceptions — expected that this hop will be absent from their shelves in 2008. Gone also will be almost all of the C-hops — including Centennial, Chinook and maybe Columbus. Willamette is also expected to be in short supply. Likewise, say toodles to English hops such as Fuggles, *aufwiedersehen* to German hops such as Hallertau and Tettnang and *sayonara* to Saaz, Styrian Goldings and most other European hops. (Even if you can find any, Saaz is reportedly coming in at a whopping 1% alpha acids this year.)

The varieties that will be available will vary from shop to shop, but again, some patterns emerged as I spoke to more and more shop owners. The information I gathered suggests that you should get to know Glacier, Sterling and Vanguard hops. Mt. Hood, (US-grown) Perle, Liberty and maybe Palisades should also be widely available. For some hops — such as Ahtanum, Amarillo, and Simcoe — I got

mixed signals.

Expect some "rationing" now and in early '08 from homebrew shops, but this may relax as the year proceeds. Homebrew shop owners all reported some attempts at hoarding by a minority of homebrewers, and most have been contacted by professional brewers looking to buy outside of their usual supply chain. In response, most shops have been limiting the quantities of hops they sell, or only selling hops when the customer also buys grains or malt extract. In 2008, some shops may reserve certain hop varieties for sale with their beer kits.

Although all these restrictions will likely rub some homebrewers the wrong way, a homebrew shop could easily be completely drained of hops if no limits were in place. "There are only four ingredients in beer. We sell three, and if you can't get one, nobody is going to buy the other two," says Chris Farley of Northern Brewer.

Gruit or Screw It?

One semi-popular rumor on the internet is that 2008 will be the Year of Gruit for homebrewers. As the story goes, the supply of hops will evaporate, forcing homebrewers to bitter their beer with spices, herbs, twigs and berries. I asked many shop owners about this. Will brewers be forced to look for alternate forms of bittering or give up brewing? Will we face the "gruit or screw it" scenario? Every one of the owners laughed at this idea. It's going to be a tough year, but not that tough.

What Should You Do?

There are a number of things you can do over the next few years to lessen the impact of limited hop availability. The first — and perhaps most obvious — is to check your freezer. Stored correctly, hops are good for at least a few years. The level of alpha acids decreases, but they are still suitable for brewing. (In fact, some breweries purposely age their hops to get a more "refined" character from them.)

If your hops have been stored in a non-frost-free freezer, in oxygen barrier bags, they may be good even if they are three to four years old. If you have any doubts, just examine them. If they are green and don't smell cheesy, they are most likely usable.

If you have some hops on hand, but

MALT PRICES (CONT.)

Continued from page 57

Hemisphere, especially Australia. Some countries — such as Russia, Ukraine and Turkey — grow substantial amounts of barley, but produce no malt from it. The European Union is the leader in malt production, producing about 55% of the world's malt in 2006 and 2007. North America follows, with 18% — 13% of which is produced in Canada, 6% in the US. The next biggest malt producer is Australia, at 11%.

This spring, the North American barley harvest was very disappointing. There were a couple highlights, but overall yields were down. In contrast to the 6-row harvest, American 2-row barley was average in yield and of variable quality, with many stocks showing high protein and a low percentage of plump kernels. In Europe, it was even worse; they had no carry over barley from 2006 and their crop was small and of variable quality. As such, in the fall, all eyes turned to the Australian harvest — which also turned out poor.

As with the hop shortage, weather wasn't the only issue; decreases in acreage played a big role. Barley competes with other agricultural crops for farmland. In recent years, the high prices paid for corn — which is sold for human consumption (including the production of high-fructose corn syrup), animal feed and, increasingly, bio-fuels — led farmers to plant more of it. In addition, as emerging economies around the globe continue to improve, there is an increase in the demand for meat — and the subsequent need for more feed grain. Competing against all these other crops, barley acreage has declined in recent years.

Increased acreage and good yields in 2008 could bring a fairly quick drop in barley prices, but barley needs to be malted to be of use to brewers. And, although there has been a global increase in demand for beer, recent low malt prices have meant that few new malting plants have been built. In fact, malting capacity has actually dropped in Europe and the US since 2003. In order to meet projected demands for beer, some have estimated that 4-5 new malting plants will need to be built every year for the next several years. So far, plans for construction do not match this estimate.

So, declining stockpiles, lowered acreage and a poor crop in 2007 led to the shortage of an agricultural product that brewers use — where have I heard that before?

have a frost-free freezer, repackage them. Take the hops and place them in a small box or large freezer bag and fill the container with crushed ice. (The hops should be bagged, not in direct contact with the ice.) This will buffer them against the freeze/thaw cycle of your frost-free freezer. If you have a "food saver" vacuum sealer, use this to seal up any open bags of hops.

If you do have some Cascade, Fuggles, Hallertau, Saaz or any other scarce hop variety, you have a couple options for using it. The first option is to brew the recipes you are used to, without making any changes, until that variety runs out. The other option is to stretch what you have. You could, for example, use your "old varieties" as aroma hops, but employ a new hop for bittering. And of course, you could brew less hoppy beers until your favorite variety runs out. (I mention that last option only as a theoretical possibility.)

In 2008, we'll all have to learn to make appropriate substitutions. If you check out byo.com, there is a hop substitution list online. Likewise, Hopunion has a downloadable .pdf detailing the hop varieties they carry and their appropriate substitutions. (Their website can be found at www.hopunion.com.)

For Cascade, Centennial is an obvious substitution, but it is also in short supply. If you can get Amarillo or Ahtanum, these are a decent substitutions. Palisades might also do in a pinch.

Vanguard and Liberty can be used as a substitute for Hallertau. Sterling is said to resemble a mixture of Saaz and Mt. Hood and Glacier can be used as a sub for Willamette, US-grown Fuggles, US Tettnang or US Styrian Goldings. The recommended substitutions for Glacier highlights an important point — you aren't going to find varieties that exactly mimic your favorite varieties. To me, Willamette, Fuggles, Tettnang and Styrian Goldings are all different hops. Any hop that could sub for all of them is not going to taste like any one them specifically.

As the year progresses, it will likely be beneficial to check out as many homebrew shops as possible, and recheck them occasionally. Different shops will be carrying different hop varieties, and some varieties may appear suddenly — for example, if the local brewpub or microbrew goes out of business. A final option may be to grow your own. Hop rhizomes are, predictably, in short supply, but if you can find some, you can have a decent crop as early as 2009.

Your best bet may be to just forget about the varieties you can't get, and learn to treat new hop varieties as their own thing. Hop varieties that are obvious substitutions for popular hop varieties will dry up quickly. Instead of brewing a beer that could never possibly live up to its old formulation, try learning about the new varieties and brew the best beer you can with them. (Look to the next issue of BYO

for in-depth information on some of the newer hop varieties.) There was a time when all hop varieties were new to all of us. We learned what they tasted like, and what beers they could be used in, by brewing, tasting and rebrewing beers.

Back in Green

This hop shortage is going to cause a big storm in the brewing community. However, the dark clouds may have a silver lining. Sometimes tragedy spurs innovation. Did the rock band AC/DC give up when their singer Bon Scott died? Hell no, they found a new singer and recorded one of the classic rock albums of all time, "Back in Black." So, in 2008, get ready to start from scratch and brew some great beers with the hops available.

Because many classic hop varieties will be absent in 2008, style guidelines based on classic beer styles will be of less value when formulating recipes. Instead, you will need to use your taste buds, nose, imagination and brewing skills to get the best expression from the hops available. By intuition, trial and error, homebrewers will need to figure out which hops go best with the caramel flavors of a red ale, the roasty character in dark beers, the crispness of a nice lager or the spicy aspects of some Belgian brews.

A little artificially-imposed constraint can actually heighten artistic expression. Bach wrote some of the best music in history under the strict rules of the Baroque period. (Likewise, look at what AC/DC has done with only four chords.) You may be down to a handful of varieties in your freezer soon, but getting to know everything about them may lead you to formulate your best beer ever.

The Future of Homebrewing

Some folks have opined that the decrease in hop varieties will cause some homebrewers to take a break for a few years or quit altogether. Others say that, as the price of commercial beers go up, homebrewing will become a more attractive option for many. Charles Culp of Austin Homebrew Supply doesn't see the hop shortage fundamentally changing our hobby. "Homebrewing is a lifestyle," he says, "We do it because we like brewing. People aren't going to throw this all away just because they can't find any Styrian Goldings."

We're all going to spend some time crying in our beers over the temporary absence of our favorite hop varieties. However, this shortage will likely spur a lot of innovation in brewing and — just as with the birth of the craft brewing industry — homebrewers will be a vital force in the process.

After a gloomy week of researching this story, I turned on CNN and saw that water may need to be rationed in some areas of the South next year. Looking for some good news, I called Greg Doss of Wyeast and asked if yeast would be available. He laughed. "Yeah," he said, "we'll make all the yeast you guys need."

Chris Colby is Editor of Brew Your Own. *His brewing motto is "Amarillo and* AC/DC."

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Down the Drain

Lautering efficiency or how to go with the flow

by John Palmer

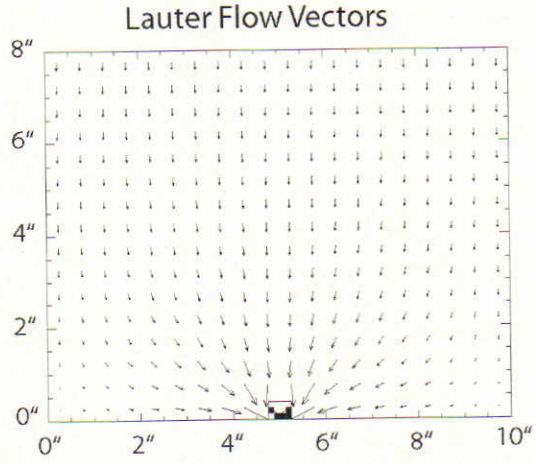
All-grain brewers are always talking about brewing efficiency — how much wort they yield from their mash into the boil kettle. There are two components to brewing efficiency: mashing efficiency and lautering efficiency. Mashing efficiency is all about the conversion of malt starches to sugars. Lautering efficiency is all about the extraction of those sugars to the kettle. There are several factors that determine lautering efficiency, but they all boil down to uniformity of flow.

No and batch sparging

At 75% yield (total extract), the first wort gravity is about SG 1.075–1.085 for the typical grist ratios that homebrewers use (1.3–1.5 qts./lb. or 2.7–3.1 L/kg). So, what is the best way to extract that typical 75% yield? The answer depends on your equipment and patience. The simplest way is to just drain it — and this is called no-sparge brewing. However, with no-sparge brewing, a proportion of the wort will be left behind in the wet grain and your wort pickup tube. To recover this extract, you will need to add more water to the mash, stir and drain it again. This is called batch sparging. Each time you fill the mash and drain the wort, you dilute the remaining extract in the grainbed and leave behind a proportion of that extract, diluted to the new concentration. (Just like re-using a teabag.) The efficiency of batch sparging is best when the volumes of the first and second runnings are equal, i.e., half of your desired boil volume. A single batch sparge in this manner should obtain most of the available extract (roughly 90%). If three runnings are collected, all at the same volume, the efficiency should improve by about 5%.

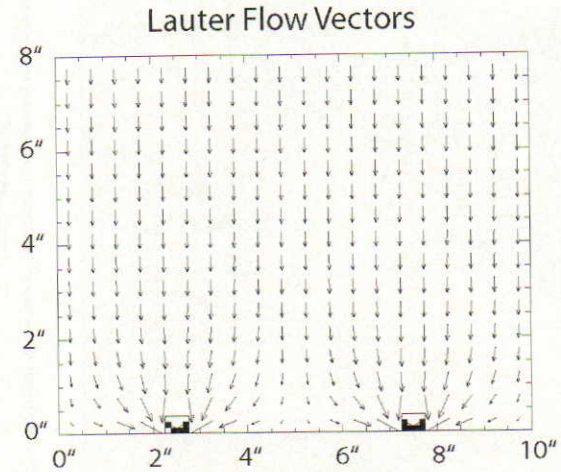
Batch sparging is nice because it is simply draining, nothing fancy about it, provided your grainbed has good permeability. A finely-crushed grist will convert very well and give a high yield, but it will lauter very slowly. Your grainbed permeability will affect your lautering capability, no matter what sparging method you use.

Figure 1:



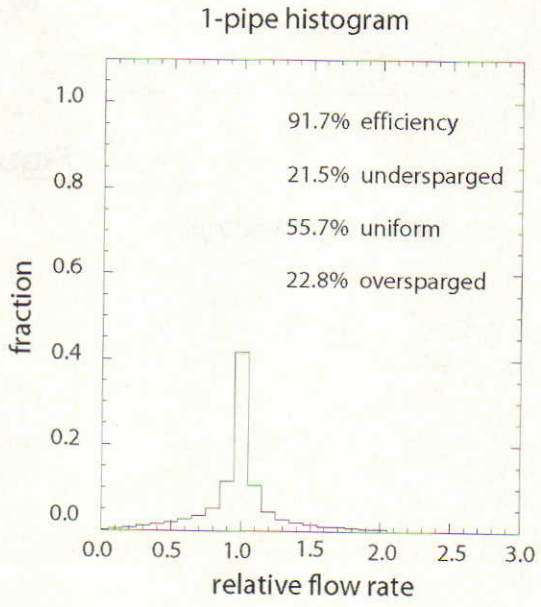
Convergence of flow of a single slotted pipe or screen in an 8" x 10" grainbed.

Figure 2:



Convergence of flow of a two pipe or screen system in an 8" x 10" grainbed.

Figure 3:



Histogram of the relative flow rates modeled in Figure 1.

Draining vs. rinsing

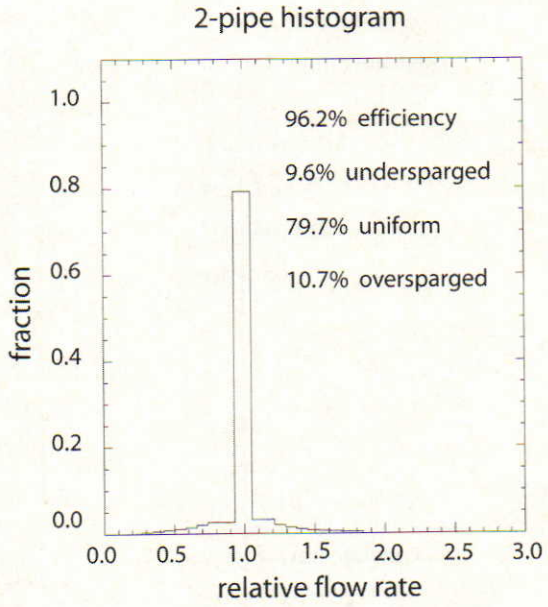
If you batch sparge, and fill the grainbed again, you dilute the sugars to a new concentration. The amount of sugar that comes out of the grain is a function of the concentration gradient between the solvent (water) and the solute. As the difference in concentration diminishes, the extraction of the sugar from the grainbed diminishes. The way to increase the extraction rate is to keep the concentration gradient high, by constantly presenting water to the grain. Continuous or "fly" sparging is a rinsing process that works in this manner. The challenge with continuous sparging is making sure that all the grain is equally rinsed.

The key to effective rinsing is uniform flow throughout the grainbed. The key to uniform flow is to maintain a steady state. The inflow should equal the outflow, and the permeability of the grainbed should be uniform so that water does not flow more easily through one side of the grainbed than the other. The inflow of water to the grainbed should be uniform

across the surface area, and the easiest way to accomplish that is to maintain an inch (2.5 cm) or so of free water above the grainbed. Likewise, the outflow should occur uniformly across the grainbed area, otherwise the flow through the bed will vector toward the drain, leaving outlying areas unrinsed. A single collection point causes the most vectoring under steady state conditions and this behavior is shown in Figure 1. Increasing the number of collection points reduces the amount of vectoring, and increases the uniformity of rinsing, as shown in Figure 2.

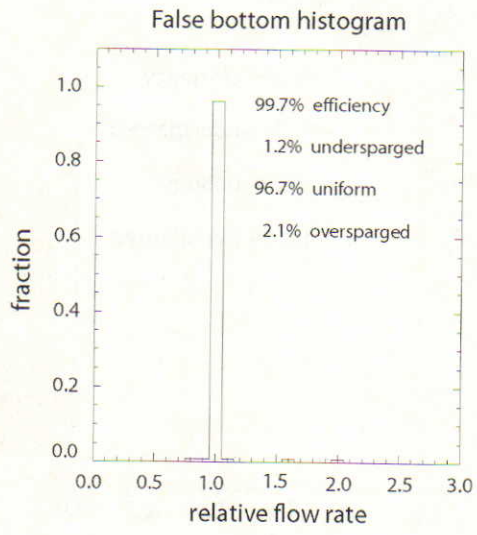
Fluid mechanics gives us the science to quantify this effect, and we can build histograms of the relative amounts of flow occurring in the grainbed. These results are shown in Figures 3 and 4. A computer model was constructed assuming an 8-inch (20-cm) deep by 10-inch (25 cm) wide grainbed, and while that may seem small, it reduced the computation time, and the results are applicable to any size grainbed. The model calculated about 56% of the flow would be uniform for a sin-

Figure 4:



Histogram of the relative flow rates modeled in Figure 2.

Figure 5:



Histogram of the relative flow rates of a false bottom in the same grainbed.

gle pipe manifold, and about 80% for a 2 pipe configuration. Increasing the coverage to 4 pipes improves the uniformity even further to 92%. The upper limit is found with a false bottom configuration. Its histogram is shown in Figure 5, and the uniformity is nearly 97%.

If you consider that the amount of extract in the grain is finite (i.e., once it's gone, it's gone) then we can estimate the efficiency of a lautering system by assuming that the percentage of extract from a region is equal to the proportion of flow that the region experiences, up to 100%. In other words, a 70% flow region will yield 70% of its total extract, and a 110% flow region will yield 100% of its extract. The model predicted about 92% of the volume lautered for a single pipe manifold, and about 96% for a 2 pipe configuration. Increasing the coverage to 4 pipes improves the efficiency to nearly 99%, almost equal to that of a false bottom at 99.7%.

The arrangement of the collection system is a big factor in flow uniformity. The examples above show that uniformity and efficiency improve with more pipes, but it's the arrangement and spacing of the pipes that make the difference. Uniformity is highest when the outflow area (floor of the lauter tun) is evenly divided by the pipes and when the

pipe spacing is as close as possible. Imagine that the bottom of the lauter tun is 12 inches wide. Three pipes could be placed across the tun at 0, 6, and 12 inches, and that evenly divides the area (uniformity = 80%). But the flow convergence is reduced and uniformity optimized when the 3 pipes are moved closer together, and placed at 2, 6, and 10 inches (uniformity = 89%). This balanced spacing arrangement increases the number of equal areas from 2 to 3 (actually 2 plus 2 halves).

The same principle applies to round tuns, like a Sankey keg or Gott cooler. A single ring manifold works very well when it is sized to a diameter that divides the circular volume in half, and that equation is ring dia. = 0.707 x tun dia. It is interesting to note that the uniformity and efficiency of a false bottom does not surpass that of a single ring manifold until the false bottom diameter is greater than 80% of the tun diameter.

The final factor to be considered in lautering (continuous or batch) is the flow rate. There are two reasons to run the lauter slowly. No matter what method or collection system you use, you need to start the flow slowly or you will tend to compact the grainbed around the device and impede flow. You want the main resistance to flow to be at the collection points (the holes/slots in the false bottom or pipes), not in the grainbed. If the resistance to flow is greater in the grainbed than in the collection system, the grainbed will compact and you will have a stuck sparge. This is especially true for false bottom systems. Second, when continuous sparging, you need to consider that rinsing involves diffusion and transportation of the sugar out of the wet grain. It takes a certain amount of time for this to occur and if your flow rate is too fast, you will simply run water thru the tun and fill your boil kettle with water and not extract.

Not surprisingly, lauter tun design has been studied extensively by commercial brewers. In commercial lauter tuns, the rule of thumb is 1 to 1.5 outlets per square meter of lauter area and the flow velocity through the outlet should be very slow, about 0.1 meters per second, to prevent significant "pull" at the drain. (On a homebrew scale, one outlet is more than sufficient for a false bottom and wort is usually collected at the rate of approximately one quart (~1 L) per minute.) In commercial designs, lauter tuns usually have flat bottoms and the false bottoms cover the whole bottom. Homebrew solutions involving pipes or other manifolds inserted in coolers or kegs are less efficient than false bottoms. Their efficiency improves as the number and spacing of outlets approaches that of a false bottom — and pipe manifolds or other homebrew gadgets can certainly deliver an acceptable level of performance.

If high lautering efficiency is your primary goal, continuously sparging your grain bed at a slow, steady rate in a lauter tun with a false bottom would be your best option.

This is John Palmer's first "Advanced Brewing" column for BYO.

Projects

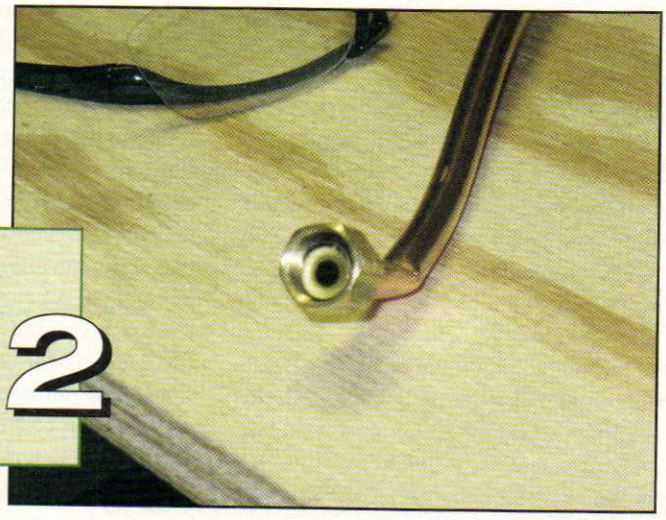
Carboy Spray Wand

The cleanest project you'll ever build

Story and photos by Forrest Whitesides

Probably every homebrewer's least favorite part of the hobby is the sometimes staggering amount of cleaning that is required to produce a sanitary, contaminant-free batch of beer. And one of the most stubborn things to clean can often be that thick, nasty-looking ring of dried kräusen gunk that is almost always present after a healthy fermentation. This is especially true for brewers who use blow-off tubing, as the kräusen travels all the way up the neck of the carboy.

You can soak the carboy overnight in a solution of water and a cleaning agent such as B-Brite and then use a carboy brush to get the stubborn cling-on gunk. Or, you could just use a high-pressure sprayer to blast away the left over kräusen and forget about all the soaking. Read on to make your own carboy sprayer.



2 This is what one end of your copper tubing should look like once you've attached the nut and flare fitting.

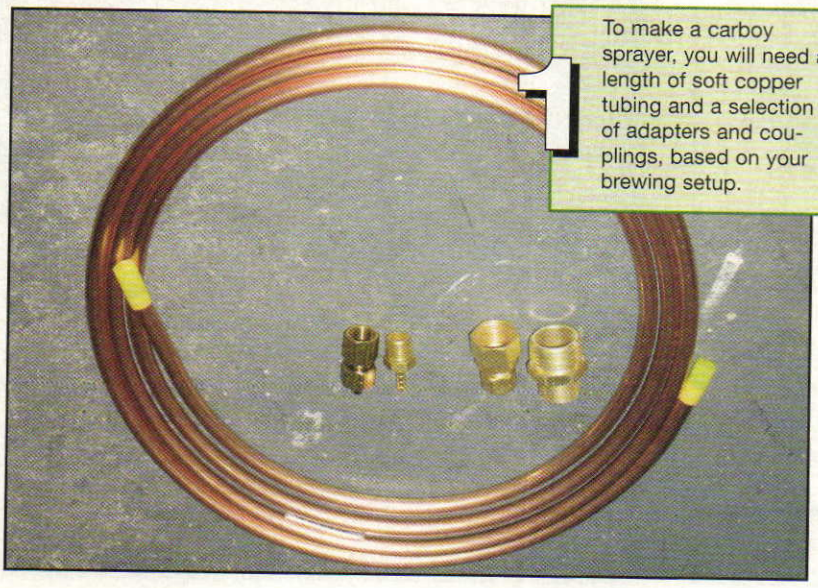
PARTS LIST

Soft Copper Option

- 2-foot (or longer) piece of 3/8" OD soft copper tubing
- 3/8" x 1/2" compression coupling (Watts part # A-118)
- 3/8" x 1/4" compression coupling (Watts part # A-116)
- 3/4" male hose thread x 1/2" male pipe thread adapter (Watts part # A-663)
- 1/8" hose barb x 1/4" male pipe thread adapter (Watts part # A-85).

Hard Copper Option

- 2-foot (or longer) piece of 1/2" OD copper pipe
- 3/4" male garden hose adapter fitting
- 45-degree street elbow
- 90-degree street elbow
- end cap



1 To make a carboy sprayer, you will need a length of soft copper tubing and a selection of adapters and couplings, based on your brewing setup.

Materials selection

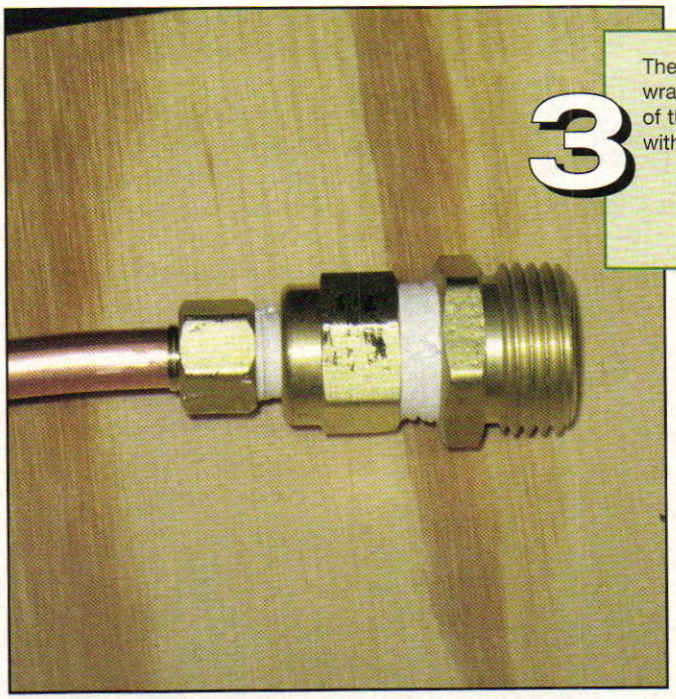
There are two basic ways to build the carboy sprayer: either with soft copper tubing or with hard copper pipe. I recommend soft copper tubing for glass carboys as it is more readily available in the smaller diameters required to fit through the narrow mouth of the carboy. For polyethylene terephthalate (PET) plastic carboys, either soft or hard copper pipe can be used, as the mouth of PET carboys is a good bit wider than their glass cousins.

The softer side

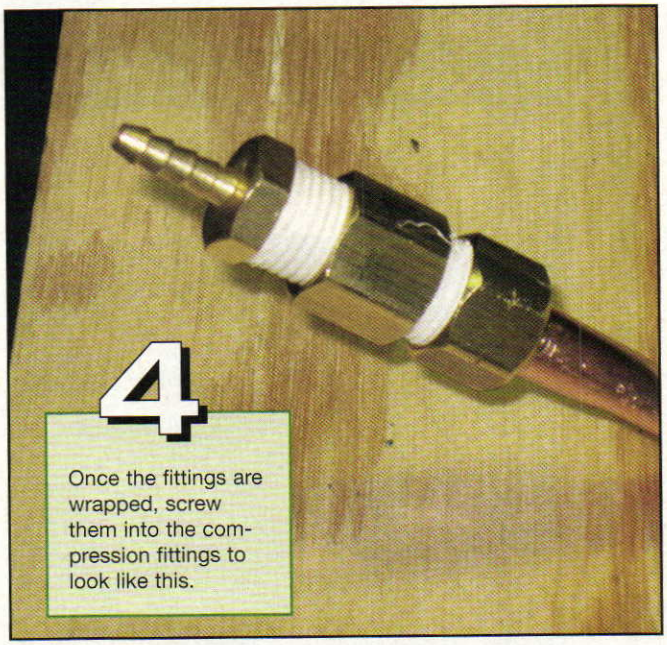
If you intend to use soft copper tubing, you'll also need two compression fittings and a few adapters. I chose to use ⅜" OD copper tubing (to navigate the narrow neck of a glass carboy) along with ⅜" x ½" compression coupling (Watts part # A-118), a ⅜" x ¼" compression coupling (Watts part # A-116), a ¾" male hose thread x ½" male pipe thread adapter (Watts part # A-663), and a ⅛" hose barb x ¼" male pipe thread adapter (Watts part # A-85). (Figure 1). These fittings work with my usual brewing setup, so feel free to make changes based on your equipment, whether it includes an outside garden hose or an indoor utility sink.

Measure off a comfortable length of tubing and make your cut. A Dremel or other rotary tool with a cutoff wheel is an excellent way to cut the tubing. A coping or hack saw will also work, but take care not to apply too much pressure as the tubing is very easily deformed, and this can make it difficult or impossible to get a good seal with the compression fittings.

Soft copper tubing is very pliable and can be



3 The next step is to wrap the threads of the two fittings with Teflon tape.



4 Once the fittings are wrapped, screw them into the compression fittings to look like this.

bent and twisted to suit many cleaning applications. Try several different angles of bend to make sure you'll be able to fit the completed sprayer into your carboy.

Unscrew the nut from the ⅜" x ½" compression coupling and slide it approximately half an inch over one end of the tubing and then do the same with the flare fitting (which looks like a small brass ring). Now screw the rest of the compression coupling into the nut until hand tight (Figure 2). To tighten fully and insure a good seal, hold the main part of the coupling stationary while turning the nut with either pliers or a wrench. A vise is handy to hold the coupling steady, but it can also be done with a crescent wrench. Repeat the same procedure on the other end of the tubing with the smaller compression coupling.

All that remains to be done is to wrap the threads of the two fittings with Teflon tape and screw them in to the compression fittings (Figure 3 and Figure 4). Hook up your new sprayer to a garden hose or sink to test the integrity of the compression fittings. Tighten and readjust as needed.

Hardcore copper

For those of you with PET carboys, or if you happen to have a glass carboy with a wider-than-normal mouth, hard copper pipe is a great alternative to copper tubing. It's less pliable than soft tubing, but far more sturdy over the long haul and there are several available fittings allowing for many different designs to accommodate a wide range of needs.

Going with hard copper pipe also means that you'll need to solder the joints and fittings together, as it is too rigid for regular compression fittings to work properly. If you've never soldered copper pipe before (often referred to as "sweating" copper), don't let that stop you from giving this project a try. The process of soldering copper is very simple to learn (but difficult to master, of course), the equipment to do it is inexpensive (less than $20 for the basic gear), and it's a great general home-improvement skill to have. Before attempting this project, I had never soldered copper before, but I was able to make adequate joints in a matter of minutes. There are several excellent illustrated introductory guides online that you can use for reference to get you started. Be sure to wear appropriate safety equipment and follow all precautions as directed.

For my sprayer, I chose a 2-foot section of ½" OD copper pipe, which is commonly available at hardware stores in short, pre-cut lengths that are perfect for this type of project. Fittings for this project include a ¾" male garden hose adapter, a 45-degree street

5 Fittings for this project are common, and are easily found at regular hardware stores.

Create the nozzle for your sprayer by cutting a hole or slit in the end cap fitting.

6

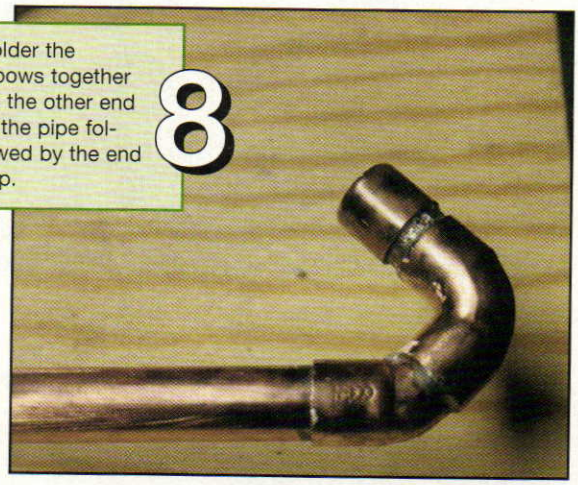
elbow, a 90-degree street elbow, and an end cap (Figure 5). These are just suggestions, so feel free to shop around for different options to suit your needs. I highly recommend that you test fit the elbows before soldering to make sure the configuration will fit through the neck of your carboy. For example, I found that attaching the 45-degree elbow and then the 90-degree elbow — but not the other way around — fit fine into my carboy.

To create a nozzle for your sprayer, cut a slit or drill a hole (or several small holes) in the end cap fitting (Figure 6). I prefer the slit, as it creates a wide, high-powered fan of water, but your mileage may vary.

Solder the ¼" male garden hose adapter to one end of the copper pipe, (Figure 7) and solder the elbows together on the other end of the pipe followed by the end cap (Figure 8). By using "street" elbows instead of the regular variety, the elbows can be fit together directly. My local hardware store did not have 90-degree street elbows in stock, so I had to cut a short piece of pipe to use as a coupling between a normal 90-degree elbow and the end cap.

Attach the sprayer to your garden hose and turn on the water to make sure your solder joints are fully seated and sealed (Figure 9). And now it's time for a homebrew!

Forrest Whitesides writes the "Projects" column in each issue of Brew Your Own. *When not sniffing airlocks, he enjoys inhaling solder fumes.*



Solder the elbows together on the other end of the pipe followed by the end cap.

8

Next, solder the ¼" male garden hose adapter to one end of the pipe so it looks like this.

7

Once you're finished, attach the sprayer to a garden hose and behold the power of water pressure.

9

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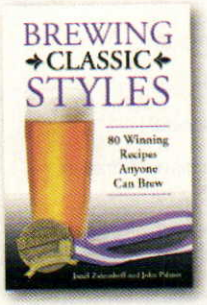
Beer reading for the new year!



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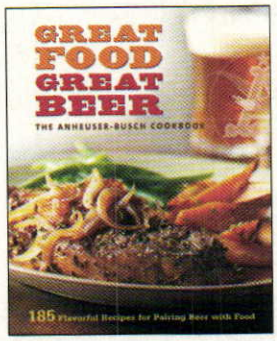

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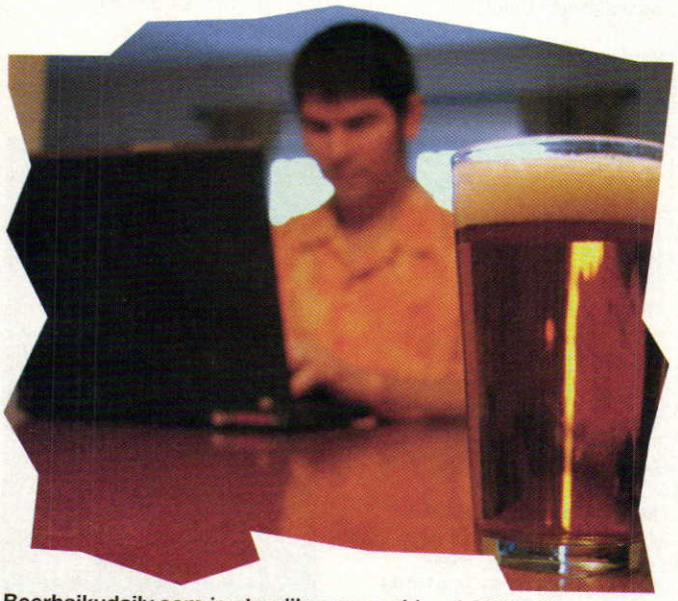
Three Lines Only

The story of Beerhaikudaily.com

Captain Hops • Timonium, Maryland

My passion for beer began in college. It was the early nineties and I found myself in the midst of a microbrew revolution. The variety and the flavor that was suddenly available captivated me. Where mass market beers were indistinguishable from each other in their blandness, microbrews were infinitely unique. This uniqueness went beyond style and flavor with each new beer coming complete with a personality, story, and local history. Beer became an adventure.



Beerhaikudaily.com is steadily approaching 1,000 haiku, according to webmaster Captain Hops.

Although I was in college when I developed a taste for craft brew, unfortunately my wallet didn't develop at the same rate. I was always broke back then and my first attempt at homebrewing was actually a plan to get better beer cheaper. I soon learned that saving money wasn't the real point. Brewing at home was about craft and love of the beer.

I think my favorite homebrew was my first one. My roommate at the time split the costs of a basic brew kit with me and we created a Porter. It was surprisingly good for a first attempt. We named it after a mutual friend who had stopped by during the brewing process. Although it couldn't have been predicted at the time, that friend would become my wife years later. I kind of like to think it was that first brew that planted the seed.

I started Beer Haiku Daily on June 16, 2005. It was supposed to be a little side project used to experiment with web technology. Now that little experiment is over two years old and the site should have 1,000 haiku by March.

Why haiku? I lived in Japan for five years when I was in my teens. It was during that time that I was first exposed to haiku. I learned to love the structure, brevity and evocative quality of them. Much later, probably after a night of drinking good homebrew and telling tall tales, I dreamt up the idea of combining haiku and beer. Even the next day the concept seemed so absurd that I decided it was a perfect idea for a Web site.

The best thing about haiku is that it forces you to pare down to only the most essential words to express the essence of an entire story. The reader will always have to draw on their own experiences to fill in the blanks and complete the story. Using fewer words to express something really appeals to me in this over communicated world.

If there wasn't a relationship between beer and haiku before my site, there is now. Beer is an acquired taste and has always been the drink of the people. Haiku is also accessible to all but the appeal and appreciation increases with time. Beer is made of just a few simple ingredients and yet there are infinite variations, styles and flavors. Haiku only uses a few words, yet it can be used to express nearly any human experience.

As for the perks of beerhaiku, it was one of my life's ambitions to have people send me free beer to drink and that has happened. I've also gotten haiku from a large variety of people including poets, humorists, beer drinkers, average folks, brewers and some of the best beer writers around.

Because of my off-kilter niche, I like to think I have brought a new world of good brew to some people that may not have expected that when they stumbled upon my Web site.

Here are a few of my favorite haiku:

after enough beers
my intelligence dazzles.
others are jealous.

after a hard day
he savors a private stout
then lets in his friends

stuck in a strange town
new beers seem to welcome me
soon I feel at home

Now that the site has been up for well over two years, my main goal is to keep it going. It's a challenge coming up with a new haiku everyday, but it is a nice challenge. I think it keeps my brain active. In the future, I am considering branching out from haiku. I think it would be cool to build a repository of references to beer in all kinds of art from today and throughout history.

Beer has been around and revered for thousands of years. I imagine having a Web site that exhibits paintings, lyrics, prose, quotes, and sculpture directly or indirectly celebrating our favorite beverage. It would be a big undertaking and I haven't quite figured out how to pull it off yet. At any rate, regardless of any features I add to the site, there will always be a beer haiku daily.

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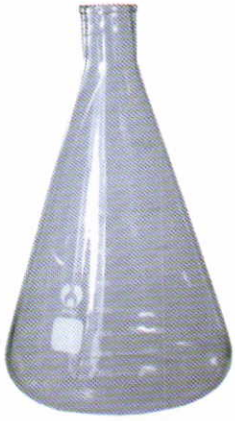

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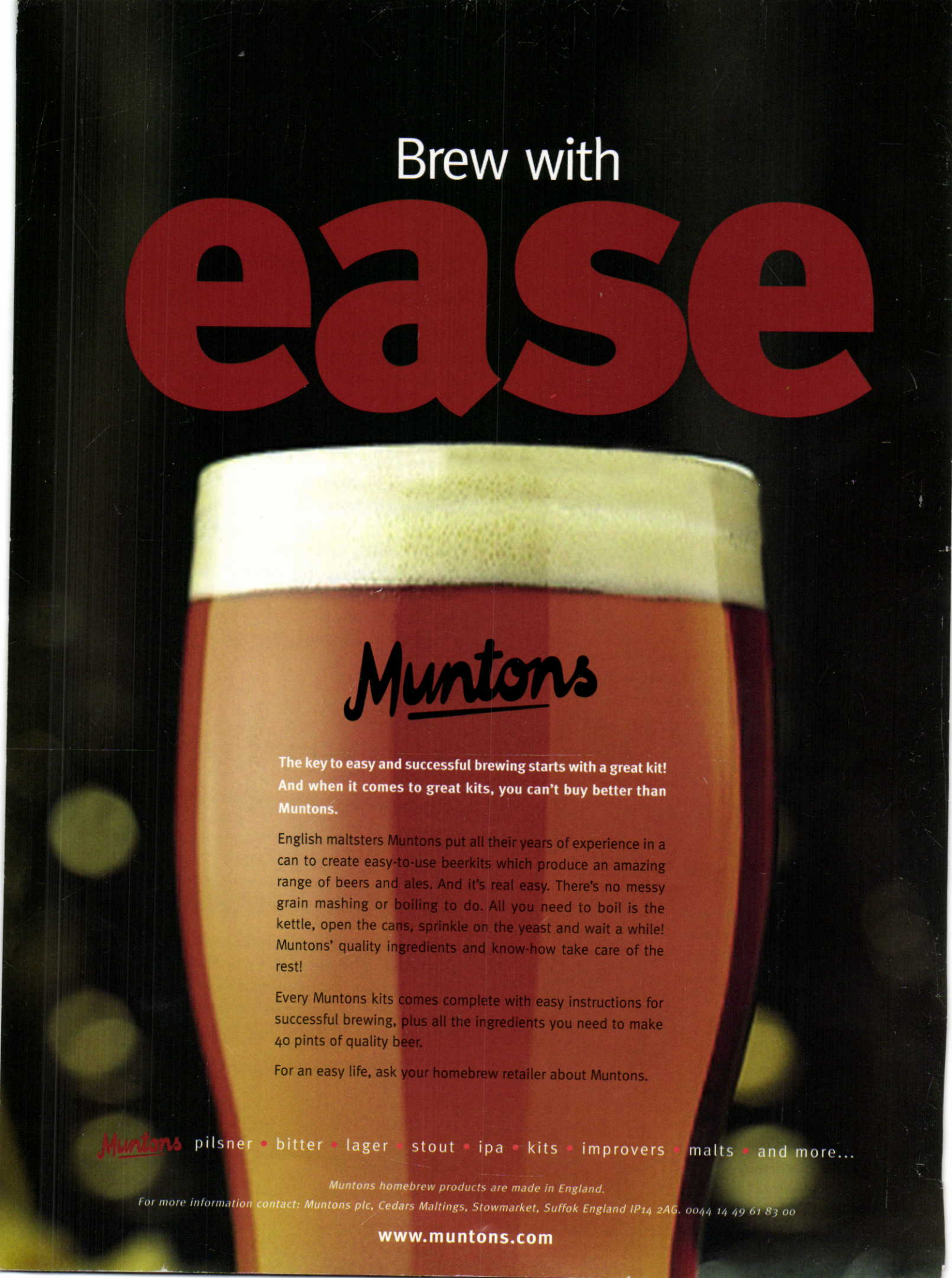
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