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MAY-JUNE 2011, VOL.17, NO.3

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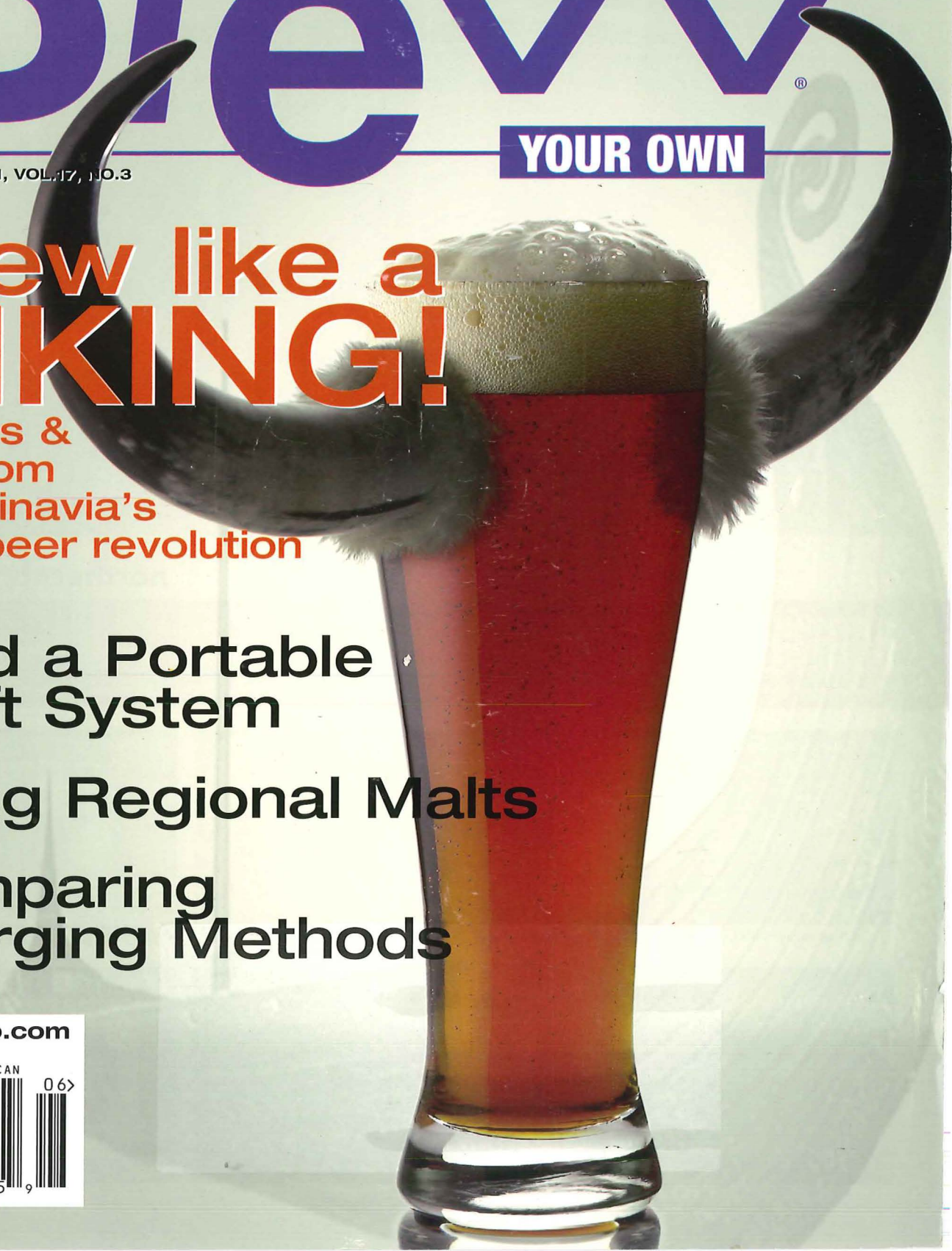

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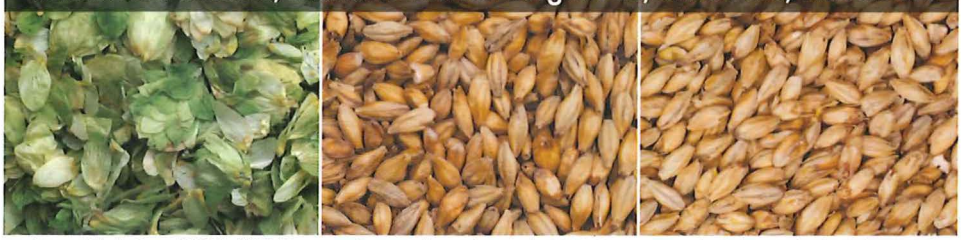

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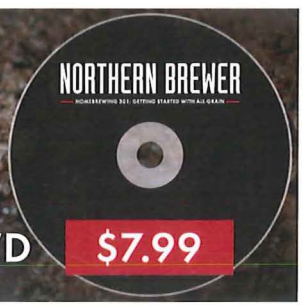

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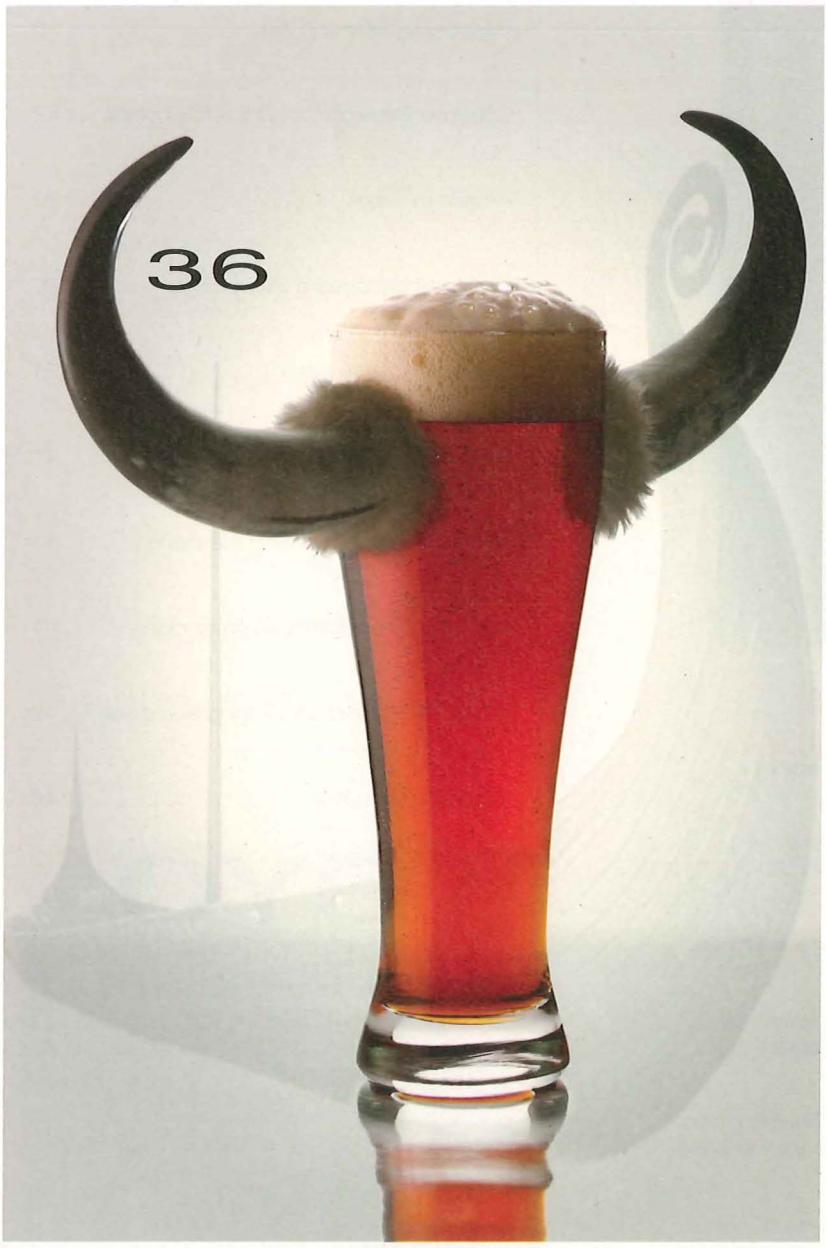

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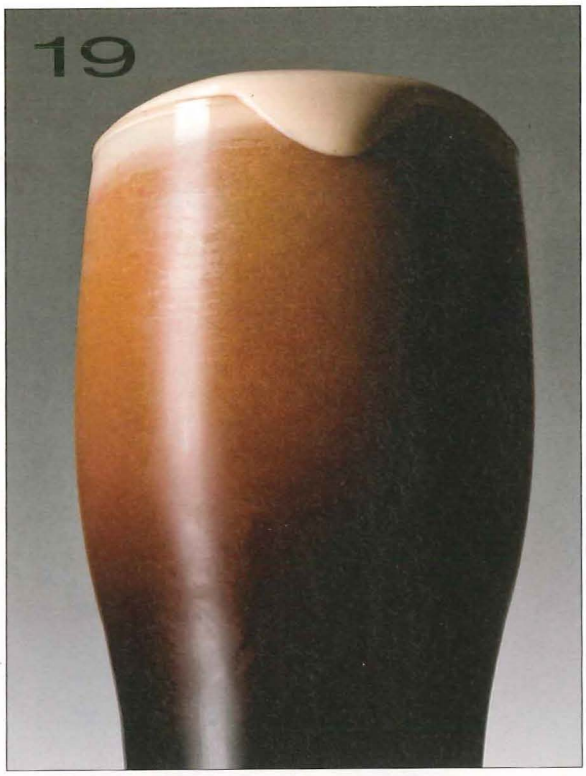

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BYO RECIPE STANDARDIZATION

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

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

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

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

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what's happening at BYO.COM

Chili Head Fred: Recipe

BYO's "Replicator" Marc Martin headed up a group of Austin ZEALOTS who were out to make a name for themselves at the Dixie Cup homebrew competition. Marc, the Primary Fermenter, Corey Martin, the Secondary Fermenter and another key member, Keith Bradley, decided to honor Fred Eckhart by brewing a clone of that famous namesake barleywine made by Hair-of-The-Dog Brewing.
www.byo.com/component/resource/article/2304

Grow Your Own Grains: Article

Join Chris Colby at his home garden for a *BYO* beginner's guide to growing barley in your own backyard. Plus, check out simple step-by-step malting instructions on processing your own grain.
www.byo.com/component/resource/article/726

Growing Barley and Hops: Video

Go a step further than the article above and take a look at *BYO* Editor Chris Colby's efforts to grow his own barley and hops in his Texas backyard. For the ultimate homebrew, grow your own!
http://www.byo.com/videos/24-videos/1807-growing-barley-a-hops-with-byo-editor-chris-colbys

Cover Photo: **Charles A. Parker**

Brew Your Own — The How-To Homebrew Beer Magazine

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Volume 17, Number 3: May-June 2011

Fruit in our 15?

I just love your 15th Anniversary beer recipe (September 2010). I've brewed it twice and it never lasts. My son is coming home (from the Air Force) for the weekend next week and we would like to brew a beer along the lines of the 15th Anniversary but with a twist. We would like to add cloves and cherries. Any ideas on how much to add and when?

Anthony Bottari
via email

Glad you liked the recipe. Adding cherries and cloves to our 15th Anniversary Ale would add an interesting twist.

Cherries are fairly strongly-flavored fruits and adding them at a rate of around 0.5–1.0 lb. per gallon (60–110 g/L) would be a good place to start. Adding cherries would also add sugar to the beer, which would then be converted by the yeast into alcohol.

To estimate the effect of the cherries on your specific gravity, start with the fact that cherries are approximately 13% sugar (or 13 °Brix as measured by a winemaking refractometer). Multiply the percent sugar in the fruit (0.13) times the weight of cherries, and then divide by the weight of the final beer. [That's the weight, not the volume. One gallon of water weighs 8.35 lbs. One liter of water weighs one kilogram. So, a 5 gallon (19 L) batch of beer would weigh approximately 42 pounds (19 kg).] This will give you the percentage sugar in the beer. Multiply this by 400 to give you the approximate contribution to the specific gravity, in "gravity points." For example, if you added 6 lbs. of fruit, you would have 0.13(6)/42 = 0.019% sugar in 5 gallons. This corresponds to approximately 0.019(400) = 7.4 gravity points added (i.e. if your beer had an original gravity of 1.090, it would now be 1.097). Given that BYO*'s 15th Anniversary Ale is already 12% ABV, you might want to consider subtracting the expected amount of sugar contributed by the cherries from the sugar added in the boil.*

Your best bet would be to ferment the beer, then rack it onto the cherries. Crush the cherries first, enough to open them up. You should also pit them, so they don't contribute a

contributors

Forrest Whitesides is a graduate of North Carolina State University and lives in Hopatcong, New Jersey. He brewed his first batch of homebrew — an English brown ale — way back in 1995. These days, he has an interest in brewing Belgian-style ales.

Forrest has contributed many installments of our Projects column in the past few years, including — recently, in the October 2010 issue — a classic picnic-cooler-based mash/lauter tun.

In addition for writing for *BYO*, he has also appeared as a guest on the Final Gravity Podcast (http://finalgravitypodcast.webs.com/) In this issue, on page 52, he familiarizes readers with five brewing software packages.

As a homebrewer, Justin Burnsed enjoyed putting together a recipe, brewing the beer and sharing it with others. In 2008, he decided to pursue brewing as a profession. Soon after, he discovered the UC-Davis Master Brewers program and enrolled. While getting his brewing education, he blogged about his experiences at byo.com. His blog continues today as he ventures into the realm of professional brewing.

In the January-February 2011 issue of *BYO*, Justin wrote about Foreign Export Stout. In this issue. on page 28, he introduces readers to Gose — the subtly salty and mildly sour brew with a hint of coriander. Gose had been brewed for over a thousand years and Justin explains how you can make a batch of this unusual, but surprisingly refreshing, beer.

Officially, Dave Green is *BYO*'s Advertising Sales Coordinator. Unofficially, he's our Vermont office's coffee roaster.

Dave was first introduced to homebrewing at Colby College in Maine. After college, he landed a job as Assistant Brewmaster at the Brickhouse Brewery in Patchogue, New York.

These days, Dave lives with his wife and two children in Dorset, Vermont. His wife's love of Mikkeller's Beer Geek Breakfast — a coffee stout — set Dave on a journey that culminates in his article on page 36. In it, Dave not only shares the recipe for a Beer Geek Breakfast clone, but relates how Scandinavian homebrewers are pioneering a craft beer scene in the north of Europe.

tannic edge to the beer. Put the cherries in a sanitized bucket that is at least a couple gallons larger than the volume of the beer, and watch that the airlock or blowoff tube doesn't get clogged from foam. (The sugar in the cherries will fuel a secondary fermentation and it will foam considerably.) Let the beer contact the fruit for about 10–14 days, then rack the beer away from the cherry skins. Wash the fruit before racking the beer onto it, but you shouldn't worry about sanitizing it with this beer as it is around 12% ABV.

You might want to add ¼ tsp. of pectinase per 5 gallons (19 L) along with the cherries if you want to ensure that the beer is clear. Cherries are not particularly high in pectin, though, so this is not strictly needed. (For more on brewing with fruit, see the "Techniques" column in the July-August 2002 issue of BYO, *p. 47.)*

As with all spices, knowing how much cloves to add is a bit tricky. The strength of spices can vary widely, especially when you consider that fresh spices are very strong, but their flavor and aroma can diminish over time. I would start with 0.25 tsp. per 5 gallons (19 L) and adjust the rate in subsequent brewings, if needed. Adding the cloves for the final few minutes of the boil would be the easiest way of adding them.

You could also soak some cloves in vodka for several days and use this extract to flavor the beer in the bottling bucket or keg. This would allow you to control the level of clove flavor in the beer.

This would, of course, also make this strong beer even more highly alcoholic. To calculate the increase in alcohol, multiply the volume of extract added by the alcohol content. Vodka is found in varying strengths, but 80 proof or 40% alcohol by volume is common. Divide the resulting number by the total volume of your beer. You can use any unit you wish for volume — ounces, gallons, liters, etc. — as long as you use the same unit for both volumes. The resulting number can be added to your existing ABV to yield your "spiked" ABV.

The Trappist High Gravity Ale or Abbey Ale yeast — one of the two strains used in the fermentation — will also give off some clove-like notes at higher fermentation temperatures, so you may not have to add cloves to get a "spicy" kick, you could just increase the fermentation temperature a bit. How much is something you would have to experiment with; we have not tried this. Raising the fermentation temperature would also cause the Scottish ale yeast to give off more esters.

Finally, cherries and cloves is an interesting choice. You don't see these two ingredients paired together often (although a Google search did reveal one food recipe featuring this pairing). If you have an idea that these two flavors

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are really what you want, that's great. If not, maybe consider picking cherries or cloves.

Minus a minus

In the October 2010 issue of BYO, *we ran a story about mash temperature calculations ("Mash Temperature Calculations," by Bill Pierce, p. 53). In one of the equations, a minus sign is missing. The equation is on page 56 and the correct version is:*

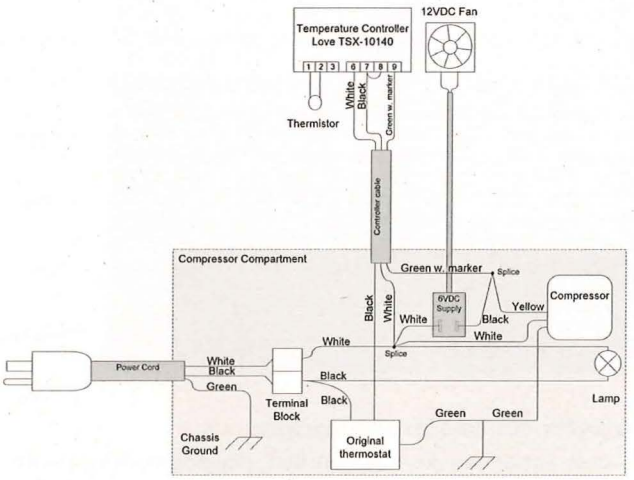
$$T_s = [T_f(ThM + (2.0372V_m) + (0.4W_g))) - (T_g 0.4W_g) - (T_v ThM) - (0.5(0.0746)T_f W_g)]/(2.0372V_w)$$

The reinstated minus sign comes between the term $T_v ThM$ and the term $0.5(0.0746)T_f W_g$. (Note: For clarity here, we have removed the multiplication signs and left them implied, as is standard in mathematical notation.) BYO *is sorry for any confusion this caused.*

Wiring diagram

In the March-April 2011 issue of BYO, *we ran a story about converting a chest freezer to a kegerator ("Projects," p. 65). A reader wrote to express his opinion that the explanation of how to connect the wires could be misinterpreted. And, if the project were wired improperly, it could be dangerous. (Wired correctly, of course, the project is safe.) At* BYO, *we take safety seriously. And so, in the interests of being 100% clear on how to wire this project, we are publishing this wiring diagram.*

As with any project that involves electricity (and especially electricity in the vicinity of liquids such as wort or beer), if you are unsure of your skills in this area, consider hiring an electrician to do the work. (BYO)



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READER PROFILE

Brewer: Kristoffer Pillar

Hometown: Oshkosh, Wisconsin

Years brewing: Four

Type of brewer: Classic ales (and very dry wines and ports)

Homebrew output: 15–30 gallons (57 to 114 L) a year

What's on tap/in the fridge:
Pilsner, American ale, Oktoberfest, dry pomegranate wine, berry mead and orange wine.

How I started brewing:
My wife and I grow fruits and vegetables in our backyard garden, and she found and tried a recipe for a raspberry-jalapeño jam, which turned out to be very good. So, a bit of a homebrewer and willing to try something, I thought, why not try the same flavors and produce a raspberry-jalapeño beer? I knew that I may not like the outcome, but I started brewing a 6-gallon (23 L) batch of American ale anyway. The beer fermented for about a week in the primary, and then I separated it into five 1-gallon (3.8-L) jugs, to which I added jalapeños (cut in half) and fresh raspberries.

The first jug contained two peppers, and the second jug contained four peppers. The third jug contained only raspberries, and the fourth jug contained two peppers and raspberries. I, of course, allowed for 1 gallon (3.8 L) to be set aside and left as a control. It turned out that each jug had its own distinctive and drinkable flavor, but all of them went down with a crisp front end and a slight peppery bite on the finish. For the strictly jalapeño beers this effect was quite cumulative, and by the end of the first beer the heat of the pepper was in full effect!

READER RECIPE

Raspberry-Jalapeño Ale
(5 gallons/19 L, extract)
OG = 1.038 FG = 1.007 ABV = 4%

Ingredients
1 can Coopers Real Ale extract kit (pre-hopped)
2.2 to 3.3 lbs. (1 to 1.5 kg) crystal liquid malt extract
2 tsp. Irish moss
10 fresh jalapeños, (washed and cut in half)
1.25 C. raspberries, (washed)
Neutral ale yeast, such as White Labs WLP001 (California Ale), Wyeast 1056 (American Ale) or Fermentis US-05 yeast
5 oz. priming sugar

Step by step
Heat the malt extracts with 5-gallons (19 L) of water at 160 °F (71 °C) for 55 minutes. Add Irish moss. Cool rapidly to pitching temperatures and place in a sanitized primary fermenter. Add yeast. Ferment for one week. Transfer to a sanitized secondary fermenter, add the jalapeños and raspberries and allow fermentation to finish. Rack the beer into bottles adding the priming sugar. Condition for two to three weeks and enjoy.

byo.com brew polls

Besides hops, do you grow any of your homebrew ingredients?

No, but I want to 61%
No, I'm not interested 29%
Yes, sometimes 7%
Yes, all the time 3%

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what's new?

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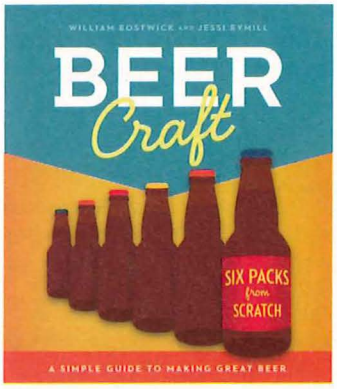
Beer Craft: A Simple Guide to Making Great Beer



Veteran brewers William Bostwick and Jessi Rymill share their love of beer and passion for DIY experimentation in this new, graphic-centric guide to brewing. Covers everything from how-to, to history of beer, brewing on a budget, pairing beer with food and much more. Perfect for new or novice homebrewers! $16.95, Rodale Books.
Available at most booksellers this May.

calendar

May 14
20th Annual Spirit of Free Beer Competition
Falls Church, Virginia

Join metropolitan Washington DC area's largest amateur homebrew competition. Featuring great prizes such as brewing ingredients and equipment, apparel and gift certificates. There is no entry limit and all styles are accepted. The fee is $6 for first entry, $5 for each subsequent entry.
Deadline: May 7
Phone: (301) 762-6523
Email: aaronridge@comcast.net
Web: http://brew.burp.org/Events/SpiritofFreeBeer2011.aspx

May 28
Aurora Brewing Challenge
Edmonton, Alberta

The Edmonton Homebrewers Guild has been hosting the Aurora Brewing Challenge (ABC) since 1999 - the only Canadian competition selected as one of fourteen North American qualifying events for the Masters Championship of Amateur Brewing (MCAB). Entrants are free to enter any one beer they wish in their qualifying style.
Deadline: May 20
Phone: (780) 469-8300
Email: seancormican@gmail.com
Web: http://www.ehg.ca/abc

June 4
15th Annual Celtic Brew-Off
Arlington, Texas

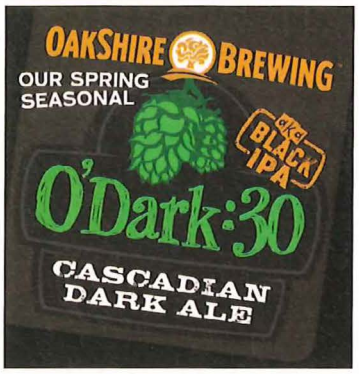
Put on your kilts, dust off the bagpipes, and heat up your brew kettles for this event, hosted by the Knights of the Brown Bottle Homebrew Club of Arlington. It is the self-proclaimed largest homebrewing competition in the country that is devoted exclusively to beers, mead and cider of Celtic origins. Following BJCP guidelines, the first and second round judging will be held May 21st and 22nd, and the conclusion will take place at the Texas Scottish Festival and Highland Games in Arlington in the first week of June.
Fee: $7
Deadline: May 12
Phone: (817) 925-5327
Email: dgtracking@yahoo.com
Web: http://celticbrewoff.com/

by marc martin

DEAR REPLICATOR,

WE HAVE PLENTY OF GOOD BREWERIES HERE IN THE BAY AREA BUT I HAVE FOUND ONE OF MY FAVORITES IN EUGENE, OREGON — OAKSHIRE BREWING. THEY BREW ONE OF THE DARK IPAS CALLED O'DARK:30 THAT IS BETTER BALANCED THAN MANY OF THIS EMERGING STYLE. IT ISN'T SOLD IN CALIFORNIA SO I ALWAYS BRING BACK A FEW BOTTLES. IS THERE ANY CHANCE YOU MAY BE ABLE TO GET THE DETAILS FOR THIS FINE BEER?

DAVID WILKINS
SAN JOSE, CALIFORNIA



david, I too am a fan of this beer. I contacted brewery owner/founder Jeff Althouse for more details about the brewery and their beers.

Jeff had been a public school math teacher when, in 1999, he discovered homebrewing. Soon his brother, Chris, became his assistant brewer, and in 2004 they decided to turn their hobby into a real business. By soliciting the help of some local investors, they pooled enough working capital to buy their first system: two 4-barrel kettles, an 8-barrel fermenter and a 20-barrel bright tank.

Oakshire Brewing was officially opened in October of 2006. That first year their total production was only six barrels. Production has grown to a projected 5,000 barrels for 2011.

For details on the O'Dark:30 ale Jeff referred me to Brew Master Matt Van Wyck. Matt, too, had been a public school teacher instructing science classes. He began homebrewing in 1998 and decided that it should be his new career. He became a pro brewer in 2001 and attended the Siebel Institute short course.

Matt reports that the development of the O'Dark:30 ale was a joint effort between he and the two other brewers, Joe Jasper and Dana Robles. The goal was to create a dark ale that didn't display over the top high alcohol and bitterness characteristics found in other similar examples.

This beer is topped by a light, creamy white head that holds to the bottom of the glass. Not as black as some the beers of this style, it displays dark ruby highlights. The flavor belies the color as no dark grains can be detected. Balance is slightly toward the hop side and the medium body rounds out an overall excellent beer.

David, it can now be O'Dark:30 in your brewery because, you can "Brew Your Own." For further information about Oakshire Brewing Company and their other fine beers visit the Website www.oakbrew.com or call the brewery at 541-688-4555. BYO

Oakshire Brewing Company O'Dark:30 clone

(5 Gallons/ 19 L, extract with grains)

OG = 1.060 FG = 1.012 IBU = 70 SRM = 25 ABV = 6.2 %

Ingredients

6.6 lbs. (3 kg) Coopers light, unhopped, malt extract
12 oz. (0.34 kg) dried malt extract
1.5 lb. (0.68 kg) 2-row pale malt
1.5 lb. (0.68 kg) wheat malt
11 oz. (0.31 kg) Weyermann Carafa® II malt (425 °L)
18.7 AAU Nugget hop pellets (60 min.) (1.6 oz./45 g of 11.7% alpha acid)
3.5 AAU Cascade hop pellets (15 min.) (0.6 oz /17 g of 5.75% alpha acid)
2.9 AAU Cascade hop pellets (0 min.) (0.5 oz /14 g of 5.75% alpha acid)
5.25 AAU Centennial hop pellets (dry hopped) (0.5 oz./14 g of 10.5% alpha acid)
2.9 AAU Cascade hop pellets (dry hopped) (0.5 oz./14 g of 5.75% alpha acid)
½ tsp. yeast nutrient (last 15 minutes of the boil)
½ tsp. Irish moss (last 30 minutes of the boil)
White Labs WLP 001 (American Ale) or Wyeast 1056 (American Ale) yeast
0.75 cup (150 g) of corn sugar for priming (if bottling)

Step by Step

Steep the crushed grain in 2 gallons (7.6 L) of water at 153 °F (67 °C) for 30 minutes. Remove grains from the wort and rinse with 2 quarts (1.8 L) of hot water. Add the liquid and dried malt extracts and boil for 60 minutes. While boiling, add the hops, Irish moss and yeast nutrient as per the schedule. Now add the wort to 2 gallons (7.6 L) of cold water and top off with cold water up to 5 gallons (19 L).

Cool the wort to 75 °F (24 °C). Pitch your yeast and aerate the wort heavily. Allow the beer to cool to 68 °F (20 °C). Hold at that temperature until fermentation is complete. Transfer to a carboy, avoiding any splashing to prevent aerating the beer and add the Centennial and Cascade dry hops. Allow the beer to condition for one week and then bottle or keg. Allow the beer to carbonate and age for two weeks and enjoy your O'Dark:30.

All-grain option:

This is a single step infusion mash using an additional 9.25 lbs. (4.19 kg) 2-row pale malt to replace the liquid and dried malt extracts. Mix the crushed grains with 3.7 gallons (14 L) of 172 °F (78 °C) water to stabilize at 153 °F (67 °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 1.4 oz. (40 g) Nugget hop pellets (16.4 AAU) and the 15-minute addition to 0.5 oz. (14 g) Cascades hop pellets (2.9 AAU) to allow for the higher utilization factor of a full wort boil. The remainder of this recipe is the same as the extract with grains recipe.

Session Creation

Brewing better beers under 5% ABV

by Betsy Parks

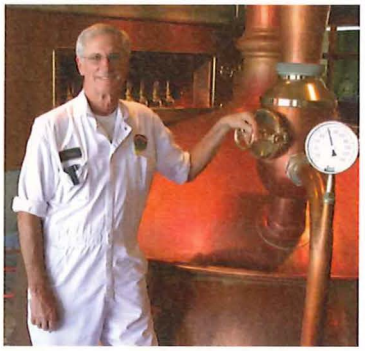
THERE IS A LOT OF TALK LATELY ABOUT BUILDING THE BIGGEST BEER. BUT BIG BEERS SHOULDN'T OVERSHADOW THE LITTLE GUYS. LOW-ALCOHOL BEERS CAN BE BOLD AND FULL-BODIED IN THEIR OWN RIGHT (AND YOU CAN DRINK MORE OF THEM TOO). TRY SOME ADVICE FOR BREWING A SESSION BEER FROM THREE U.S. EXPERTS.

Brewing small beers from the second runnings of a high-gravity beer, like Anchor's Small (3.3% ABV), is a very traditional English practice. When you make a big beer (like Anchor's Old Foghorn, which is where Small comes from) there is a lot of sugar left in the grains.

When we initially made Old Foghorn, we thought it would be great to make a small beer. However, we didn't have the space at the time. The gravity of the Foghorn is so high that it took three mashes to fill our traditional copper kettle (for more about Anchor's brewhouse, visit www.anchorbrewing.com/brewery/brewhouse.htm) and we didn't have the space to save the second runnings. If you want to make a small beer this way, keep in mind that you will need a second vessel.

Once we started experimenting with Small, however, we discovered that if Small were brewed from scratch with the same malts as Old Foghorn that it would be an entirely different beer. Separating the runnings creates a much more grainy taste.

We use an English hop for Small, which is Goldings. We actually use a really large amount of Golding hops because the grainy flavor really balances it out. At home, I think you could use a lot more hops if you brew a low-alcohol beer this way than you think you might be able to use because of that grainy-ness.



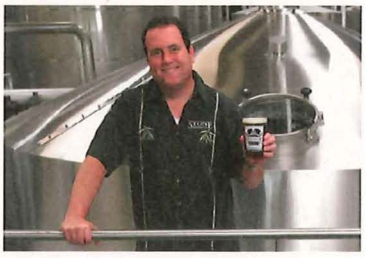
Mark Carpenter, Brewmaster of Anchor Brewing in San Francisco, California. Mark joined Anchor Brewing Company in 1971. Forty years later, he is now Anchor's Brewmaster. In 2000, he received the Russell Schehrer Award for Innovation in Brewing.

I'm not sure how Levitation Ale (4.4% ABV) came about originally, as that was before I was with Stone Brewing Co. But the brewing team was challenged by Greg Koch and Steve Wagner to develop a beer that had all the bold flavors of a Stone beer, but with a lower alcohol content.

Steve asked me to reformulate the Stone Levitation Ale shortly after I arrived, and what I did was pull out some of the crystal malts to dry the beer out a bit. I think the earlier versions of Levitation were a bit heavy on the crystal malt character, which made the beer taste sweet. Then I dry-hopped the beer to make the hop character more forward. We added just a touch of chocolate malt to retain the amber color and add some malt flavor complexity. We changed the hops to the newer (at the time) varieties of Amarillo and Simcoe because we liked these hops, we could get them easily and we weren't using them in any of our other core brands.

This is the only beer we brew where we have a diacetyl rest after primary fermentation. We were having some issues with diacetyl reduction, and this process took care of it.

For homebrewing advice, I think one of the things we've learned from brewing low-alcohol beers is that high dry-hopping rates work great in lower ABV beers. Also, don't try to make the beer sweet as an alternative to forming alcohol during fermentation. Sweet beers, especially at lower gravities, tend to get very cloying. Minimize the amount of crystal malts and use normal conversion temperatures during the mash rest.



Mitch Steele, Production Manager and Head Brewer at Stone Brewing Company, Escondido, California. Before coming to Stone, Mitch worked as the Assistant Brewmaster for Anheuser-Busch's Merrimack, New Hampshire facility.

Jenny Talley (center), Head Brewer and Director of Research and Development for Squatters Pubs in Salt Lake City, Utah. Born and raised in Chicago, Jenny moved to Utah in 1988 to pursue her education at the University of Utah and in tandem, her passion for homebrewing. In 1991, she heard there was an opening for a brewer's apprentice at Squatters and was hired on the spot by brewmaster Dan Burrick. Jenny became Head Brewer of Squatters Pub Brewery in 1994.

Squatters has always been required by the state of Utah to brew 4% ABV beer for draft. We have always had the ability to brew higher alcohol beer, but it had to be packaged. (Now the state lets us sell our bottled or canned high-alcohol beer directly to the customer through our in-house packaging agency licenses without going to the state store first, and a lot of breweries are choosing to do so.)

Full Suspension Pale is our flagship 4% beer. We built some Munich malts into the recipe to enhance the body and also kept the bitterness in line with the lower alcohol. This makes for a really nice sessionable pale ale.

It's easy to brew a low-alcohol beer if you choose the style wisely. English ales are the best for 4% brewing, including milds, summer ales and original bitters. Also, American wheat beers and dry Irish stouts are perfectly suited for the 4% ABV range. Many styles can be altered to make at 4%, however, they sometimes will no longer fall into "style." For instance you can't make a 4% IPA, you are simply brewing a session pale ale. You can easily make an in-style Schwarzbier but by no means can you make a barleywine at 4%. If the style parameters call for between 4%-6% ABV, I feel it is appropriate to try and produce the beer at 4%. But there really is no such a thing as a 4% Russian imperial stout — you are simply brewing a cream stout at that point.

Procedurally, mash temperatures in low-alcohol beers tend to be slightly higher to help produce more unfermentable sugars, which add to the overall body of the beer. I also tend to use a lot of Munich malt to enhance body.

I feel that two major characteristics of a well-constructed 4% ABV beer are, first, to keep the bitterness units in line with the level of alcohol. If you overhop, it becomes hard to drink too much of the finished beer. Second, start the fermentation at about 11 °Plato (1.044 SG) and let the beer fully ferment out. Residual sweetness is never a very enjoyable component of a lower alcohol beer. BYO

Mash Efficiency

Cloudy beers, preserving hop flavor

by Ashton Lewis

Q AS I UNDERSTAND IT, 100% MASH EFFICIENCY ON A BREWERS LEVEL IS ACTUALLY 80% DUE TO GRAIN HULL MASS AND INSOLUBLE STARCHES. SO A MASH THAT CONTAINS PILS MALT HAVING A MAXIMUM 37 POSSIBLE GRAVITY POINTS PER GALLON, AT 80% EFFICIENCY, WOULD YIELD APPROXIMATELY 30 GRAVITY POINTS PER GALLON; A VERY EFFICIENT MASH BY MOST STANDARDS. IF YOU ACHIEVE LESS THAN 100% OF A BREWER'S POSSIBLE YIELD, ARE THERE NOT UNCONVERTED STARCHES PRESENT IN THE BEER THAT WILL CAUSE A HAZE? OR ARE ALL THE REMAINING STARCHES INSOLUBLE? IF YOU PERFORM AN IODINE TEST FOR COMPLETE CONVERSION, AND THE RESULTS SHOW NO REMAINING STARCHES, AND YOU HAVE A MASH EFFICIENCY OF 70%, DOES THAT MEAN 30% OF THOSE STARCHES ARE INSOLUBLE NO MATTER WHAT, OR DOES IT MEAN YOUR SPECIFIC MASH REGIMEN COULD NOT CONVERT THE REMAINING STARCHES AND THEY REMAIN SOLID AND NOT IN SUSPENSION? IS THE FINAL PRODUCT MISSING SOMETHING WITHOUT INSOLUBLE STARCHES PRESENT TO THE POINT I SHOULD INTENTIONALLY DECREASE MY EFFICIENCY? HOW WILL THE WORT FROM A MASH TUN THAT PRODUCES VERY HIGH EFFICIENCIES WITH ACCEPTED NORMAL WATER TO GRAIN VOLUMES, GRAIN CRUSH, MASH AND SPARGE TIMES, TEMPERATURES, pH, ETC. COMPARE TO WORT PRODUCED UNDER THE SAME PARAMETERS BY A MASH TUN THAT IS LESS EFFICIENT?

BILL BRODERICK
NEWNAN, GEORGIA

A Mash efficiency is normally expressed by comparing what is extracted from malt during brewing to the hypothetical or so-called "laboratory" yield. You are correct by stating that when the yield in the brewery equals the laboratory yield that 100% of the hypothetical has been extracted. That is rarely the case because the lab method used to determine the maximum yield uses malt that has been very finely milled and the mash is "sparged" with excess water so that anything soluble in the malt is extracted. Rarely do brewers use this type of mashing and sparging method and the result is that most brewers get somewhere between 85% and 95% of the hypothetical yield.

The stuff that is not extracted into wort during mashing is mainly comprised of husk material and protein. There is often some starch contained in spent grain, but not much. There also may be some large molecular weight carbohydrates that are associated with cell walls in spent grain, such as beta glucans, pentosans and arabinoxylans, but again these compounds don't make up the majority of the solids contained in spent grains. If the lab yield (hypothetical yield) is 80% that means that for every pound of malt used in mashing that 0.80 pounds of extract can be dissolved into wort. The 20% that cannot be dissolved into wort are the compounds I have just named, again mainly husk and protein.

When brewers get yields that are less than the lab yield, they are leaving behind wort in the spent grains, so the loss is primarily in the form of fermentable and unfermentable carbohydrates originating from starch and possibly some unconverted starch. Yielding less than the lab yield is caused by a combination of factors. The primary things that effect yield are milling (fine grist yields more extract), mashing technique (thin stirred mashes tend to yield better than thick infusion mashes) and lauter tun or mash tun design and mode of operation.

You ask about possible problems when the efficiency is less than 100% of lab yield. The problems actually arise when yield is too high. If you measure the concentration of various compounds extracted from the mash during sparging you will find that the wort composition changes. Sugars are continually being leached from the

"When brewers get yields that are less than the lab yield, they are leaving behind wort . . ."

Photo courtesy of Justin Burnsed

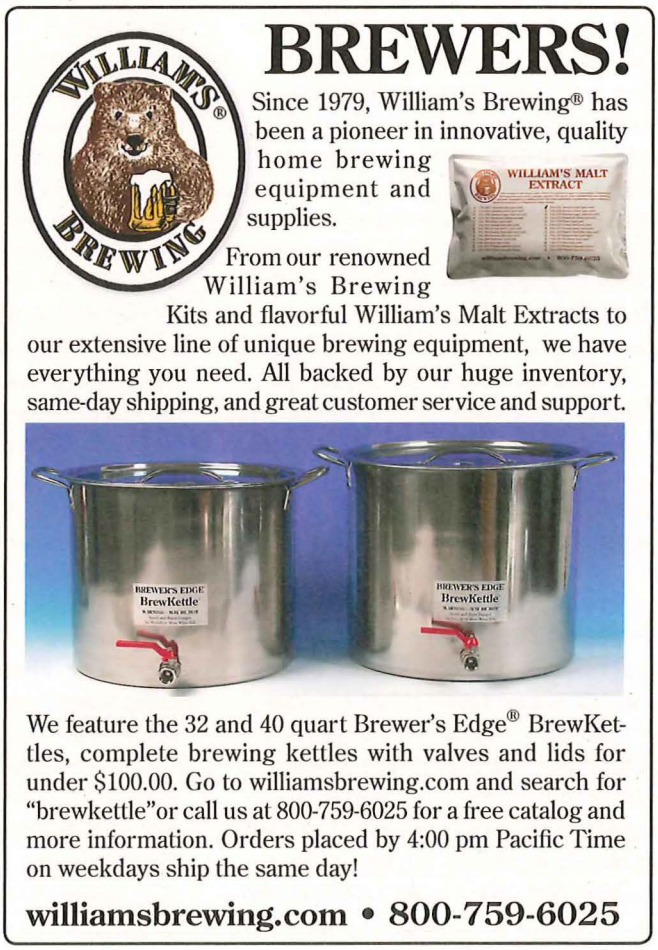
mash bed during sparging and the concentration of sugars (approximated by wort gravity measures) steadily declines as sparge water dilutes the wort. Other compounds begin showing up in wort as the mash/wort pH begins to increase towards the end of wort collection. The concentration of polyphenols or tannins from the malt husk is the main compound of interest that begins to pop up in higher concentration as pH increases. Unconverted starch can also move from the grain bed into the wort as sparging continues. Therefore, many brewers intentionally stop sparging before extracting everything possible from the grain.

Some brewhouses routinely produce less than stellar yields. This is usually due to deficits in equipment design or because of certain techniques. While low yields can be expensive to commercial brewers, they do not have a negative impact on the finished beer. Brewhouses with high yields are normally preferred by commercial brewers because brewing raw material loss in the form of low yield becomes expensive, but it is possible that too much efficiency can be detrimental to finished beer quality.

Q I BREWED A WEIZENBOCK WITH AN OG OF 1.070 AND TRANSFERRED IT INTO SECONDARY CONDITIONING WHERE IT HAS BEEN EVER SINCE AT ROOM TEMPERATURE. I PLAN TO KEG IT SOON, BUT I WAS WONDERING IF I SHOULD COLD CONDITION IT FIRST, AS TO MY KNOWLEDGE, IN HEFEWEIZENS AND WEIZENBOCKS, A CERTAIN AMOUNT OF YEAST LEFT IN SUSPENSION IS DESIRABLE FOR THE STYLE? FINALLY, IS THERE ANYTHING ELSE I NEED TO CONSIDER BEFORE KEGGING IT, AS I KNOW HEFEWEIZENS AND WEIZENBOCKS ARE GENERALLY BOTTLE CONDITIONED.

BRIAN TRIVITT
SPRINGFIELD, MISSOURI

A I think the key with kegging unfiltered beers where you really do want haze and some yeast in the keg is in haze control. If you simply rack cloudy beer from the primary into a keg, force-carbonate using a proven method, and tap the beer, say, three days after racking you are likely to be pretty unhappy with the results. My guess is that the first several pours from the keg will be in the form



of yeast slurry, which is probably not what you want in your pretty weizen glass. You will eventually blow the yeast from the bottom of the keg and net what you seek, but then the next time you pour from this keg you may have a few more pours of yeast slurry.

Haze control is attempting to balance the impossible. You want a beer that is cloudy and has some yeast in suspension, but you don't want yeast slurry pouring from your keg. Haze control at Springfield Brewing begins for our wheat beers with wheat malt selection. I have empirically found a type of malted wheat that works quite well for our brews and it is important to use malt that is able to result in cloudy beer because not all haze is from yeast. We also use a little raw wheat for our American-style unfiltered wheat (and of course we skip this addition when brewing weizens.)

The next major step in haze control is what to do after fermentation. This really depends on the yeast strain. Most weizen beer yeasts are true top cropping yeasts and if you have the ability to skim a fermenter or use a vacuum skimmer (check out "Brewing with a Vacuum Cleaner" in the June 1996 issue of *BYO*) you will be able to remove much of the dense yeast from the top of the fermenter after fermentation is complete. But since most weizen yeast have fairly low flocculation characteristics there will still be a fair amount of yeast in the beer giving a nice haze.

Our American-style wheat is fermented using WLP001 from White Labs. This yeast is fairly flocculent so it is important to allow flocculation to occur before racking. We cool our unfiltered wheat down to 32 °F (0 °C) and hold it for two days before racking, which knocks the bulk of the yeast from solution. It helps if you have some way of dealing with yeast that settles in your keg. We put a ring around the outlet of our serving tanks to prevent yeast that settles from being pulled out into our draft lines since most people prefer drinking beer to yeast sediment. If you use Cornelius kegs you can trim the outlet tube by about a half-inch (1.2 cm) to limit yeast carry-over.

Another approach is to forget about trying to remove yeast before racking and to rack the beer after fermentation is complete and the beer has had time for diacetyl and acetaldehyde reduction. This is where your brews are right now. You could simply rack the beer warm, cool it down in a refrigerator and then carbonate. The trick to prevent half-liter yeast slurry pours is to give your keg a careful "rock" before each tapping session. This moves the yeast off of the bottom of the keg and makes for a nice cloudy pour minus the little yeast clumps that may appear otherwise. There are several commercial brewers of unfiltered wheat beers who suggest keg rocking to draft accounts in order to maintain consistent haze.

Q MY FAVORITE BEER STYLE IS AMERICAN IPA. I'VE BEEN WORKING VERY HARD TO BREW THIS STYLE, COMING UP WITH SOLID RECIPES AND ADJUSTING MY WATER WITH JOHN PALMER'S EXCEL SPREADSHEET. I'VE REACHED THE POINT THAT WHEN I POP OPEN THE FIRST BOTTLE OF MY IPA AFTER ONE TO TWO WEEKS I ANNOUNCE TO THE WHOLE HOUSE, "I HAVE MADE THE BEST IPA ON THE PLANET!" IT TASTES AS GOOD IF NOT BETTER THAN MY FAVORITE COMMERCIAL EXAMPLES. ONE MONTH LATER, IT TASTES TERRIBLE. IT TASTES STALE AND ALL THE WONDERFUL COMPLEXITY OF THE MALT AND HOPS WORKING TOGETHER IS GONE. OTHER STYLES I BREW TASTE GREAT FOR MONTHS. FOR SOME REASON, HOWEVER, I CANNOT KEEP THAT AWESOME FRESH HOPPY TASTE AND AROMA AFTER ONE MONTH IN THE BOTTLE. WHAT CAN I DO TO PRESERVE THIS HEAVEN IN A BOTTLE WITHOUT DRINKING THE WHOLE BATCH IN TWO WEEKS!

MIKE FINN
MIDDLETOWN, NEW JERSEY

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A The problem you describe is not an unfortunate oddity confined to your brewery, rather it is something that plagues all brewers of hopalicious beers.

The main reason that beer aroma goes off in general terms has to do with oxygen pick-up during bottling. Although homebrewers, and many commercial brewers who package unfiltered beers, are comforted by the yeast in the bottle, controlled experiments conducted by brewing scientists have repeatedly demonstrated that unfiltered beers also suffer from oxygen pick-up during filling. Controlled experiments of course are not required if you have ever knowingly had packaging problems with your favorite unfiltered beer. So my initial thought about this problem begins with minimizing oxygen pick-up during packaging. Oxygen pick-up can be difficult to control at home, especially if you bottle flat beer (later conditioned in the bottle) that cannot be fobbed before crowning. Kegging is one way for homebrewers to minimize oxygen pick-up.

Another well-known enemy of beer freshness is storage temperature. If you do bottle your beer flat and bottle condition you must store your beer warm long enough for carbonation to occur. This does not mean that you need to store your bottles at room temperature forever. I suggest moving your beer to a refrigerator after carbonation is complete. This may improve hop aroma stability.

Oxygen and temperature are the two obvious things to focus on when wanting to extend shelf life. I saw a presentation in 1997 at the annual Master Brewers Association Conference held in Montreal that still sticks out as one of the more intriguing technical talks I have attended. The researchers were from the University of Louven in Belgium and their research related to the effect of yeast autolysis on beer stability. The basis for their scientific question is pretty straightforward; when yeast cells die and lyse, enzymes spill into the beer. Since enzymes are not living beings they are active after death. As it turns out there are a wide variety of enzymes that do indeed affect beer stability. Proteolytic enzymes from lysed yeast affect foam stability and esterases from the same source degrade some of the esters associated with beer flavor. Perhaps yeast autolysis also relates to hop aroma stability.

I know that this answer lacks a silver-bullet cure to your problem. I did want to address some of the common causes of loss of freshness and to also let you know that you are not alone with this particular problem. I think the take home message is to do your best at addressing the known causes of staling and then to enjoy your tasty hoppy creations while they are at their peak and be happy with that rewarding experience while it lasts! BYO

American Stout

Dark and bold

by Jamil Zainasheff

I love the rich roastiness of a good American stout, but that was not always the case. Initially I was not impressed with the commercial examples that were supposedly in the American stout category. They were harsh, biting and overly dry. Luckily, I had a chance to drink a Rogue Shakespeare Stout before giving up on liking this style. Filled with dark chocolate, coffee and some citrusy hop notes, it is easy to see why Rogue Shakespeare Stout is the BJCP top example of the style. It is a great example of being bold, but remaining highly drinkable.

Like the Rogue stout, a good example of this style needs to have a big roasted malt aroma and flavor that is reminiscent of coffee and dark chocolate. American stout has more roasted malt flavors and aromas, almost bordering on burnt coffee in some examples, than all the other stout styles except Russian imperial. It is this high level of roasty character that also makes American stout appear anywhere from very dark brown to jet-black in color.

The overall balance of the beer is usually to the bitter, although there should also be a low to medium malt sweetness. That sweetness helps balance the substantial bitterness of the roasted grains and hops. The finish ranges from medium to dry and may even present a slight roast grain astringency. While this is a medium to full-bodied beer, it should not be overly heavy or cloying. Generally, like most American-style ales, this should have a clean fermentation profile, although light fruity esters are acceptable. Late hop character in this style varies from substantial hop character to relatively little. When present, the hop character is often of the citrusy or resiny American type.

The current BJCP style guide lists the ABV at 5 to 7%, but more and more you might see beers that many consider American stouts pushing past this 7% limit. Regardless, if you are brewing a beer in the upper range for alcohol, keep the alcohol character restrained. It should be clean and even though warming character is acceptable, it is better if it never gets too strong. You are not making a great example of the style if it has a hot alcohol character.

You have some flexibility in choosing base malt for American stout. My preference for almost all "American-style" beers is to use domestic two-row, which gives the beer a clean, subtle, background-malt character common to many fine American craft beers. For American stout you could also use domestic pale ale malt which adds a slightly richer background malt character. Again, this is the type of malt character found in many fine US-based craft brews. British pale ale malt or Pilsner malt has too much grainy and biscuit character for this style. Extract brewers should use a light color US-based malt extract. All-grain brewers can use a single infusion mash and a low enough mash temperature so that the resulting beer does not end up too viscous. A temperature range of 148 to 154 °F (64 to 68 °C) works well. Use a lower mash temperature when using lower attenuating yeasts or high starting gravities and use a higher temperature when using the higher attenuating yeasts or lower starting gravity beers.

The majority of the character that defines American stout comes from specialty malts and there is plenty of room for experimenting with specialty grains and rich malt flavors. Every American stout needs roasted malt notes and many examples include caramel malt flavors. Experimenting with the amounts and colors of crystal and roasted malts is a great way to change the character of your beer.

The roast, chocolate and coffee character of the style comes from the use of highly kilned grain. Roasted barley, black malt and chocolate malt are

Continued on page 21

American Stout by the numbers

OG: . . . . 1.050–1.075 (12.4–18.2 °P)
FG: . . . . . .1.010–1.022 (2.6–5.6 °P)
SRM: 30–40
IBU: 35–75
ABV: 5.0–7.0%

Photo from IStockPhoto

citrusy, acidic notes from the hops might play alongside the roast character.

To cut back on the amount of hop material at the end of the boil and subsequent wort loss, I prefer to use high alpha hops for the bulk of the bittering. While all American stouts should have a medium to high bitterness, the balance of bittering versus malt sweetness can range from balanced to firmly bitter. The calculated bitterness to starting gravity ratio (IBU divided by OG) can range anywhere from 0.7 to 1.5, but I like to target in the range of 1.0 to 1.3.

Fermentation should result in a well-attenuated, low ester beer. If you prefer a cleaner, less fruity, more American ale version, ferment with one of the clean American-type strains, such as White Labs WLP001 California Ale or Wyeast 1056 American Ale. You will not have to worry too much about leaving an overly sweet beer with these yeasts either, as they tend to attenuate well even in big beers and at a range of temperatures. Other good choices along these lines are White Labs WLP051 California V Ale Yeast and Wyeast 1272 American Ale II, 1450 Denny's Favorite 50 or 1764 Rogue Pacman.

If you want a more complex beer, you can consider a British or Irish ale yeast, such as White Labs WLP004 Irish Stout or WLP002 English Ale and Wyeast 1968 London ESB or 1084 Irish Ale Yeast.

Regardless of the yeast, you want good attenuation and a relatively clean profile so make certain you oxygenate the wort and pitch an appropriate amount of clean, healthy yeast. Most of the fermentations should be around the 65 to 70 °F (18 to 21 °C) range depending on the yeast strain and recipe. Try to pick a temperature and stick with it, holding the temperature steady throughout fermentation. Holding the temperature steady is important to getting a proper level of attenuation and avoiding off-flavors, especially if you are making a bigger beer. Large temperature swings can result in the yeast flocculating early or producing solventy and/or overly 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 that shouldn't be necessary.

One thing about beers with a high level of roast character is that fresh out of the fermenter they can have an acrid, biting, sharp character. If you experience that in your beer, a little time can let some very dusty roast malt particles settle out and can help lessen that character. Time also affects the balance and intensity of other flavors, and can mellow some of the harsher aspects, so sometimes letting the beer sit for a few weeks before drinking is a wise move. BYO

Jamil Zainasheff is the co-author of two brewing books, Brewing Classic Styles *and* Yeast: The Practical Guide to Beer Fermentation.

FATHER'S DAY GIFT GUIDE

Sunday, June 19th is Father's Day. Let's face it, your dad already has a closet full of ties, a glovebox overflowing with roadmap atlases and a cupboard full of #1 Dad mugs from Father's Days past. Doesn't he deserve to get some gifts this year that he'll really enjoy?

This Father's Day give him something he'll really use. Imagine his surprise when you show up with some of the fine beer and brewing related items on the next several pages to make him feel extra special. How about also bringing a six-pack, or better yet – a fresh Corney keg, of homebrew to let him know how much he means to you. If you're the homebrewing dad of the family, leave your copy of *BYO* on your wife's desk open to these pages or put them up on the refrigerator. Don't be shy – it's your day. Make sure your family knows what you'd really like to get this year that'll say, "Thanks, Dad," more than anything they might think you want.

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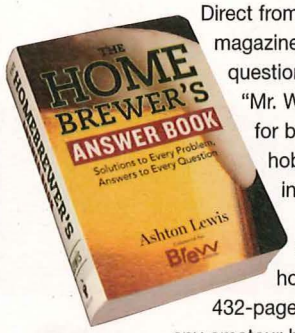

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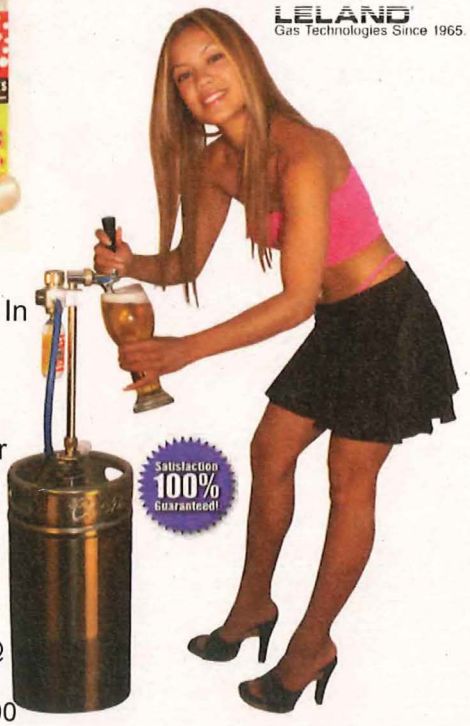

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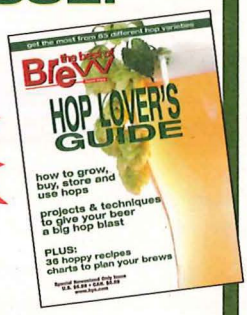

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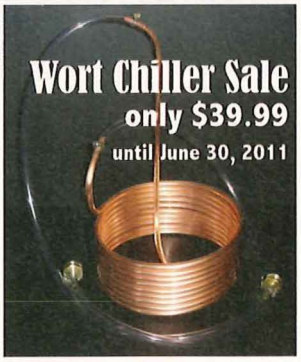

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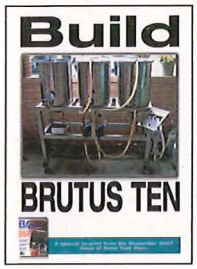

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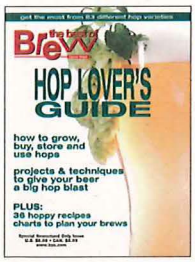

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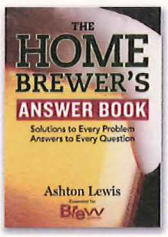

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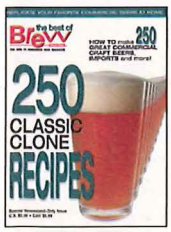

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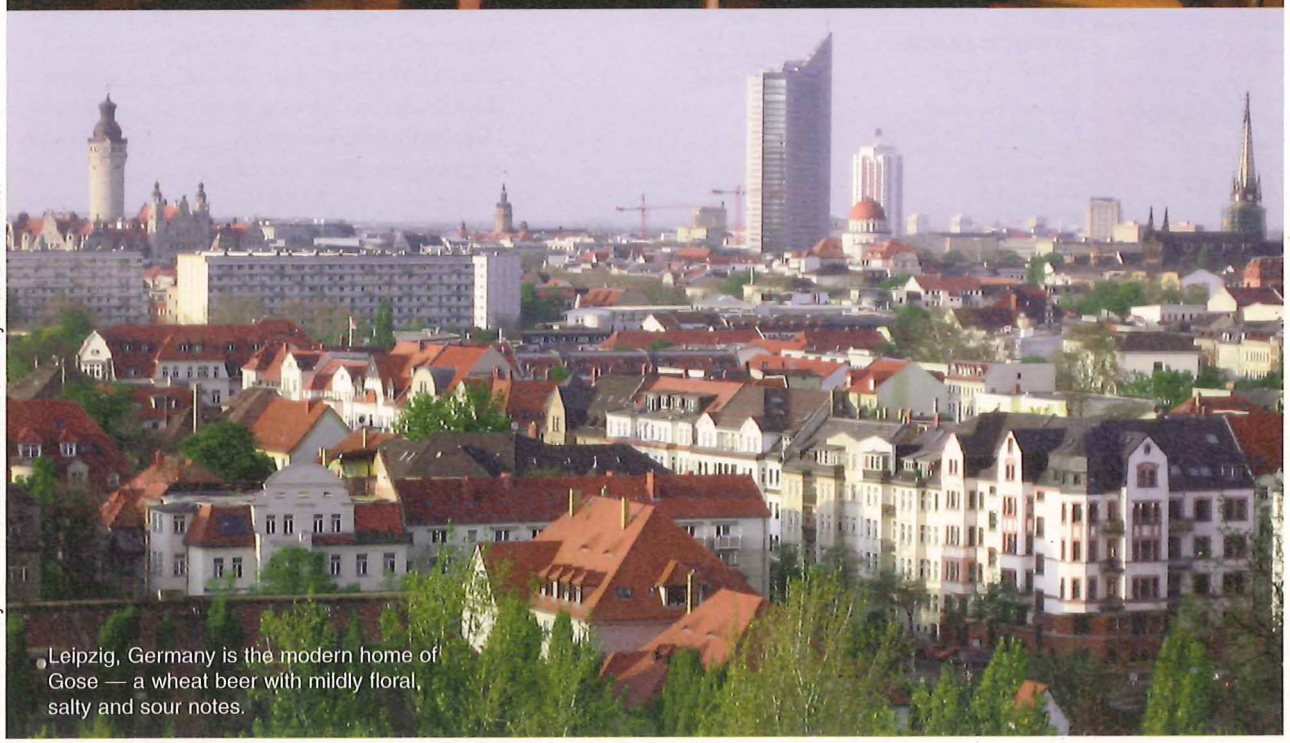


Leipzig, Germany is the modern home of Gose — a wheat beer with mildly floral, salty and sour notes.

Photos courtesy of Gasthaus & Gosebrauerei Bayerischer Bahnhof

Story by **Justin Burnsed**

GOSE

A RELIC RETURNS

We've all seen those advertisements depicting people on vacation south of the border, holding a beer bottle in their hand. More often than not, this bottle has a lime wedge sticking out of its neck. Some folks decide to take their condiment crazed addiction one step further and enjoy dumping salt into their cerveza. Between those funky 3-day old lime wedges the bartender is probably using and the heart seizing dose of salt your sun soaked brother-in-law added to the beer he just handed you, I'd have to pass.

But what if I told you there was a style of beer that is brewed with a gentle hand, using this concept of sour and salty? In addition to that, the floral notes of coriander contribute to a unique flavor and refreshing quality that the style is known for. The beer is called Gose (pronounced goes-uh). It's a style with an interesting history, and perhaps some hope for a future.

Despite the tropical reference above, it isn't likely you'll find this beer at your favorite Caribbean getaway. Before we get into where you can find it today, we must look to the town of Goslar, Germany to find its roots. It has been over 1,000 years since this ale was first brewed. The name itself comes from the river Gose that runs through the town, and rightfully so considering the large contribution that the local water has on the beer's flavor. This particular area was known for mining and one of the most abundant minerals present was salt. Not surprisingly, some of this salt dissolved into the local groundwater which was used during the brewing of their local beer. Since they didn't have water softeners or bottled water, they just used what they had and made it work.

After centuries of dominating the local beer market in Goslar, the popularity of Gose fell. Lucky for us, the town of Leipzig picked up the torch in the early 1800s. Despite the heavy damage done to the local breweries from the bombings of World War II — and the not so brewing friendly attitude of the communist regime in East Germany that followed — Leipzig is still the Gose capital of the world today.

Some of you reading this might be wondering how a sour beer with salt and coriander got past the Reinheitsgebot, the German purity law that states beer must only contain water, barley, hops and yeast. The area that brews Gose falls outside of Bavaria, where this law

was first enforced. After the unification of Germany, there were hurdles that needed to be overcome as this law was then applied to the entire country. Special considerations were eventually made, as they should be for a style that has been brewed for such a long period of time.

The reason a lot of people don't even know this style exists, is that it is extremely hard to find outside of Germany. My first experience with it was about a year ago after obtaining a bottle through some online beer trading. I have never seen it in any of the specialty stores I've been to in Southern California and my only success since was ordering it through an online retailer based out of New York. If you can find it, I recommend the Gasthaus & Gosebrauerei Bayerischer Banhof Gose, although I don't recommend trying to say that three times fast. The limited availability of this style is just one more reason why making it at home just makes good sense.

Speaking of senses, let's talk about what ours should experience when cracking open a Gose. (Despite the ever growing number of styles being added to the BJCP guidelines for us to reference, Gose has yet to make the cut.)

The aroma of the style should be clean, with a detectable level of floral/spicy notes from the use of coriander during brewing. Esters and fusel alcohols should be very low. The unmistakable noble hop character found in most other German beers should not be present in the least bit. As with most beer styles, the signature buttery smell of diacetyl should also be absent from the aroma profile. Generally speaking, the flavor of a gose is moderately sour, crisp, with a slight hint of salt and spiciness from the coriander in the background. Citrusy flavors such as lemon and grapefruit are often present. Bitterness should be very low and hop flavor can range from barely perceivable to non-existent. The mouthfeel of the style is dry, refreshing, light to medium bodied, with a fair amount of carbonation. The appearance can be straw to deep gold in color (3–6 SRM), with clarity that varies from cloudy to semi-translucent.

The traditional base malts for a Gose are wheat and Pilsner malt, used in a 60:40 ratio. The grain bill for a Gose is very simple and in the brewhouses of Leipzig these two grains are the only ones used during the brewing process. For us homebrewers, that may also be the case depending on how we decide to introduce sourness to the beer. The haziness that is often associated with Gose is provided by the high protein levels of the wheat,

Gose is an obscure style, but it has survived for more than a thousand years. Today it is brewed primarily in the German town of Leipzig.

GOSE recipes

There She Gose Again
(5 gallons/19 L, all-grain)

OG = 1.048 FG = 1.012
IBU = 12 SRM = 4 ABV = 4.7%

Ingredients:

5 lbs. (2.3 kg) wheat malt
3.25 lbs. (1.5 kg) German Pilsner malt (2 °L)
2.0 lbs. (0.91 kg) acidulated malt (2 °L)
0.50 lbs (0.23 kg) rice hulls
2.8 AAU Santiam hops (60 min.) (0.5 oz./14 g of 5.6% alpha acids)
1 tsp Irish moss or 1 Whirlfloc® tablet (15 min.)
1.0 oz (28 g) ground coriander seed (10 min.)
0.75 oz (21 g) sea salt (10 min.)
White Labs WLP029 (German Ale/Kölsch Yeast) or Wyeast 1007 (German Ale) yeast
0.75 cup (150 g) priming sugar

Step by Step

Mill the grains, but be sure to keep the acidulated malt separate. Do not mill the rice hulls. Dough in all but the acidulated malt using 4.0 gallons (15 L) of water with a target mash holding temperature of 149 °F (65 °C). Hold the mash temperature for approximately 60 minutes or until the conversion is complete. Add the acidulated malt to the mash for an additional 45 minutes. Try to keep the temperature as close to original mash temperature as possible using an available heat source. Anything between 144–149 °F (62–65 °C) will work. Raise the temperature of the mash to 168 °F (76 °C) and begin sparging with 170 °F (77 °C) water until you collect 6.0 gallons (23 L) of wort in the kettle.

The total wort boiling time for this recipe is 60 minutes. At the onset of a full rolling boil, add your scheduled hop addition. When there are 15 minutes remaining in the boil, be sure to add your Irish moss or Whirlfloc® tablet to help with precipitation of the hot break. At 10 minutes remaining, add both the ground coriander seed and the salt.

Cool the wort to 68 °F (20 °C), transfer to your fermentation vessel and aerate the wort adequately. Add the contents of your yeast starter to the chilled wort. Ferment around 68 °F (20 °C) until the final gravity is reached, which should be in 5 to 7 days. Rack to a secondary vessel and allow the beer to mature another 5 to 7 days around the same temperature. Your beer is now ready to rack into a keg or bottles along with the priming sugar.

There She Gose Again
(5 gallons/19 L, extract with grains)

OG = 1.048 FG = 1.012
IBU = 12 SRM = 4 ABV = 4.7%

Ingredients:

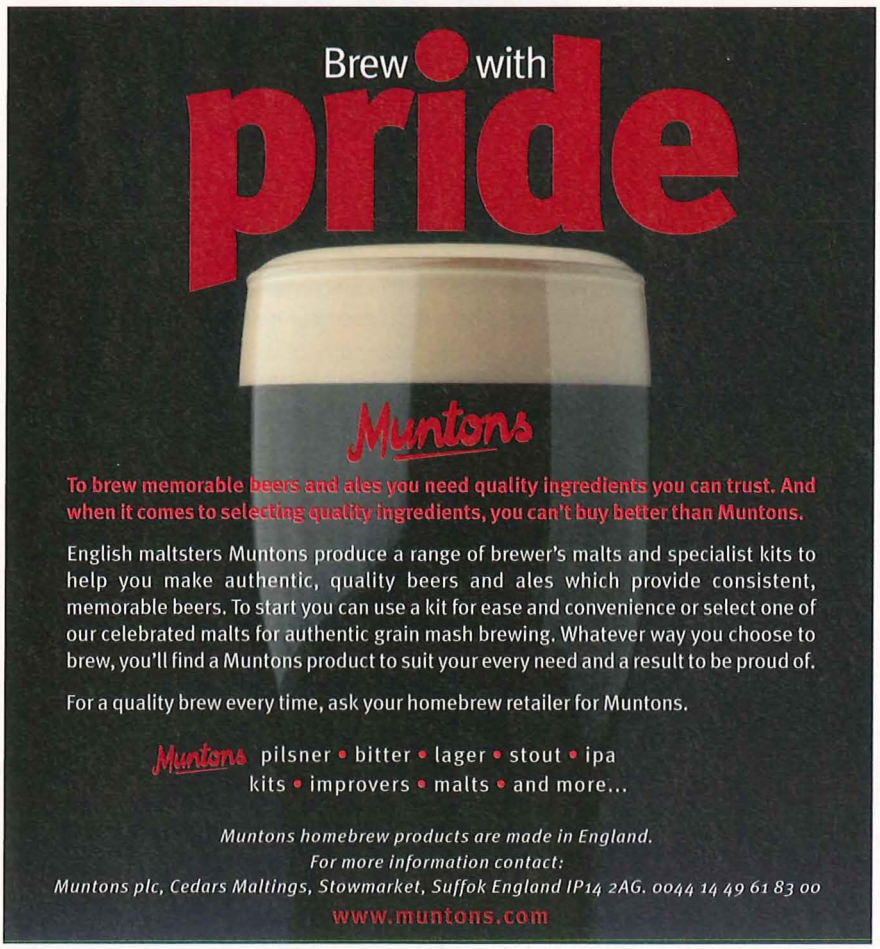
4.0 lbs. (1.8 kg) wheat liquid malt extract
2.4 lbs (1.1 kg) Pilsner liquid malt extract
2.0 lbs. (0.91 kg) acidulated malt (2 °L)
2.8 AAU Santiam hops (60 min.) (0.5 oz./14 g of 5.6% alpha acids)
1 tsp Irish moss or 1 Whirlfloc® tablet (15 min.)
1.0 oz. (28 g) ground coriander seed (10 min.)
0.75 oz. (21 g) sea salt (10 min.)
White Labs WLP029 (German Ale/Kölsch Yeast) or Wyeast 1007 (German Ale) yeast
0.75 cup (150 g) priming sugar

Step by Step

Mill the acidulated malt. Place it in a grain bag and steep using 1.0 gallon (3.8 L) of 154 °F (68 °C) water for 45 minutes. Rinse the grain bag with about 2 quarts (1.9 L) of water and allow it to drip into the kettle for about 15 minutes, but be sure not to squeeze the bag. Add enough water for a pre-boil volume of 6.0 gallons (23 L). Stir in both malt extracts and begin the boil. The total wort boiling time for this recipe is 60 minutes. At the onset of a full rolling boil, add your scheduled hop addition. When there are 15 minutes remaining in the boil, be sure to add your Irish moss or Whirlfloc® tablet to help with precipitation of the hot break. At 10 minutes remaining, add both the ground coriander seed and the salt.

Cool the wort to 68 °F (20 °C), transfer to your fermentation vessel and aerate the wort adequately. Add the contents of your yeast starter to the chilled wort. Ferment around 68 °F (20 °C) until the final gravity is reached, which should be in 5 to 7 days.

Rack to a secondary vessel and allow the beer to mature another 5 to 7 days around the same temperature. Your beer is now ready to rack into a keg or bottles along with the priming sugar.



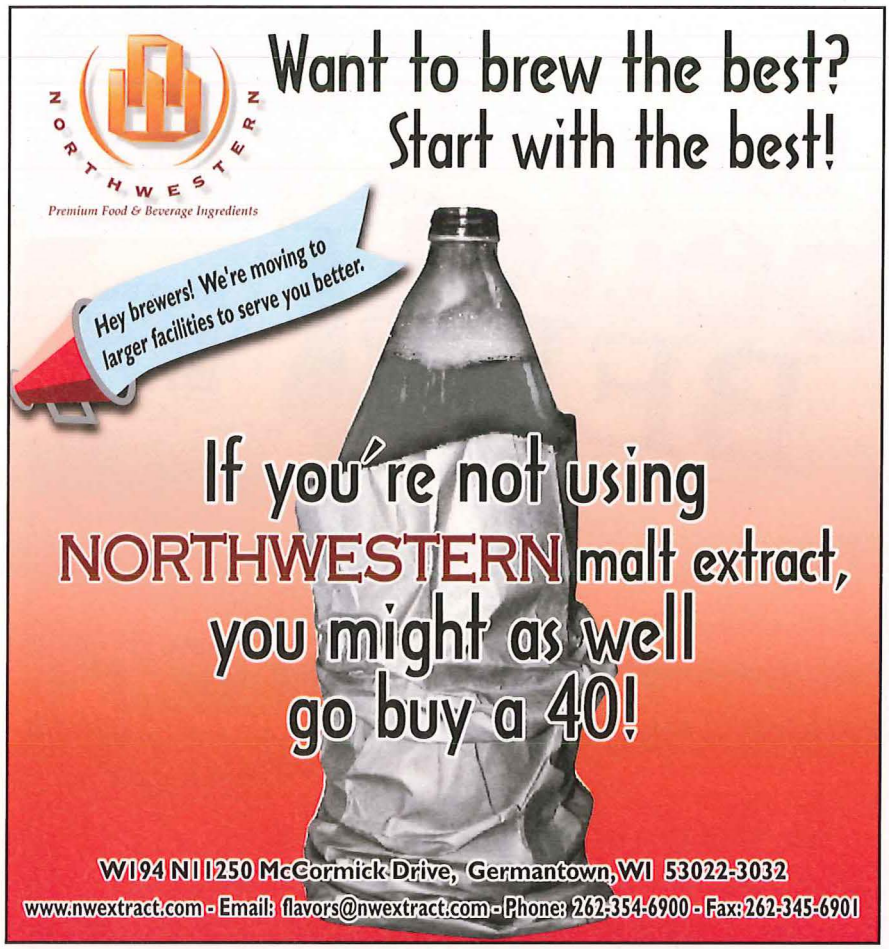
which also lends itself to some of the fruity flavors that we are looking for in the final product. The Pilsner malt gives us that very familiar crisp, clean flavor that many pale German beers are well known for. Extract brewers will want to use dry or liquid wheat and Pilsner malt extracts in the same ratio mentioned earlier. If you can't get your hands on any Pilsner malt extract, you could use standard light malt extract as a substitute, although I am sure that some of the signature flavor will no doubt be missing from the finished beer. As is always the case in extract brewing, you need to find the freshest malt extracts available. When calculating the amount of grain or extract necessary to brew a successful Gose, you are looking for a beer that weighs in at about 3.9–4.9% ABV.

One of the trickier parts of brewing this style of beer is how you decide to bring lactic acid to the party. Traditionally, the brewers used to spontaneously ferment the beer. A mix of yeast and *Lactobacillus* would float into the open fermenters and provide them with the flavor profile and attenuation they were looking for. These days it is a more exact science. A specific strain of yeast is selected and pitched into the wort along with a measured amount of *Lactobacillus*. We as homebrewers can do the same thing. Just as with many other aspects of brewing, adding the use of bacteria to your arsenal takes practice. Pitching rates, fermentation time and special attention to sanitation are just a few of the extra considerations you need to be aware of when using any bacteria to ensure you get the flavors you are looking for. If you have experienced successful results using them before, there's no reason not to here.

For those of us that have little or no experience using bacteria, no need to worry. There are two other methods we can employ to sour the beer. First would be to simply add lactic acid to the beer after fermentation is complete prior to kegging or bottling. That is of course, assuming you can get your

hands on some. Many online retailers have it in stock if you aren't able to find it at your neighborhood homebrew shop. Since the perception of sourness can differ from person to person, I would recommend adding only a couple milliliters at a time to your beer and taste it just before bottling. This beer is supposed to be noticeably sour, but not to the extent of a Berliner weiss or a lambic. The third way to accomplish this is to add acidulated malt to the mash. Acidulated malt is a pale malt that has been sprayed with lactic acid and allowed to dry. The lactic acid content may vary from 1–3% by weight depending on which supplier you get it from. The information as to the actual acid content may or may not be present when you purchase it. As a general rule of thumb, I would use 1.0–2.5 lbs. (0.45–1.1 kg) of acidulated malt per 5.0-gallon (19-L) batch. If you aren't able to get an exact lactic acid percentage, I'd shoot for somewhere in the middle.

Since the beer we are trying to create needs to be on the drier side, a mash conversion temperature of 148–150 °F (64–66 °C) is recommended. The base malts should be allowed to rest for a minimum of 60 minutes. If you use acidulated malt in the mash, there is a specific way you need to do it. The acid in this specialty malt brings down the overall pH of the mash and will have a negative impact on the enzymes that are responsible for the conversion of starches to fermentable sugars. If you add the acidulated malt too early in the mash, it could prevent you from getting the amount of sugars you are looking for. My recommendation is to wait until conversion of the base malts is complete, then add the acidulated malt and rest for another 45–60 minutes. Remember, the primary purpose of this malt is to provide sourness to the beer. You should get a higher amount of total extract as a result of more enzymes being available to



work on the second malt addition. Stirring occasionally can help facilitate that. In the case of extract brewing, you can use a similar strategy by steeping the acidulated malt for the recommended time and temperature in 2 qts. of water per pound of grain (~4 L/kg) prior to adding it to the brew kettle.

Depending on how your system at home is set up, you may want to employ the use of rice hulls during the mashing process. Anytime you have a large amount of wheat or any other huskless grain in your mash, you increase the risk of the runoff getting stuck from the lack of space between the starchy endosperm of the kernels. Even if that has never been a problem for you, it can help ensure your wort flows into the kettle at the rate you are accustomed to. Using a half pound (227 g) of rice hulls per 5.0-gallon (19-L) batch should do the trick.

A 60 minute boil time will be sufficient for this beer, as we aren't striving for much color pickup or extensive wort concentration. Hop additions should be minimal and done very early in the boil. A single addition of a noble German hop like Hallertauer, Tettnanger or any American equivalent hop variety will be sufficient to provide the limited amount of bitterness required (8–15 IBU). There should be just enough iso-alpha acids to offset any residual sweetness in the beer allowing the sour flavors to take center stage. You should shy away from adding hops when there are less than 30 minutes left in the boil.

Another area where personal preference can be exercised is the amount of salt and coriander you decide to use. In the case of salt, you have the added bonus of deciding what type of salt you want to put in your beer. These days you can find anything from Kosher, Brittany Gray, Hawaiian Red, to just plain old sea salt. All of them will have a unique mineral profile and flavor, but that may be a little difficult to detect with everything else that's going on in this beer. Just be sure to stay away from iodized salt, for flavor reasons. 0.5–1.0 oz. (14–28 g) of salt should provide you with enough flavor without

overdoing it. I would start on the low end and sample the wort quickly — after cooling it a bit of course! — to see if any more needs to be added prior to the boil being completed.

The coriander seed you add should be fresh and freshly ground. You may even want to toast the seeds in a dry pan for 5–10 minutes like the chefs do to bring out the essential oils. To obtain the appropriate level of coriander flavor and aroma, I would use 0.5–1.0 oz. (14–28 g). When tasting the beer, it's inclusion in the recipe should be self-evident, but never overpowering. Both the salt and coriander should be added with 10–15 minutes remaining in the boil. You can correct low levels of salt or coriander in the keg or bottling bucket — another reason to start at the low end.

As for the yeast that is appropriate to the style, you'll want to pitch a strain that is very clean and not too flocculent. Attenuation should be at around the 74–78% range to help achieve the dryness this style requires. A couple of commercially available strains that fit these parameters are White Labs WLP029 (German Ale/Kölsch) or Wyeast 1007 (German Ale). Fermentation should be conducted in a temperature range of 66–68 °F (19–20 °C). This will help keep the flavor compounds produced by the yeast to a minimum and allow the ingredients you added to do the talking when it comes time to enjoy the fruits of your labor.

Everyone has heard the overused cliché that when life gives us lemons, we should make lemonade. In relation to how this style was born, I think that that phrase certainly rings true. It is a testament to the human creative spirit in all of us that the good folks of Goslar were able to take their salty water and somehow figure out a way to use it as a foundation for a great beer. But don't take my word for it. Fire up your kettle and see if you agree. I will say this (from my San Diego perspective), on a hot summer day at the beach there's nothing quite like it. Next time you go on vacation, you may just want to throw a couple in your suitcase. Just make sure to check your bags! BYO

Justin Burnsed is a homebrewer turned professional. He blogs at byo.com about the UC-Davis Master Brewer's program and beyond.

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beers from the TOP OF THE WORLD

Story by **Dave Green**

"Denmark?" my wife asks, slightly incredulously.

"Denmark," I say.

It was Valentine's Day 2010 and my wife and I had just finished up a fairly extensive beer tasting of commercial offerings of chocolate, coffee and vanilla stouts. The line up of beers was a present to my wife who — luckily for me — doesn't want roses or jewelry for Valentine's Day, but is absolutely giddy when I send her on a scavenger hunt to find beer bottles hidden around the house. Some of these beers might even have been considered white whales (highly sought after) in the world of stouts. Among the line up is Mikkeller's Beer Geek Breakfast — a last second addition as it had just recently shown up on shelves in my area. I had little prior knowledge of the beer or the brewer, and figured it was an underdog at best. So, as we revealed our favorites, I don't think anybody could have been more shocked than I when our blind taste test revealed that we unanimously picked Beer Geek Breakfast as the winner, chosen for its velvet cream-like body, which exploded on the palate with incredible coffee, dark chocolate and roasted grain flavors. As most fellow beer geeks do at this point, we poured over every nugget of information the bottle offered about the beer and its brewer. It was obvious to me that more research was needed.

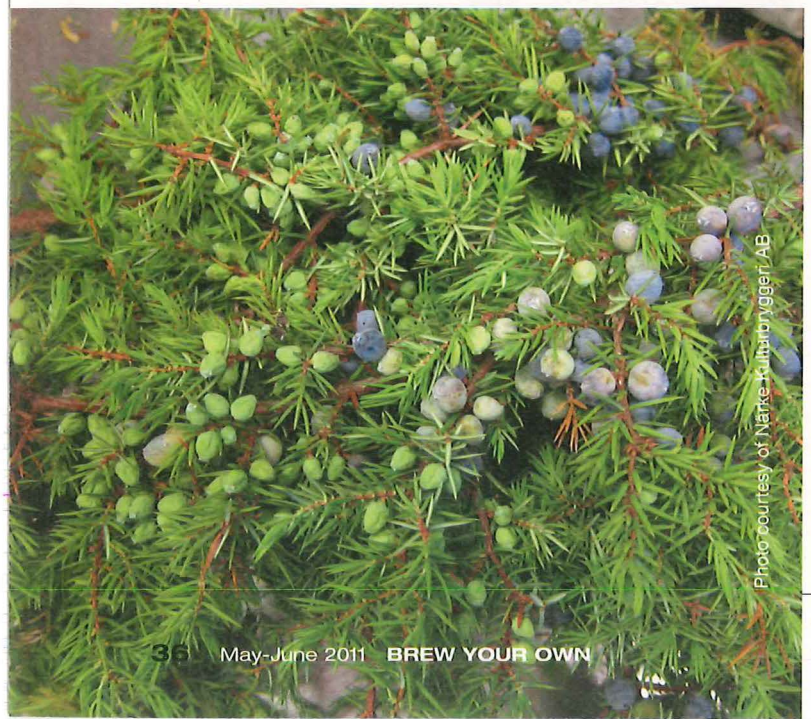
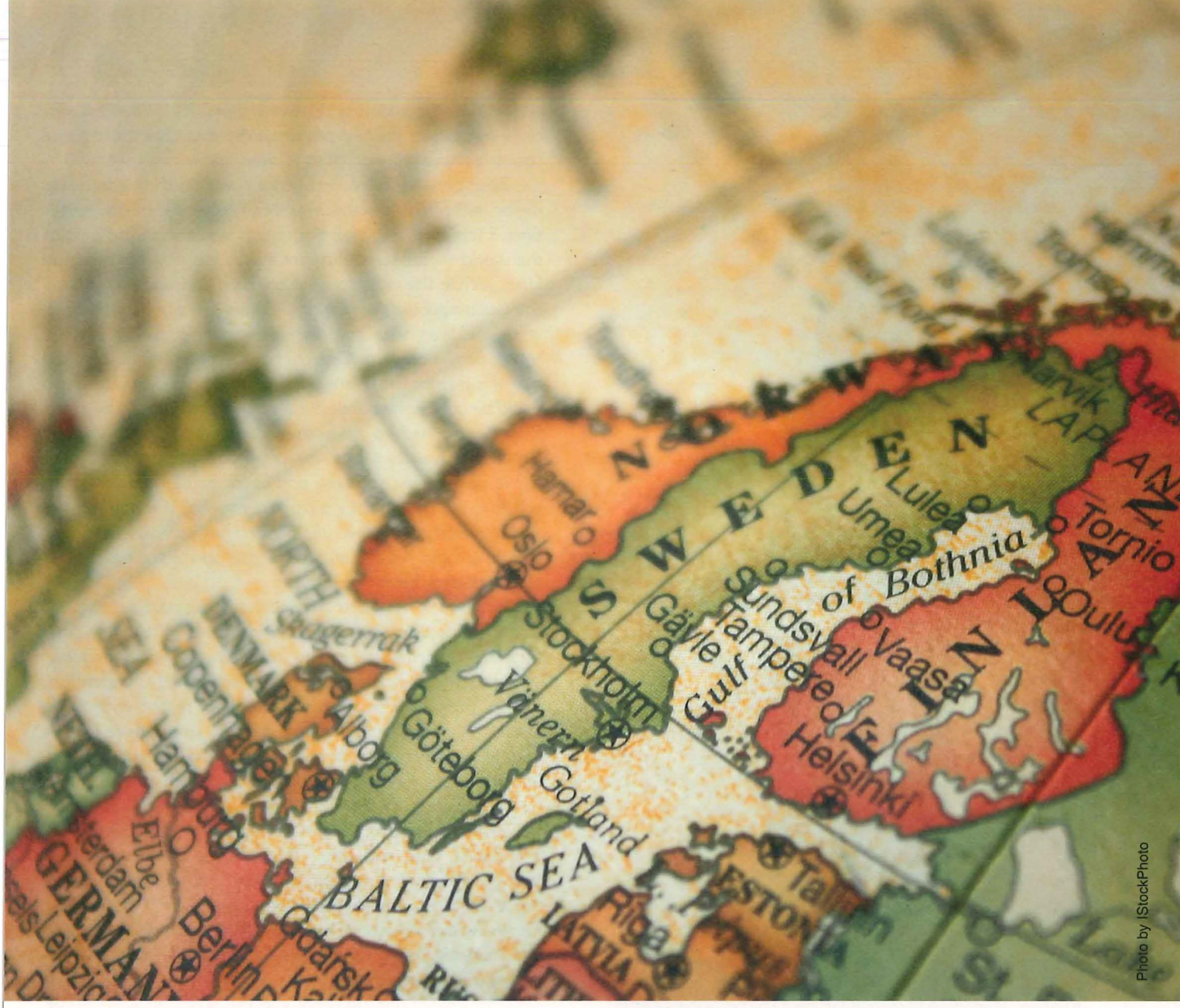


Photo courtesy of Nanke Kulturbryggeri AB

Over the course of the next couple of months, I believe my wife was able to completely sack any stock of Beer Geek Breakfast that our region received. As a homebrewer, the obvious next step was to see what Mikkeller's website had to offer for information on the beer, piece together a possible recipe and see if the brewer would offer comments on the recipe. Mikkel Borg Bjergsø, Head Brewer and founder of Mikkeller's, promptly responded to my email and a whole series of email exchanges followed. Soon, I became transfixed not only with Mikkel and his brewery, but also the whole beer culture, both past and present, of the region.



Norway, Sweden and Denmark all boast a growing band of beer enthusiasts. Tightly woven into this beer culture is the homebrewing subculture, since a growing number of these beer enthusiasts are getting their own hands dirty cleaning their own brewpots. Homebrewing is taken seriously and tasting quality, hand-crafted beers is a thing of pride and enjoyment. It is from this pool of homebrewers that the new Scandinavian craft brewers are emerging.

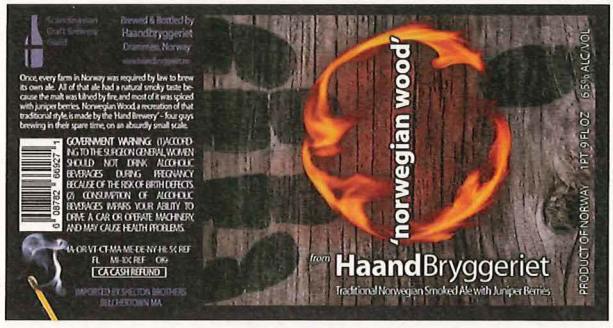
This beer movement is, however, in its nascent stages. Homebrewers in the region were hard pressed to find any brewing supplies in the 1990s through the early 2000s. Kjetil Jikuin of Nøgne Ø Brewery remembers, as an airline pilot in the '90s, stowing brewing supplies from abroad. "Often I had a whole 50 lb. bag of malt in my suitcase and frequently kept my yeast in the cold carts and lockers in the galley," he says.

Craft breweries in these countries have started springing up just in the past decade and the brewers behind the wheels

Top: Norway, Sweden and Denmark are in the early stages of a craft beer revolution. Brewers are inspired by the world's great brewing centers — and increasingly from the region's own extensive farmhouse brewing traditions.
Facing Page: Juniper berries were traditionally used in Scandinavian brewing before the spread of hops.

didn't have a Fritz Maytag or Ken Grossman as forerunners. These are the folks leading the charge in their part of the world and they all have one thing in common — they all got their start homebrewing.

Rising out of the ashes of the long lost traditions of Scandinavian beer is a brand new phalanx of brewers, mixing Old World style with New World spark. Each brewer I talked to mainly cited the traditional centers of brewing — Britain, Belgium and Germany — as their inspiration, but some also gave credit to the American craft scene, leading



the way in the "why not here, why not now?" realm to create a new, distinctive path. Some also are looking inwards for sources of inspiration, since most all sections of Scandinavia have brewing traditions dating back hundreds, even thousands, of years and are actually quite storied once you delve into its history.

Historical Background

The three countries were once united under a single monarch, starting in 1397, although each retained their independence. This union was known as the Kalmar Union and although its lifespan was relatively short since Sweden officially cut ties in 1523, it reaffirms the fact that these three countries have a history that is inextricably tied together.

Beer brewing has long been a tradition throughout this region, although its exact origins can only be surmised at this time. Homebrewing was not only a tradition in this part of the world — for some farmers it was the law. No beer; no farm. While the exact origins are hard to trace, in Norway the *Gulatingsloven*, or law of *Gulating* (an early legislature), were the laws that governed their people during the late Viking period onward. One part of the *Gulatingsloven* stated that if a farmer didn't brew a beer for three years, his farm could be confiscated and split amongst the church and state. Every farm had to have their own working brewhouse, although it usually served many purposes such as acting as the farm's bakery, smokery and even the bathhouse. Farms would grow their own grains, kiln (smoke) their own malts and brew their own beer. Juniper and bog myrtle would have been the most widely utilized spice to add to the beer, especially prior to the arrival of hops.

Beer was a farmer's commodity and was subject to being taxed, traded and, of course, consumed. While I couldn't find any information in my research, I kept wondering whether there would have been homebrew competitions back in the pre-industrial times, village or region-wide. I feel that it's likely because a farmer's beer would have been a source of pride for the farm and in the spirit of competition, leaders would have organized such challenges.

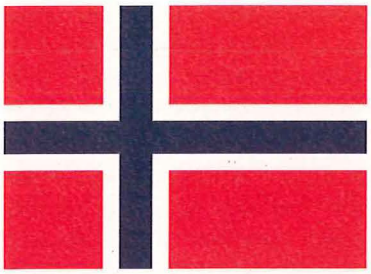
While each region in Scandinavia has its own unique heritage, communication with Germany, the Baltic countries, the British Isles and other far-reaching European regions would have been a regular occurrence due to the fact that these cultures are all well known seafarers. Beers from Germany and Britain Isles would have had some influence on the brewing practices, especially near larger ports where heavy trading occurred.

Hops were not indigenous to the area and were slowly introduced to the southern parts of the region around the 10th Century, adding a new element for the brewers to utilize. Hops were slow to gain traction, though, amongst the farmer/brewers as juniper was very much an intricate part of their beers and flavor profiles.

Another late comer to the area was lager yeasts from Germany, which would have also slowly gained preference over baker's yeasts. But over time lagers came to dominate the baker's yeasts found in farmhouse ales until the point in the past century when the traditional Scandinavian farmhouse ales were all but extirpated from the region. Luckily for us, small pockets of farmhouse brewers survived long enough for the modern movement to gain direct ties with the traditional brewing practices.

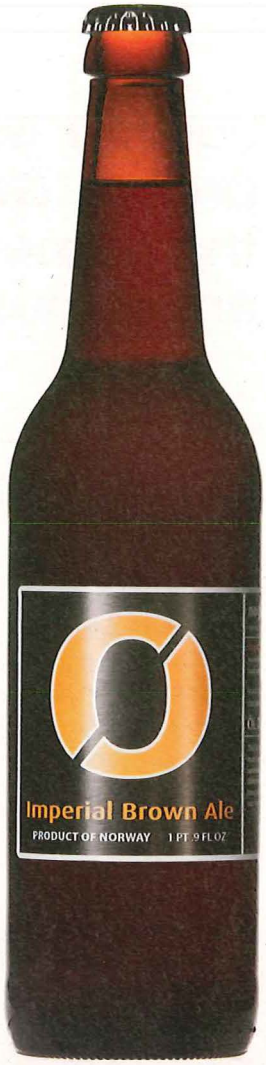
Another Scandinavian tradition which survived the onslaught of pale lagers was the annual tradition of brewing Christmas beers — *Juleøl* in Norway, *Julbrygg* in Denmark and *Julöl* in Sweden. I don't think any culture in the world took the tradition of brewing holiday beers more seriously than Scandinavians.

NORWAY

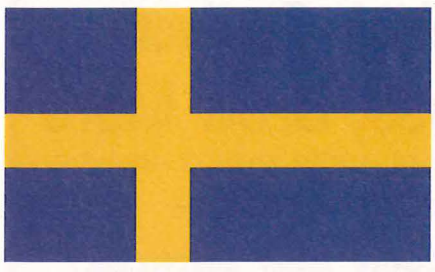


Jens P. Maudal of Haandbryggeriet jumped on the homebrewing bandwagon early after returning from studies abroad in England during the first part of the 1970s. He kept at it and by the early 1990s, he helped organize Norway's homebrewer's society, *Norbrygg*, and was its first sitting chairman. As an early homebrewer, he looked mainly to Germany, Britain and Belgium for inspiration. A quick glance at beers brewed by Haandbryggeriet reveals a nod to each of these brewing epicenters, from a Flemish red to a lambic to a Bavarian weizen to a pale ale. Since he has been brewing for four decades, Jens has had to look deeper for new inspiration. And, he has found it in his backyard, in the tales of how beer was brewed throughout not only Scandinavia, but adjacent regions as well, in the pre-industrial age. Jens has gone to great lengths to try to reproduce these by-gone beverages. In his line-up you will find such beers as Norwegian Wood, *Hesjeøl* and Farewell, a funeral ale, to name a few. Jens and his fellow brewers at Haandbryggeriet are very much into experimenting with traditional beers. Sit back with one of his creations and you may understand why. Jens has no plans to slow down brewing these historical beers of Northern Europe.

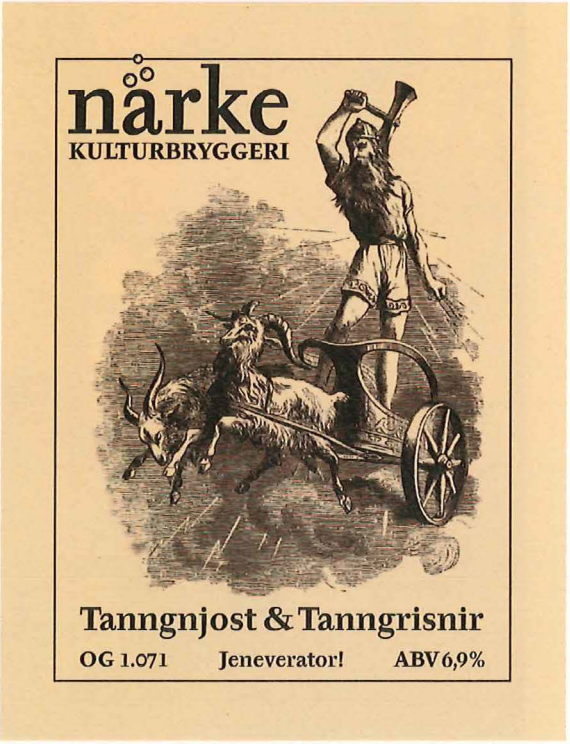
When Kjetil Jikuin founded Nøgne Ø (naked island) brewery in 2002, there were few other craft beers commercially available in Norway aside from some imports. As an extra hurdle, there was very little interest in full-flavored beers at the time. Luckily for Kjetil, "we got lots of attention in the media when we started," which — when coupled with his palate-enticing beers — seemed to be the catalyst for the change in the general public's attitude towards what beer could be. Inspiration for Kjetil came from all over the world since his job as an airline pilot took him to all corners of the globe. But, it was beers from the United States and its respective homebrewing scene that seemed to be most influential to him. He built his own 6-barrel brewhouse and his fermenters from scrap metal and dairy equipment, bottling each beer by hand. Nowadays, he is at the helm of a 40-barrel system making only beers that are true to his heart. English, American and Belgian-style beers dominate his line up. Nøgne Ø also makes sake and their craftsmanship stands up to the best the world has to offer.



SWEDEN



For more than 400 years, starting in 1442, it was mandated by law that all peasants in Sweden grow their own hops to assure a good steady supply. Obviously, beer had quite the historical significance in Sweden. One island off the coast of Sweden has garnered a lot of attention in recent years with the help of beer journalists such as Michael Jackson writing this island onto the world beer map. Gotland is a small 90-mile (145-km) long by 35-mile (56-km) wide island located in the middle of the Baltic Sea off the southeast coast of Sweden. Its claim to fame may be the fact that it has been the proposed homeland for the Goths, whose incursions on the Roman Empire wrote



> "Juniper is a must for a proper *Gotlandsdricka* in the same way that hops are a must for an IPA."

them into the annals of history. But for our purposes it is the *Gotlandsdricka* or "the drink of Gotland" that is of greatest interest. Farmhouse beers are still brewed here in a very traditional manner. The malt for a *Gotlandsdricka* is smoked, sometimes heavily, with the use of birch wood. Juniper is a must for a proper *Gotlandsdricka* in the same way that hops are a must for an IPA. If you take a trip to Gotland today, you will still come upon many farmers operating their farmhouse brewery in a fashion similar to their forefathers.

H-G Wiktorsson and Berith Karlsson from Närke Kulturbryggeri feel very deeply about reviving these vestigial beers and the hand-crafted beers that once dominated their country. According to Berith, "one hundred years ago, there were about 400 breweries alone in Sweden. That's just counting breweries that brewed higher strength beers, since lower alcohol beers didn't need to be taxed and therefore were not counted. By the mid 1990s there were six breweries left in the whole country." The Swedes can once again revel in their beer scene with 25 new craft breweries opening in the past 10 years and more on the way.

H-G and Berith are long time homebrewers. In 1994 they started their own homebrew club, *Källarknut*, and Berith is now the president of the Swedish Craft Brewers Organization, *Föreningen Sveriges Småbryggerier*. Both Berith and H-G hold a special place in their hearts for traditional Belgian beers, especially spontaneously fermented brews, although they have not tried this in their brewery . . . yet. They also cite Bamberg's diverse Franconian beers as a source of inspiration, as well as the traditional English ales and the modern US craft beers. Since their earliest days of homebrewing, inspiration to brew fuller, more enticing beers has always been a priority. Look no further than their mouth watering Stormaktsporter, a 9.5% ABV Russian imperial stout. (Hopefully next time I'll get the recipe for it from them.)

SCANDINAVIAN CLONE RECIPES

Norwegian Wood clone (Haandbryggeriet)

(5 gallons/19 L, all-grain)

OG = 1.060 FG = 1.010

IBU = 28 SRM = 22 ABV = 6.7%

Jens P Maudal, Head Brewer at Haandbryggeriet AS, "The recipe is our recreation of a traditional farm ale that was every farm's regular drinking ale, and a stronger version was normally brewed for the Christmas holiday season."

Ingredients

8 lbs. 3 oz. (3.7 kg) Weyermann smoked malt
2.0 lbs. (0.91 kg) Munich malt
19 oz. (0.55 kg) Weyermann CaraAmber® malt
18 oz. (0.51 kg) British amber malt
11 oz. (0.31 kg) British pale malt
0.3 oz. (8.5 g) Northern Brewer hops (mash hop)
1.8 AAU Northern Brewer hops (60 mins)
(0.21 oz/6.0 g of 8.5% alpha acids)
5.9 AAU Centennial hops (20 mins)
(0.6 oz./17 g of 9.75% alpha acids)
5.6 AAU Cluster hops (0 mins)
(0.8 oz/22 g of 7% alpha acids)
2 branches of fresh Juniper (with green berries)
Wyeast 3638 (Bavarian Wheat), White Labs WLP315 (Bavaria Weizen Yeast) or other wheat/wit yeast
(2 qt./2 L yeast starter)

Step by Step

Single infusion mash at 151 °F (66 °C). Mix the two juniper branches and mash hops in with mash. Mash malts for 60 minutes. Boil wort for 90 minutes. Fermentation temperature is 68–70 °F (20–21 °C) "We use a wheat beer yeast with little banana flavor, or you could use a wit beer yeast." (Note: banana flavor/aroma decreases with pitch rate.)

Imperial Brown Ale clone (Nøgne Ø – Det Kompromissløse Bryggeri)

(5 gallons/19 L, all-grain)

OG = 1.079 FG = 1.021

IBU = 36 SRM = 32 ABV = 7.5%

Ingredients

12 lbs. 2 oz. (5.5 kg) Thomas Fawcett Maris Otter pale malt
1 lb. 11 oz. (0.77 kg) wheat malt
1 lb. 11 oz. (0.77 kg) Munich malt
1.0 lb. (0.45 kg) Caramalt malt
6.3 oz. (0.18 kg) amber malt
3.2 oz. (90 g) brown malt
3.2 oz. (90 g) chocolate malt
9 AAU Chinook hops (90 mins)
(0.75 oz./21 g of 12% alpha acids)
11 AAU East Kent Golding hops (5 mins)
(2.3 oz./65 g of 4.75% alpha acids)
16 AAU Columbus hops (0 mins)
(1.6 oz./45 g of 13.5% alpha acids)
White Labs WLP007 (Dry English Ale), Wyeast 1098 (British Ale) yeast

Step by Step

Mash in at 151 °F (66 °C) for 45 minutes; raise to 162 °F (72 °C) for 15 minutes to finish saccharification. Or, you can just hold the mash at 151 °F (66 °C) for the duration of the 60 minutes. Boil wort for 90 minutes. Pitch yeast at 68 °F (20 °C) and try to maintain that temperature through primary fermentation. Age for ideally 6 months after packaging before consumption.

Partial mash option:

Replace pale malt with 2.0 lbs. (0.91 kg) light dried malt extract and 5.75 lbs. (2.6 kg) light liquid malt extract. Mash grains in 6.5 qts. (6.2 L) of water at 151 °F (66 °C) for 45 minutes. Rinse grains with ~4 qts. (~4 L) of 170 °F (77 °C) water. Dissolve dried malt extract into wort and bring to a boil. Boil wort for 90 minutes, stirring in liquid malt extract for the final 10 minutes of the boil. Cool wort and transfer to fermenter. Add water to top up to 5.0 gallons (19 L), aerate and pitch yeast. Ferment at 68 °F (20 °C). Age for 6 months.

Beer Geek Breakfast clone (Mikkeller)

(5 gallons/19 L, all-grain)

OG = 1.080 FG = 1.023

IBU = 80+ SRM = 112 ABV = 7.5%

Mikkel, Mikkeller's gypsy brewer, says what truly makes this beer special is, "The coffee. The way of adding coffee gives the beer a fresh true coffee aroma and flavor."

Ingredients

7 lbs. 13 oz. (3.5 kg) Pilsner malt
2 lbs. 3 oz. (1.0 kg) flaked oats
2 lbs. 3 oz. (1.0 kg) oat malt
1 lb. 2 oz. (0.5 kg) Caramunich malt
10 oz. (0.27 kg) smoked malt
1 lb. 2 oz. (0.5 kg) brown malt
12 oz. (0.34 kg) pale chocolate malt
1 lb. 2 oz. (0.5 kg) chocolate malt
1 lb. 2 oz. (0.5 kg) roasted barley
12.3 AAU Centennial hops (90 mins)
(1.4 oz/39 g of 8.8% alpha acids)
8.7 AAU Chinook hops (90 mins)
(0.7 oz./20 g of 12.4% alpha acids)
2.8 AAU Cascade hops (90 mins)
(0.4 oz./11 g of 7% alpha acids)
7 AAU Cascade hops (1 min)
(1.0 oz./28 g of 7% alpha acids)
1.0 oz. (28 g) ground coffee
Wyeast 1056 (American Ale) or White Labs WLP001 (California Ale) or Safale US05 yeast

Step by Step

Mash in at 153 °F (67 °C) and hold for 75 minutes. Lauter slowly to account for the high levels of glucans in the mash. Boil for 90 minutes, adding hops as indicated. Ferment between 68–72 °F (20–22 °C). Two days prior to bottling or kegging, add the ground coffee to a 1 liter French press for hot extraction of the coffee. Press off and very gently pour into the fermenter.

Tanngnjost & Tanngrisnir clone (Närke Kulturbryggeri)

(5 gallons/19 L, all-grain)

OG = 1.071 FG = 1.014

IBU = 27 SRM = 14 ABV = 7.5%

Berith Karlsson, from Närke Kulturbryggeri, "being a double bock lager, is named after the two goats pulling the wagon of Thor, the god of thunder."

Ingredients

7 lbs. 8 oz. (3.4 kg) smoked malt (Gotland, Viking or Weyermann)
5 lbs. (2.3 kg) Munich malt
1.0 lb. (0.45 kg) Carapils® malt
1.0 lb. (0.45 kg) wheat malt
13 oz. (0.36 kg) sucrose
7.5 AAU Northern Brewer hops (60 mins)
(1.0 oz./28 g of 7.5% alpha acids)
4.3 AAU Hallertau Mittelfruh (1 min)
(1.3 oz./38 g of 4.25% alpha acids)
4 twigs female (with berries) juniper
Lager yeast (your choice)

Step by Step

Measure out the water required for mashing and sparging. Toss in the juniper twigs and bring to a boil, boil for 5 minutes. Remove twigs and use for mash and sparge water. Single infusion mash at 151 °F (66 °C).

"The most important, and maybe the hardest part is the juniper. There are 50 different sorts of juniper. The Nordic version is called *Juniperus communis L.* For brewing you have to take the female juniper, the one with berries. The rest of the recipe can vary. You could take your own homegrown hops if you want. We think you should use the Gotland smoked malt (Gotland smoked malt is smoked with birch). You can also use honey and oats."

Homebrewing in Scandinavia

Scandinavia has ancient brewing traditions — including beers spiced with juniper (as seen above) — but modern homebrewing there borrows mainly from the brewing centers of England, Germany and Belgium . . . and to a lesser extent, the United States.

Here in Scandinavia, homebrewing lives and develops in a setting which takes influence both from the regional history and from the world around us. Scandinavia consists of Denmark, Norway and Sweden. Finland and Iceland are also sometimes thought (by non-Scandinavians) to be included in Scandinavia, although this wider community of nations should really be referred to as "Norden," or the Nordic countries. Norway, Sweden, Finland and Iceland uphold retail alcohol monopolies, which have an impact on the beer scene. Denmark is directly connected to the main part of the European continent and much more densely populated than the others. It plays a more important role in the history of beer and brewing (think of the groundbreaking yeast isolation work by Emil Christian Hansen at Carlsberg around 1880), and it has a distinctly less restrictive alcohol policy.

Norway, Sweden and Finland all still have their own living traditions of centuries-old homebrewing. In Finland there is traditional sahti (juniper-flavored beer) brewing, and Norway has its traditional dark and smoky *maltøl*.

Gotlandsdricka, or *dricke* (drink) as it is called on the Swedish island of Gotland in the Baltic Sea, is the only traditional homebrewed beer to survive the industrialization of brewing in Sweden, and still is produced in largely the same way as several centuries ago. *Gotlandsdricka* is characterized by smokiness, spiciness and turbidity. Traditionally, the barley is home-malted, and some farms still produce their own malt for *dricke*. Malted wheat or rye can also be used. Kilning is performed using open fire, typically beechwood, and the malt is heavily smoked and even tarry. The wooden vats used for mashing are lined with juniper twigs to provide a false bottom for lautering, and this gives the dricke its distinctly spicy character. Fermentation is typically carried out using baker's yeast. *Dricke* is drunk very young, actually while still fermenting, and more sugar is added during the weeks it is being consumed, to keep the fermentation going and the dricke from souring.

Present-day homebrewing in Scandinavia is, however, more influenced by international trends in the professional brewing scene than by the locally-surviving traditional homebrews. Judges at the national homebrewing competitions in Norway or Sweden would find it much more difficult to judge a *maltøl* or a *Gotlandsdricka* than an imperial IPA or saison.

Until recently, homebrewing was dominated by Australian and British beer kits, but their sales have dwindled, as homebrewers in Scandinavia have gained access to top-quality malts, extracts, hops and yeasts.

A fair amount of barley is grown in Scandinavia, and there are domestic maltsters, but the internationally recognized producers of quality malts have a strong position in both the microbrew and homebrew markets.

The malt extracts used by homebrewers are to a large extent spraymalts (dried malt extracts) from the UK. Unlike in the US, homebrew retailers cannot rotate liquid malt extracts quickly enough to ensure freshness.

Historically, hops have been grown rather extensively in Scandinavia, but nowadays practically all hops used for both professional brewing and homebrewing are imported from the most prolific hop growing countries, including the UK, Germany, Czech Republic and Slovenia. In recent years, there has been a strong increase among microbrewers and homebrewers alike in the demand for American hops and most recently New Zealand hops, due to their unique aroma characteristics.

Arguably most important of all, homebrewers and microbrewers in Scandinavia have ready access to the whole range of liquid yeast cultures as well as dried yeasts from the top yeast laboratories of the world.

Of course, good ingredients will only get you so far. To make great beer you also need to know how to make good use of them. So how do Scandinavian homebrewers obtain their information? Modern homebrewing in Scandinavia is to a large extent inspired by the English-speaking brewing community, and there is a multitude of books available. (For example, "How To Brew" by John Palmer is popular.) In addition, *Brew Your Own* has a sizable circulation in Scandinavia.

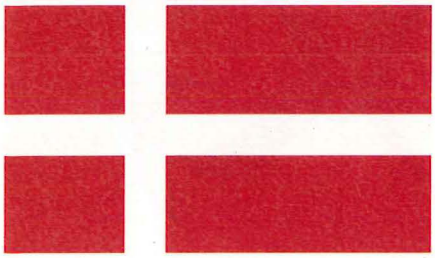
All these types of information sources are also available in the local Scandinavian languages. Each country has at least one modern brewing book written by homebrewers. In Sweden the magazine *Hembryggaren* (The Home Brewer) was founded twenty years ago. Each country has at least one Internet forum and several blogs dedicated to homebrewing, and at least one country has a homebrewing podcast.

In each of the countries there are several local brewing clubs, and each also has its own national homebrewing competition. To top it off, for the last several years there has been a Scandinavian championship where the top three brews from each national competition competed.

All in all, Scandinavian homebrewing is alive and well. The future looks bright for this great hobby in the north of Europe.

Svante Ekelin is a co-founder of the Swedish Homebrewers' Association and the Swedish Beer Judge Certification Program.

DENMARK



With the closest ties to Germany of the three Scandinavian countries, it may come as no surprise that Northern-German-styled Pilsners came to dominate the beer output of Denmark relatively early. Despite this fact, a few regional breweries kept the Scandinavian Christmas beer (*Juleøl*) tradition alive. Even through the dark ages of beer in the country, when the pale lager dominated the market, *Juleøl* could still be found in most corners of the country. Even today pale lagers dominate 95% of the market, but the dynamics for change are well in the works. A microbrewery explosion has hit the country which roughly parallels Sweden and Norway.

One of those leading the charge is Mikkel Borg Bjergsø. Mikkel has taken an interesting road to opening a brewery. When he launched his brewery in 2006, instead of sourcing a brew system, fermenters, filter, pumps, grain mill, bright tanks, warehouse space etc., Mikkel decided to look at existing breweries that would allow him to rent their brewing equipment and fermenting space so that he could brew his beers at their breweries. And so the age of the "gypsy brewer" was born. Mikkel travels extensively to various breweries to brew his own beers. He has to adapt to the changing water profile and equipment, but it also allows him to pick and chose among various profiles if and when fermenter space is available to him.

Mikkel started homebrewing in 2003 as "a way of getting a good hoppy IPA without having to pay $10 for it." He cites the US and Belgium as his two biggest influences for his brewing since Hoegaarden and Chimay were his original jumping off beers into the greater craft world. Later he found the big hop-bombs, imperial stouts and barrel aged beers of the US-scene to be very alluring. One particular aspect of Mikkeller's beers that appealed to me is his experimental line of beers, most notably his single hop and yeast strain lines. Just as a homebrewer might split a batch between two or more yeast strains or dry hopping with different hop varieties, Mikkel has done these experiments at a commercial scale. If you come across any one of these series, I highly recommend doing some side-by-side tasting.

So do yourself a favor, find one of these Scandinavian offerings. You may feel like me and look north for inspiration for your next brew session. BYO

Dave Green is an avid homebrewer and Advertising Coordinator for Brew Your Own.

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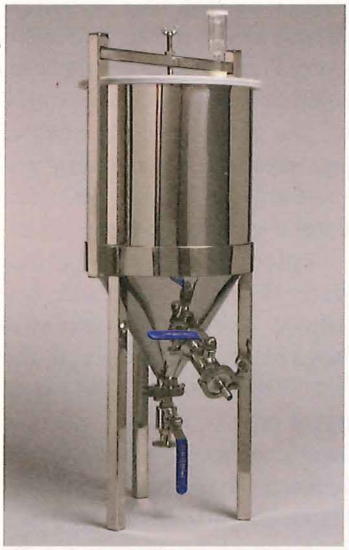

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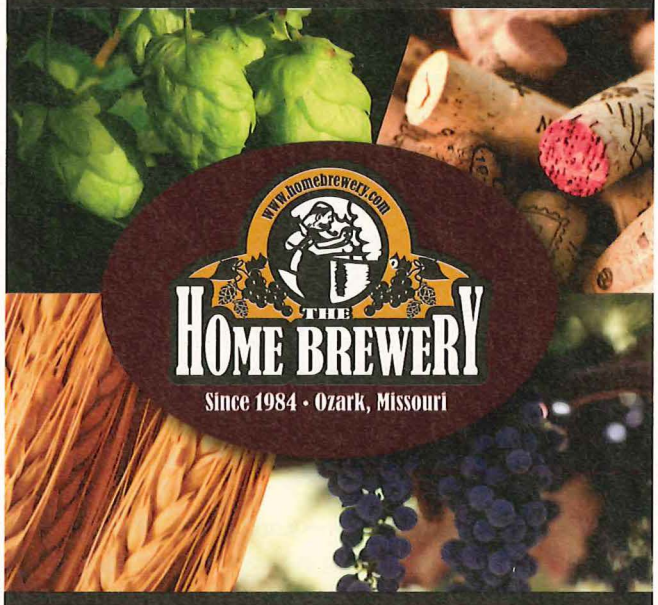

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Viking Ale

Raid, Pillage, Plunder . . . Then Brew.

What do you know about Irish beers? Something about Guinness stout would likely be most people's answer to that question, yet it's really nothing but an import. Porter and stout were English brews, which Guinness took up in the 18th Century and brewed so successfully as to almost entirely eliminate its English predecessors. Of course, brewing had been carried out in Ireland for some while before Arthur Guinness got into the business, but for how long? And when was beer first brewed in Ireland?

The stock answer is that we don't know, because there's very little written history about Ireland prior to the Christian era. When the latter arrived, Ireland did become a center of learning with the establishment of monasteries, but it seems that the monks were more concerned with writing about Latin learning and Christian theology than with more mundane topics such as brewing.

There is quite a bit of archaeological evidence of settlements established during the Neolithic or late Stone Age, especially in the shape of megalithic tombs. The Bronze Age left behind various bronze ornaments, along with weapons and tools, but it was not until the Iron Age (from about 600 BC on) that Celtic peoples arrived, and artifacts were produced in continental Celtic style.

In the absence of written evidence, one of the modern archaeologist's tools for finding out about earlier people's cultures has been that of reconstruction. In Britain I've seen working models of ancient war engines, construction of medieval villages, and of course attempts to work out methods of moving and lifting the great weighty uprights and lintels that make up Stonehenge. One such experiment in Ireland concerned the brewing of beer, which is where this story really starts. And it's really a story about homebrewing with something of a different twist from our usual approach.

The Bronze Age Beer

There is an Irish field monument consisting of a horseshoe shaped mound and an associated trough, known as a *fulacht fiadh*. The purpose of the trough was not clear, although experiments in the 1950s suggested that it was used in cooking, but other purposes such as tanning and dyeing have been proposed. The general consensus was that whatever the end purpose, the main function was that of heating water in the trough by means of adding hot rocks.

Enter Billy Quinn, Nigel Malcolm and Declan Moore of Moore Environmental and Archaeological Consultants in Galway. They report that while breakfasting to dispel a hangover, they came up with the idea that the *fulachts* were early Irish breweries. They discussed their idea with a variety of people, took in a conference on Prehistoric beer in Barcelona, Spain, visited Canada and the Orkney Islands off Scotland, finally making a call at the Rauchenfels Brewery in Marktoberdorf, Germany. The latter, as you may know, is the home of Rauchenfels Steinbier, a beer made by boiling the wort through the addition of hot stones.

That done, they set about making the beer, aiming to use as authentic a method as they could, which meant starting with a 60-year-old wooden trough "posthumously donated by Billy's granduncle." This was caulked with clay and moss, then lowered into a pit in the ground, and filled with water. For the heating stones they brought in granite and sandstone from Connemara, since local limestone was deemed unsuitable for this purpose. They did make some compromise,

Story by **Terry Foster**

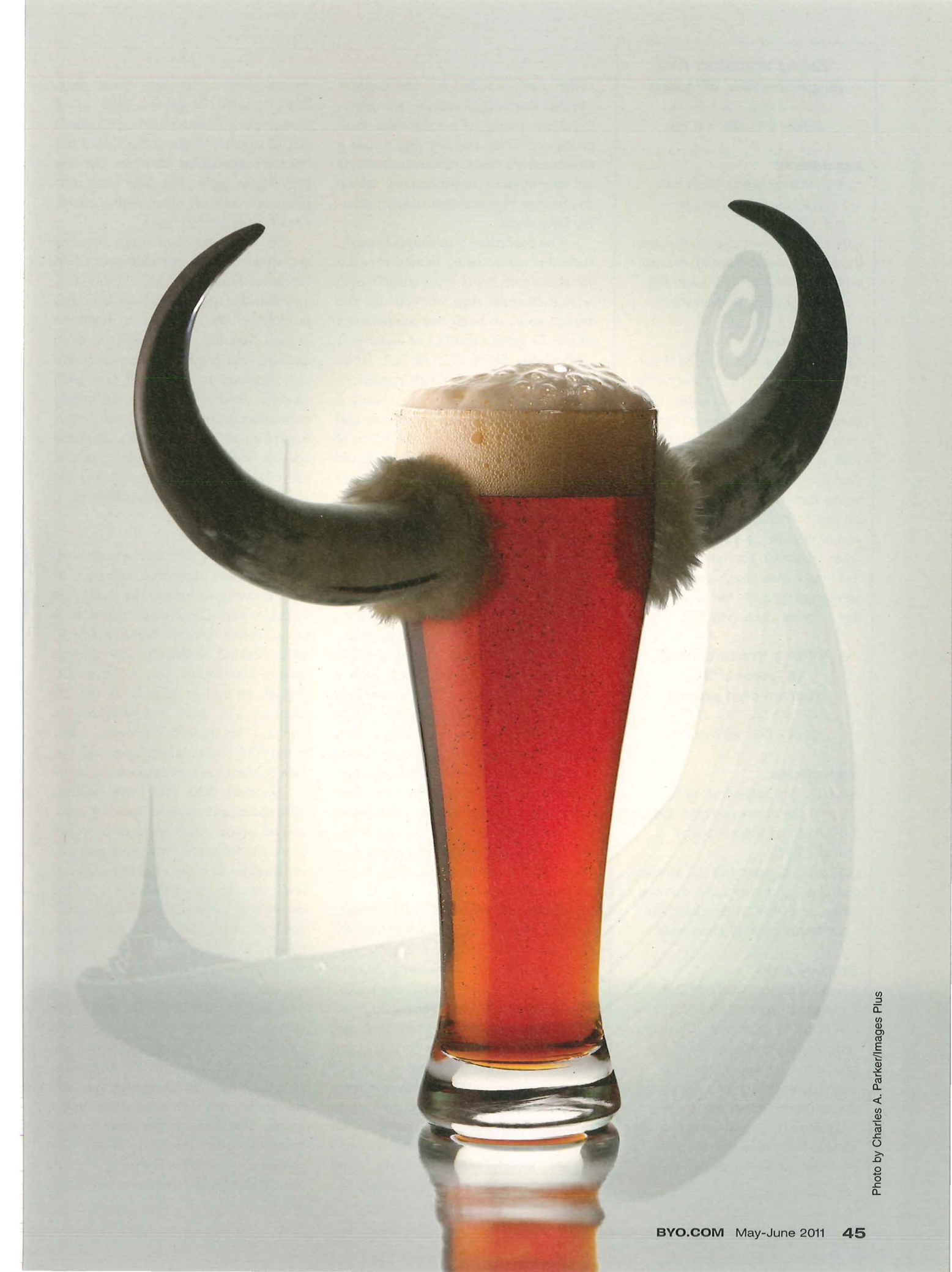

Photo by Charles A. Parker/Images Plus

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

OG = 1.055 FG = 1.013
SRM = 6–8 ABV = 5.1%

Ingredients

10.5 lb. (4.8 kg) Briess Pilsen malt
1.0 lb (0.45 kg) Briess Caramel malt (20 °L)
0.07 oz. (2 g) sweet gale (60 minutes)
2.0 oz (57 g) heather tips (0 minutes)
White Labs WLP011 (European Ale) or Wyeast 2000 (Budvar) yeast

Step by Step

Mash in the grains at 152–154 °F (67–68 °C) with 14 qt. (13 L) hot water; let stand 1 hour, run off and sparge to collect 6.0 gallons (23 L) wort. Boil for 1 hour, adding the sweet gale at the start, and the heather tips when the heat is turned off. Let stand ½ hr to infuse flavors from the heather, strain off wort cool to 65–70 °F (18–21 °C), and pitch yeast. Let ferment for one week, transfer to secondary for further 1–2 weeks, then keg or bottle; in either case go a little low on carbonation — below 2 volumes CO_2.

Viking Invasion Ale
(5 gallons/19 L, extract plus grains)

OG = 1.055 FG = 1.013
SRM = 6–8 ABV = 5.1%

Ingredients

6.0 lb (2.7 kg) pale extract syrup
1.0 lb (0.45 kg) pale dried malt extract
1.0 lb (0.45 kg) Briess Caramel malt (20 °L)
0.07 oz. (2 g) sweet gale (60 minutes)
2.0 oz (57 g) heather tips (0 minutes)
White Labs WLP011 (European Ale) or Wyeast 2000 (Budvar) yeast

Step by Step

Steep the caramel malt with 2 qt. (2 L) hot water at around 160–170 °F (71–77 °C) for 15 minutes. Strain the liquid into the boiler, and wash the grain with a further 2 qt (2 L) hot water. Carefully add the extracts, stirring to dissolve them, then make to 5.0 gallons (19 L) with hot water, and bring to boil. Follow the rest of the procedure as for the all-grain brew.

using malt provided by the Galway Hooker Brewing Company, and grinding it by means of an electrical food processor. They also decided to use a true brewer's yeast, rather than relying on spontaneous fermentation, which the Bronze Age brewers would probably have done.

The procedure was simple enough, with the stones being heated in a fire for about two hours, then added (using a non-Bronze Age shovel) to the trough so as to bring the temperature of the 79 gallons (300 L) of water in it up to 140–158 °F (60–70 °C). They added 50 kg (110 lb.) of malt in portions over a period of 45 minutes, using a wicker basket that was half submerged in the water in the trough, the intent of this being to prevent balling of wetted grains. The mash temperature was maintained by further addition of hot rocks, and conversion was judged complete when tasting revealed that the mash was sugary sweet. No iodine testing was done, so in fact we cannot be sure that starch conversion had gone to completion, but this only adds to the authenticity of their approach.

At this point the liquid was ladled out into plastic vessels (each with a spigot), and plants and herbs from Billy Quinn's garden were added. These were juniper berries, yarrow and elderflower heads, ground in a mortar, and suspended in the wort in a muslin bag. Choice of these seems to have been arbitrary, but elderflowers have found considerable use in fruit winemaking, and I know of a commercial brewery in Southern France that uses them in one of its beers.

The wort was cooled by immersing the vessels in a cold water bath for 3 hours. Our imagined Bronze Age man would not have known that hot wort will kill yeast, but he was probably relying on airborne yeasts, anyway. The brewers pointed out that the spent grains underwent fermentation within a few hours; they attributed this to wild yeasts, although I would have suspected a lactic fermentation instead. The wort was pitched with 150 mL (about a pint) of brewer's yeast, which seems a fairly small amount, but the ale was "ready for consumption" after only three days. Starting with 79 gallons (300 L) of water, they finished with 29 gallons (110 L) of beer. Without the OG of the beer, it's impossible to work out the brewhouse yield. The beer was pronounced relatively clear, with a sharp, sweet, caramelized flavor.

So, the experiment was a success, showing that an acceptable beer could be brewed relatively easily in this way, and that this might well have been the purpose of the *fulachts*. It might be argued that they were used for both cooking and brewing, since each site only appears to have had one such trough. And it does not definitely prove that Bronze Age man was brewing in Ireland. Stronger evidence would require finding traces of grain in one or more *fulachts*, something which is not likely in the damp climate of Ireland.

A Viking Brew

By the time the Christian era arrived, there is more definitive evidence of beer brewing in Ireland. In 1 AD, the Greek writer Dioscorides refers to a brew called *kourmi* being made in either Ireland or Britain, according to which translation you believe. St. Patrick arrived in Ireland in the 5th Century and there is a reference to him and "his friend and brewer." Later in the 7th Century, a legal poem talks of "ale drinking" as a widespread pastime.

Around 800 AD, the Vikings descended upon Ireland, causing widespread havoc, although their presence there did not apparently cause as much devastation as it did in Britain. Legend has it that the Viking invaders in Ireland drank enormous amounts of heather ale in order to help induce their battle frenzy. So where did they get this ale? We know that heather ale has been brewed in Scotland since perhaps as long ago as 2000 BC. The recipe for that supposedly disappeared when the Pictish king who guarded it threw himself to his death over a cliff, rather than reveal it to the Scot king who was torturing his son. That story is surely myth, but Fraoch Heather Ale is brewed commercially today by Williams Brothers Brewing Co. in Scotland, this beer being a recreation

from a 17th Century recipe.

It should be remembered that the Vikings didn't just make brief raids then return to Scandinavia, but often settled in the lands that they raided, occupying almost half of England at one time, for example. In particular, it seems that they were very fond of Ireland. Olaf and Ivar were two renowned Kings of the "Northmen," Ivar having been responsible for conquering most of England. The annals of Ulster reported that the two kings came again to Dublin in 870 from Scotland and "a very great spoil of captives, English, British, and Pictish was carried away to Ireland." It would be very surprising if those spoils did not include the recipe for heather ale given the presence of the Picts in this group, unless, of course, the ale was already being brewed in Ireland. Incidentally, the Irish name for ling heather is *fraoch lochlannach*, which apparently translates as "Viking" or "Scandinavian" heather.

And indeed our intrepid trio of archaeologists/brewers came across a recipe for it published in 1859, and thought to date back to somewhere around the Viking era. As well as heather, it includes bog myrtle, a plant well-known in Britain as a flavoring for ale in the days before hops. I should point out that the published recipe was based on a story told by an Irish peasant who claimed to be 100 years old, and said he got the recipe from his grandfather. For some that might cast a little doubt on the authenticity of the recipe, suggesting myth rather than true history. But from a brewer's angle the recipe makes sense and the threesome decided they would have a try at brewing this heather ale, using a somewhat more refined approach than that for the Bronze Age beer.

The heather was collected from Maumeen Lake in County Connemara, and was a mix mostly of ling with some bell heather. The bog myrtle leaves were also handpicked. They also chose to use pale lager malt, provided by the Oslo Hotel microbrewery, who apparently also provided a barrel of their beer to help the process along. It was decided to take a short cut and to have the grain milled at the brewery, rather than

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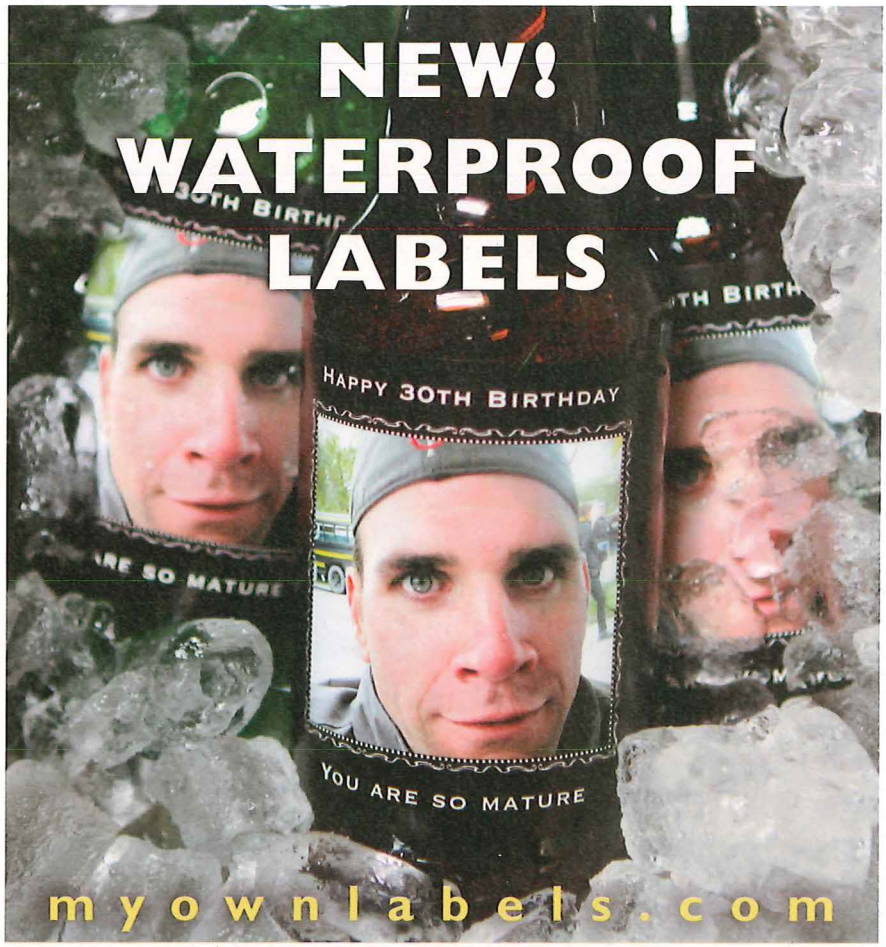


using the laborious method employed for the earlier beer. Of course, the Vikings would likely have used a stone mill to grind the grain, so I don't think that the effort of constructing such a mill from scratch was warranted. Ground malt is ground malt, no matter what the process!

Instead of using a wooden trough, they opted for a large metal cauldron; surely the Vikings would have used something like this for by that time iron had been around for centuries. The cauldron was set on a fire, filled with water which was lightly heated, and then the grain was mashed in. The mash was heated to 149–153 °F (65–67 °C), although the presence of a non-authentic thermometer was not actually mentioned! This was allowed to stand for an unspecified period, then more water added. The brewers used the term "sparged," but it seems that what they did was simply to use a wicker basket to strain out most of the grain, washing it with water after the liquor had drained.

At this point the heather and bog myrtle were added to the still cloudy liquor, and the whole brought to a boil over a fierce flame. Hot rocks were also added "for a little caramel," and the boil was continued, again for an unspecified time. Finally, the wort was siphoned off through a strainer into fermentation vessels, and the yeast added when cool. Fermentation took a week, then the ale was bottled off (without addition of priming sugar).

Recipe Specifics For Viking Ale

It is reported that the finished ale, also known in Irish as *bheoir lochlannachis* contained 5.5% ABV. Since they used a regular brewing yeast strain, we can assume that finishing gravity was around one-quarter original gravity, so that OG was close to 1.055. They started with 110 lbs. (50 kg) pale malt, and finished with 24 gallons (90 L) of ale. That means they got a specific gravity of 1.012 for each pound of malt per gallon, which contrasts with the gravity of 1.024 we use as the *BYO* recipe benchmark for pale malt. The latter represents 65% extract efficien-

cy, so that the Viking brew would be only around 32%. This may sound like a poor yield, but remember they were deliberately using crude procedures.

The amount of heather used was one bushel, which is a volume, not a weight measure. Because of the springy nature of heather sprigs, it is impossible to determine the actual weight used by our brewers. To put it into context, an Imperial (that is British) bushel is around 9.6 US gallons (36 L). Therefore, if they had actually made only 5.0 US gallons (19 L) of ale, they would have needed to add 2 US gallons (7.6 L) of heather sprigs. In the case of bog myrtle they used "20 or so leaves," which would mean about 4–5 leaves for 5.0 gallons (19 L). That does not look like very much, but bog myrtle, or sweet gale as it is also called, can have a significant narcotic effect. In fact, I have just come across a reference which states that an essential oil derived from it has found use as an abortifacient. It should therefore be used sparingly, and is probably best added at the start of the boil, so that the oil is distilled off during the boil.

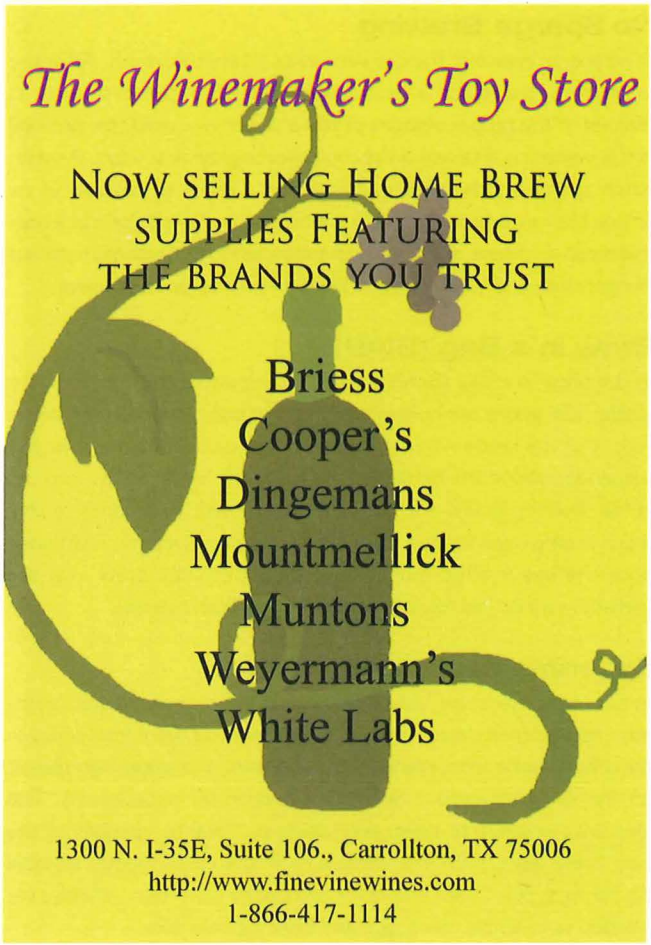
As far as hot rock heating is concerned, this is not a very practical approach for most homebrewers. However, there is good evidence that the technique does produce a very nice caramel flavor in the beer; just how much depends on how long the wort is boiled and how much hot rock is added. Achieving this without using hot rocks is probably best accomplished by using caramel malt. This should be one of the lower roast caramels, say 20–30 °L, at around a maximum of 10% of the pale malt, so that it does not add too much color or flavor to this otherwise pale and delicate brew. For an extract brew, the caramel malt can simply be steeped in the usual manner.

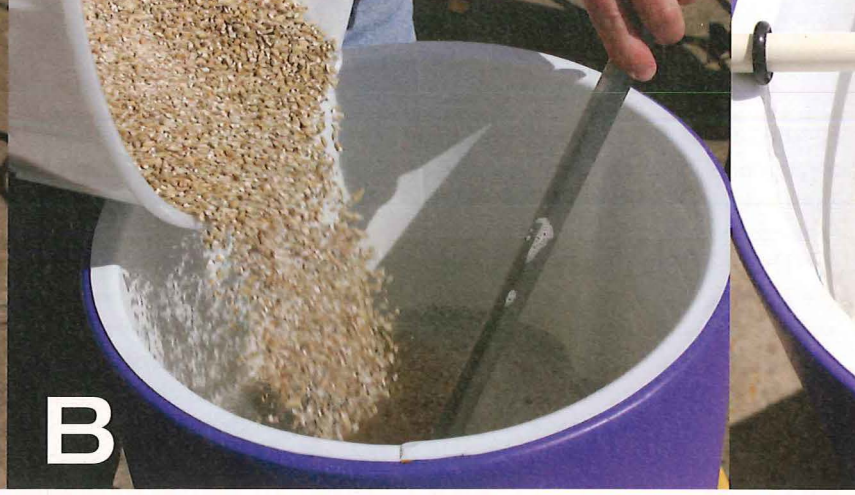
It may be best if you collect fresh heather for such a brew, but that may be difficult for many of you, and homebrew suppliers do offer both heather tips and bog myrtle/sweet gale, so a lack of heather in your backyard need not be a deterrent to brewing this beer. I think the heather is best added at the end of the boil, since you want to capture its fragrance.

Reflections

So we have seen some heroic efforts by relative amateurs to recreate ales that were produced a thousand or more years ago. They have certainly cast some light on Irish brewing history. Of course, their efforts did not establish with any certainty when brewing was first carried on in Ireland; much more work would be needed to do that. But that's the nature of research — it always poses more questions than it answers! And now you can brew a batch of Viking heather ale and come to your own conclusions. BYO

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





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LAUTERING METHOD SHOWDOWN

HOW SHOULD YOU COLLECT YOUR WORT?

In all-grain brewing, brewers must separate the sweet wort from the spent grains after the mash rests have been completed. This process is called lautering. In homebrewing, there are several popular methods. In this, the latest in the *Brew Your Own*/Basic Brewing Radio (BYO/BBR) Collaborative Experiment Series, we put four popular lautering methods to the test. As always, *Brew Your Own* readers and Basic Brewing Radio listeners contributed to the project.

Continuous (or "Fly") Sparging

In continuous sparging, the brewer begins to drain the first wort from the lauter tun after the mash has finished and the wort has been recirculated briefly. Once the level of liquid drops almost to the top of the grain bed, he (or she) begins applying sparge water. Ideally, the rate at which sparge water is applied to the top of the grain bed matches the flow rate out of the lauter tun. As such, the liquid level above the grain remains constant. Once the pre-boil volume in the kettle (or other indicator) has been reached, the brewer quits collecting wort. The flow rate is typically adjusted so that collecting the entire wort takes 60–90 minutes. Among the benefits claimed of continuous sparging is high extract efficiency.

Batch Sparging

In batch sparging, the wort is collected in two (or sometimes three) batches. After mashing, the brewer recirculates the wort then completely drains the first wort to the kettle. Sparge water is not added while the lauter tun is draining. Next, the batch sparging brewer reconstitutes the mash by adding hot water and recirculating. Then, he drains the second wort to the kettle. As commonly practiced, the amount of water added at mash in and when reconstituting the mash is adjusted so that half of the pre-boil kettle volume is collected as the first wort and half is collected as the second wort. Both times the lauter tun is drained quickly because, unlike in continuous sparging, there is no benefit to collecting the wort slowly. One of the main benefits of batch sparging is its ease and simplicity.

No Sparge Brewing

In no sparge brewing, the brewer makes a very thin mash. After the mash rest, the wort is recirculated and then the first wort is drained. If the proper amount of strike water was used, the pre-boil kettle volume is attained simply by collecting the first wort. As with batch sparging, the wort is drained as quickly as possible in no sparge brewing. As an option, sometimes the mash is done at a normal mash thickness, then hot water is added to both reach mash out temperature and yield the total pre-boil volume upon draining.

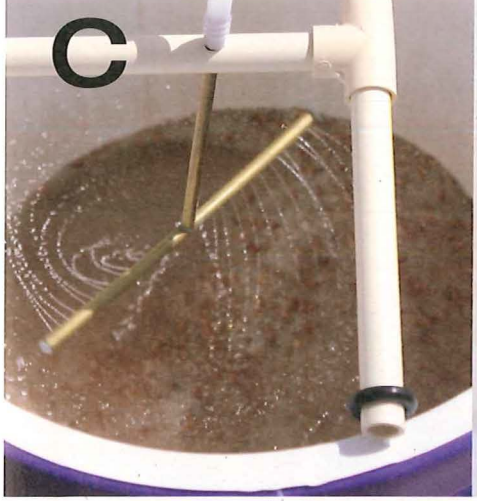
Brew in a Bag (BIAB)

In the brew in a bag (BIAB) method, the mash is performed in the kettle. The grains are held in a large mesh bag, which is then hoisted out of the kettle when the mash is complete. The bag is briefly suspended above the kettle to let any drainable liquid flow into the kettle, but the grains are not otherwise rinsed. Frequently, a thin mash is employed so that the full pre-boil kettle volume is attained once the bag is lifted out of the kettle. With the brew in a bag method, you do not need a separate mash/lauter vessel.

Experimental Design

In our experiment, we asked participants to pick two lauter methods and test them head to head. Experimenters were instructed to brew both beers from the same recipe, using the same ingredients, on the same equipment (except as needed for experiment). The idea was to strive to make everything as equal as possible on the two brew days, with the exception of the experimental variable (lautering type). Given that color and clarity were two variables we wanted to examine, we suggested brewing pale beer.

Story by Chris Colby and James Spencer



Experimenters were asked to pay special attention to their pre-boil kettle volume. In both cases, they should have collected the same amount of wort from their grain bed, so a fair comparison of extract efficiency could be made.

The Data

We asked the experimenters to record a number of variables although, in this article, we will only discuss extract efficiency and the comparative character of the finished beer. Each experimenter tasted his own beer. In addition, Jeff Karpinski and Hank Rowe shipped samples of their beers for us (Chris Colby and James Spencer) to sample. Most of the sampling was done with the taster knowing the identity of the beers. One of us (Chris) sampled some of the beers blindly. The table below shows the OG and calculated extract efficiencies for the six experimenters.

Results and Conclusions

The most salient result in the experiment was the finding that two beers produced using different lautering methods could look, smell and taste almost identical. When we proposed the experiment, we assumed the methods would produce different beers. In addition, we assumed that simple batch to batch variability — which we thought would be inevitable at the homebrewing scale — might confound our ability to get meaningful results. In contrast to our expectations, the results were clear — in every case, the two (or more) homebrews made with different lautering methods were very similar. When slight differences were tasted, they tended to favor the continuously sparged beers, but there were exceptions. In the only blind tasting in the experiment, I (Chris) expressed a preference for the continuously sparged beer, but the difference was very small between the samples.

As for extract efficiencies, the data suggested that brewers set up for continuous sparging could achieve higher extract efficiencies with that method, whereas brewers set up for batch sparging would not benefit (efficiency-wise) by switching to continuous sparging. More data would, however, be needed to state this with any confidence. (For a point-by-point examination of the data, listen to the Basic Brewing Radio show for January 20, 2011 and download the accompanying .pdf file. It's at www.basicbrewing.com.)

The clear — albeit boring — take home message seems to be none of the lautering methods produce markedly inferior beers. BYO

Chris and James are diligently trying to think up an experiment in which the experimental variable might make a difference. Stay tuned.

A: This experiment required two all-grain brew days, brewing the same beer twice and only changing the lautering method.

B: So that differences in color could be seen, if present, we suggested that experimenters brew pale beers.

C: Here James uses continuous sparging, even though he has a batch sparge mash tun.

D: In some cases, the mash thickness would vary along with the lautering method. For instance, BIAB brews use thin mashes.

E: Collecting the same amount of wort from each of the trials allowed for a fair comparison of extract efficiencies.

OG and Efficiency for Experiment Participants

Lautering Method	Jeff Karpinksi	Hank Rowe	Christopher Owen	Andreas Schermaier	Dan Kerkman	James Spencer
Fly Sparge	1.064 (87%)	1.053 (56%)	1.062 (81%)	1.057 (77%)	1.052 (80%)	1.049 (60%)
Batch Sparge			1.058 (75%)		1.052 (80%)	1.048 (59%) 1.049 (63%)
BIAB						1.057 (70%)
No Sparge	1.061 (82%)	1.055 (58%)		1.046 (63%)		

brewing SOFTWARE

Story by **Forrest Whitesides**

	BeerSmith	Beer Alchemy	BrewTarget	BeerTools Pro	Brew Pal
Price	$21.95	$29.95	Free	$29.95	$0.99
Native OS	Windows	OS X	Windows, OS X, Linux	Windows, OS X	iPhone/iPod
Emulated OS[1]	OS X, Linux	None	Not needed	Linux	None
Version Tested	1.40	1.8.18	1.2.3	1.5.12	1.6.12
Inventory/Shopping List	Yes	Yes	No	Yes	No
Custom Beer Styles	Yes	No	Yes	Yes	No
Database Backup	Yes	Yes	Yes	Manual	No
Standalone Calculators	Yes	Yes	Yes	Yes	Yes
Recipe Export Formats[2]	BeerXML, HTML, Text	BeerXML, PDF, HTML, Pro Mash	BeerXML, Text	BeerXML, Text	BeerXML, Text
Brew Day Cheat Sheet	Yes, custom	Yes	Yes	Yes	No
Brew Day Timers	No	No	Yes	No	Yes
Units of Measure	Metric, US, mixed	Metric, US, mixed	Metric, US, mixed	Metric, US, mixed	Metric, US, mixed
Languages Supported	English	English	English, Spanish, French, German, Polish, Portuguese	English	English
Dedicated Support Forum	Yes	No	No	Yes	No

1 - Using emulation, some Windows software can be run on Linux and Mac OS X.
2 - These are output formats other than the software's native file format.

TOOLS TO MANAGE YOUR BREW DAY

In this day and age, just about everybody in homebrewing uses some kind of software tool to aid them in crafting their beer. In this article, I describe four computer applications — BeerSmith, BeerTools Pro, Beer Alchemy, and BrewTarget — and one smartphone "app," BrewPal. All five have the three functional components that I consider essential for comprehensive homebrew planning: 1) Recipe Ingredient Formulation, 2) Mash Schedule and Volume Calculation, and 3) Editable Ingredient Database.

The four software packages can be tested for free, and I highly encourage trying out more than one to see which user interface you prefer. (The app costs $0.99.) I have found that all of these tools are useful, but I prefer the way a few of them are set up over the others. It all comes down to personal preference, as the applications themselves all perform admirably when it comes to brewing calculations.

Long-time software users may note the conspicuous absence of the venerable homebrewing application ProMash. ProMash is a perfectly functional application, it has not been updated in several years and future updates are uncertain. (For a review of ProMash, Strangebrew and Suds, see the March-April 2002 issue of *BYO*.)

Here are the things all of these packages will do for you.

Recipe Formulation

This is really the core of what brewing software is all about. This functionality facilitates the creation of beer recipes. Ingredients are selected from a database and, as they are added to the recipe, real-time updates to the recipe metrics are shown (things like original gravity, color, bitterness, attenuation, etc). How well the recipe matches up to the BJCP recipe specification chosen can also be shown.

The applications also track volume loss during boiling and transferring, hop utilization, and several other factors that affect the final style metrics. There is also functionality in these applications to keep notes on each batch brewed.

Mash Scheduling

For the all-grain brewers, working out the timing, volumes, and temperatures for mashing is a critical feature. This covers everything from strike water volumes and temperatures, to the timing of complex decoction mashing. These applications also take into account specific details about your brewing equipment (volume, specific heat, ambient temperatures, etc.) to help dial in the most accurate mash schedule possible. You can save both mashing profiles and equipment profiles to be applied to recipes quickly. This allows for quick switching between mashing styles (batch vs. sparge, for example) or for swapping out equipment set ups.

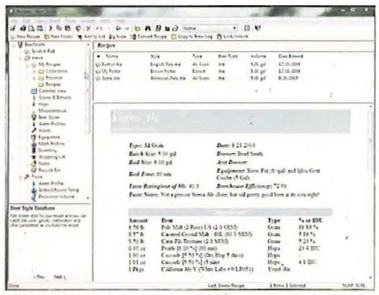
Editable Ingredient List

As comprehensive as the included ingredient databases are in these applications, there is no way the developers can anticipate all possible ingredients that homebrewers may want to use. So to remedy that, users can enter their own ingredients and save them in the database for future use.

The Extras

Following is an app-by-app breakdown of what makes these great programs different from each other. These are the extra "goodies" beyond the core functions they all share.

BEERSMITH $21.95 WINDOWS



www.beersmith.com

BeerSmith is the most mature of the group, and its robust feature set bears this out. The current version is a little dated, but a major update is planned in the near future, according to the developer's Website.

BeerSmith features a full-fledged personal inventory database that tracks your actual on-hand ingredients. You can see what ingredients you have to work with on your next batch. And when you mark a recipe as "brewed," it automatically deducts the ingredients used in that batch from your inventory. It also features a shopping list that helps you keep a tally of what you need to buy for upcoming planned batches. Further, it uses the pricing data from your inventory to calculate the unique cost of each batch in your recipe list. There are also several standalone calculators and tools, including: strike water volume, hop bitterness, hop aging, boiloff loss, mid-mash temperature adjustment, refractometer adjustment, carbonation and unit conversion calculators.

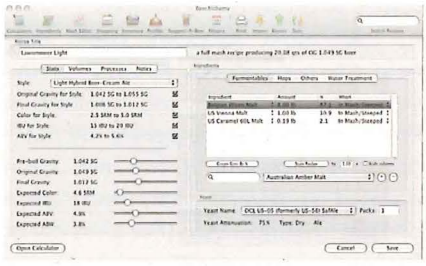
BeerSmith has a dedicated web site with a user forum and support section. It also has downloads to extend the applications, including maltster-specific grain data.

Even though it runs natively only on Windows, with a little bit of work, BeerSmith can be made to run on Linux or Apple's OS X. Using a free and open-source program called Wine (www.winehq.org), it is possible to run BeerSmith on Linux and OS X. Sometimes printing can be nonfunctional, but almost everything else works just fine.

The Bottom Line: For the price, the wide range of features, and the mature online support and community presence, BeerSmith is hard to pass up. It lacks a modern user interface, native support for Linux and OS X, and localization for languages other than English. However, a new version is due out soon.

BEER ALCHEMY $29.95
OS X
www.kentplacesoftware.com

Beer Alchemy is the lone Mac-only application in the group, and its slick user interface and iPhone integration



should make Steve Jobs proud. It, too, has an inventory database that tracks the ingredients in your brewhouse. It also features a shopping list that is automatically updated based on which ingredients you lack to brew the recipes you've created. And it even has Skype integration so you can directly call your local homebrew supplier to place an order.

The real standout here, however, is the "Suggest a Beer" feature. With a mouse click, Beer Alchemy compares your stored recipes to your personal ingredient inventory and gives you a list of which recipes you can brew right now. It also lists recipes for which you are missing one, two or three ingredients. There are many standalone tools and calculators.

The developer also offers a companion application for iPhone, iPod Touch, and iPad called Beer Alchemy Touch. It sells for $4.99 on Apple's App Store and synchs with Beer Alchemy.

The Bottom Line: If you're a hardcore Mac addict, the familiar interface of Beer Alchemy and broad feature set is likely to appeal to you.

BREWTARGET $0
WINDOWS, OS X, LINUX
brewtarget.sourceforge.net

BrewTarget is an open source project, meaning that anyone is allowed to view, modify, and redistribute the program's source code. It is also free of charge to download and use, with no limitations to functionality and no time limits (as some demo software has). It runs natively on Windows, OS X, and Linux. If you've had less-than-stellar experiences with free software in the

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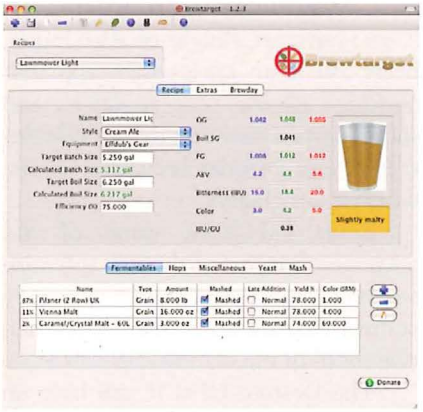


past, I encourage you to give BrewTarget a try. It has all of the core functions you'd need plus quite a few extras you might not expect considering its non-existent price tag.

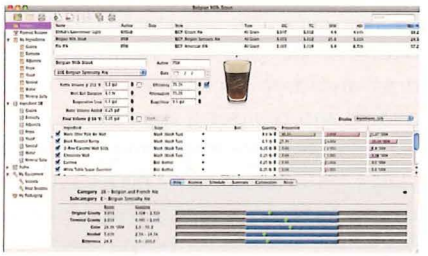
One of the big standout features is the "mash wizard." Once you've input your grain bill into a recipe, BrewTarget can automatically formulate a simple mash schedule for you. The mash wizard takes into account the size of your mash tun and your target pre-boil volume when calculating volumes and temperatures. Granted, it sticks to a single-step infusion mash and assumes that you want to batch sparge, but this could be a great tool for mashing beginners to get a feel for how things work.

BrewTarget has a variety of tools and calculators and also features a set of three independent timers that you can be set for brew day usage. These are useful when you've got multiple things going on at once, as often happens while in the midst of a brew day.

If you want to use brewing software in any language other than English, BrewTarget is your only option (out of the group reviewed in this article). It is localized for Spanish, Portuguese, French, Polish, and German, as well as English.

The Bottom Line: For the money, the feature set is beyond impressive. The interface is intuitive, but not quite as polished as its commercial competitors. However, if inventory management is a must-have, you'll have to look elsewhere.

BEERTOOLS PRO $29.95
WINDOWS, OS X
www.beertools.com



BeerTools Pro is a mature, robust application that runs natively on both Windows and OS X (although a separate license must be purchased for each operating system). The developer releases updates and bug fixes on a regular basis, and you can offer direct feedback on the support forum. The software was designed to be used by both hobbyists and professionals, so it

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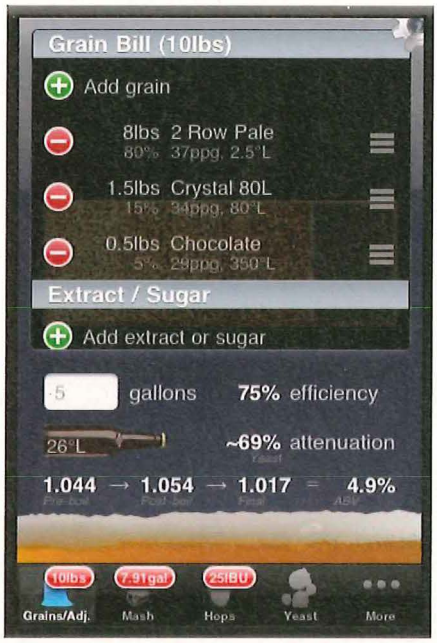
can handle your recipes and inventory if you scale up.

What makes it stand out is the fact that almost every recipe metric is displayed both numerically and visually (as a bar chart or graph). For the "visual learners" out there, this is going to be very appealing. Adding to the visual nature of the software, most things are drag-and-drop capable, including adding and removing ingredients from a recipe. Another interesting feature is called "My Packaging." This allows you to specify how the finished beer will be packaged (different bottle and keg sizes) and help calculate how many containers you'll need.

The Bottom Line: BeerTools Pro has everything you need for basic and advanced brewing. The fact that it runs on Windows and Macs natively is a big plus, and the developer has stated the next major release will also run on Linux without any emulation. The massive amount of info presented through the interface might be too much for some, but metrics/statistics fanatics will be in heaven.

BREW PAL $0.99 iPHONE AND iPOD TOUCH



www.brewpal.info

If you have an iPhone or iPodTouch, Brew Pal is an inexpensive app that performs all the core functions and sports quite a few standalone calculators. It also includes brew day timers, which is very handy.

Brew Pal lacks some of the advanced features of the full software packages, most notably an inventory control feature, but also costs one twentieth of the commercial software.

The Bottom Line: If you have an iPhone, you can put it to work in your brewery for $0.99.

What it really comes down to when choosing an application is what extras you require and what operating system you use. Give as many of them a try as you can. The cost to experiment is zero (or close to it), so it's easy to make an informed choice for your brewing software. BYO

Forrest Whitesides is a regular contributor on Final Gravity Podcast.

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A Global Perspective

Brewing with regional malts

by Terry Foster

I thought that an article on brewing with regional malts might be fun to write. Then I sat down in front of my computer, and the first question that came to mind was, "What is a regional malt?" My first thought was that a regional malt is one that is used for a specific beer style in a specific country.

But then again, American 6-row pale malt fits that bill since it is largely used to produce pale lagers with high levels of adjuncts, the so-called American Pilsners. The same argument could be applied to European Pilsner malts/Pilsner beers, and English 2-row malts/bitter and pale ales. And the picture has become blurred by the fact that a number of malts that fit that "regional" description not long ago are now produced in other countries and used for a variety of beer styles. For example, Munich and caramel malts spring to mind immediately, as well as a range of roasted malts.

So in order to keep this column to a reasonable length, I made some arbitrary decisions as to which malts to call "regional." In the table on page 58, I opted to discuss a selection of malts other than base and crystal or caramel malts, and to stick largely to those with specific uses. Most of these originated from outside the US and are designated as such in the table.

Versions of them may be made by US maltsters, and are usually fairly similar, though not necessarily identical. Read the descriptions and look at the parameters — such as color — before you make a purchase.

Acidulated malt

This is a highly-specialized malt that is acidified by permitting growth of lactic acid-producing bacteria which occur naturally in the starting barley. As such it can be used in brewing beers, which conform to the rules of the German Reinheitsgebot. Its primary purpose is to adjust mash pH levels, especially with brewing waters high in carbonates, although it is also used for brewing sour beers like Berliner Weisse. Usual addition rates are up to about 10% of the total grist.

Amber and brown malts

Amber and Brown malts are relatively highly-roasted malts, modern substitutes for those originally used in porter brewing. A common recipe for porter in the 19th century used equal parts of these and of pale malt.

However, modern brown malt tends to give a very pronounced flavor when used in high proportions, so I would recommend you use less. Use 10–15% each of brown and amber and 70–80% of 2-row pale malt in the mash, add bittering hops to give around 25 IBU in the beer and you will have a pretty good brown porter.

Both these malts contain significant amounts of starch, so they must be mashed with a malt (usually pale) that contains sufficient enzymes to convert this starch. That means that for an extract beer you would have to do a partial mash of these grains. If you use 1 lb. (0.45 kg) of pale, amber, brown in the partial mash and add to the liquor 6 lb. (2.7 kg) of amber malt extract, hop to around 25 IBU, to make 5 gallons (19 L) of porter.

Brown malt can also be used to advantage in brewing English mild and dark old ales. But for mild especially keep the proportion of brown down to a maximum of 5% of the grist.

> "Amber and brown malts are relatively highly-roasted malts, modern substitutes for those originally used in porter brewing."

Pale chocolate malt

Pale chocolate malt falls between brown malt and the more highly roasted "regular" chocolate malt. It does not add unfermentables as brown malt tends to do, and it has a smoother, less harsh palate than regular chocolate. It is therefore good for adding color to dark beers where you are looking for a balanced palate and do not want strong coffee/roasty notes. It works especially well in dark mild ales,

Photo Courtesy of Muntons

Table of Regional Malts

TYPE	ORIGIN	ENZYMES/STARCH*	COLOR °Lovibond
Acidulated malt	Germany	YES/YES	11
Amber malt	United Kingdom	NO/YES	25-30
Brown malt	United Kingdom	NO/YES	50-60
Victory® malt	USA	NO/YES	25-30
Honey malt	Canada	YES/YES	25
Rauch malt	Germany	YES/YES	2
Peat smoked malt	United Kingdom	YES/YES	2.5
Rye malt	USA/Germany	YES/YES	3.5
Melanoidin malt	Germany	NO/YES	23–33
Belgian Special B	Belgium	NO/NO	147
Debittered black malt	Belgium	NO/NO	515
Dehusked Carafa® I, II, III	Germany	NO/NO	337-470
Pale chocolate malt	United Kingdom	NO/NO	218

* All of these may be used in extract brews; those with starch only require partial mashing, along with an enzyme containing malt. All others will require steeping in the usual manner.

porters, stouts (other than the dry versions), bock and dunkel beers in general. Clearly, it contains no enzymes and needs only steeping for use in extract beers. It can be added in a higher proportion than regular chocolate malt without overwhelming the palate of the beer — at a rate of 5–10% of the total grist, depending upon the original gravity of the wort.

Debittered chocolate malt

Debittered black malt is exactly what it sounds like, a highly-roasted, high-colored malt that does not give harsh or astringent flavors, although it does tend to add a roasty aroma to the beer. It is therefore useful in brewing very dark colored beers in which the dry, biting flavor of "regular" black malt is not required, such as sweet and oatmeal stouts and Schwarzbier. It can also be used to advantage in brown ales, porters and darker versions of bock beer. It has no enzymes, so requires only steeping to extract its flavors, and should be used at the rate of 1–5% of the grist, with the lower end being applicable to brown ales and bock beers.

Dehusked Carafa® malt

Dehusked Carafa® malts I, II, and III (from Weyermann) are roasted malts, the intensity of roasting increasing from I (337 °L), to II (425 °L), up to III (470 °L). Therefore the first two approximate in color to regular chocolate malt, while the third is somewhat less dark than regular black malt. They are produced from dehusked barley, which means that they are smoother and mellower, in flavor than chocolate or black malts. They are somewhat similar to the Belgian debittered black malt discussed earlier, but less highly-colored, and obviously have similar applications to that malt, but can be added in slightly higher proportions than the black malt (up to 10% of the grist). In deciding how much to add, bear in mind the requirements of the beer style when adding any type of high roast malt. For example, if you wanted to brew dark mild ale at, say, 3.5% ABV, this should not be black in color. It has only a limited amount of body so it can support just a hint of roastiness, so you would probably need to add no more than 1–2% of Carafa® I in the grist.

Rauch malt and peat-smoked malt

Rauch malt and peat-smoked malt are of course intended to produce smoked flavors in beers. They have been smoked in a gentle fashion so that they are low in color and high in enzymes, and must be mashed. Rauch malt is really designed for producing Bamberger Rauchbier, a beer with a powerful smoky presence. The rauch malt can make up to 90% of the total grist in these beers. It can also be used in other lager beers, if you wish, although at much lower levels. Peat smoked malt is more often reserved for ales, particularly porters. How much you use is up to your own taste buds, but just remember that smoke flavors can easily be overdone. A couple of years ago I tasted a sample of the famed Alaskan Brewing Smoked Porter and found it

much too overpoweringly smoky, whereas in this year's sample the smoke was much more muted and the beer was excellent. I would go for no more than 5% of the grist as smoked malt to begin with and work your way up on the next brew if that is not enough for you. Note that smoked malts in general can be somewhat variable, and that the smoke flavor tends to decrease with age, making it difficult to brew consistently flavored smoked beers.

Rye malt

Rye malt is unique in its flavor contribution to beer, with a pronounced spicy character. It has to be mashed along with pale malt, and can cause sticking problems if used in amounts greater than 20% of the grist. In that case it is desirable to use a proportion of rice hulls in the mash to facilitate run-off. It is, of course used in brewing rye beers, such as roggenbier and sahti, but I find that in smaller proportions (5–10%) it can a little extra to a whole variety of beers, especially IPA and double IPA.

Victory® and Gambrinus honey malt

Victory® malt and Gambrinus honey malt are my two North American candidates in the category of regional malts. I have bracketed them together because they are similar in color and both tend to give toasty notes in the malt spectrum of the beer. They also help to improve the body (or mouthfeel) of the beer, with the Gambrinus malt adding some honey notes as well. Neither of them contains enzymes, and they are usually mashed along with pale malt. Both lend a nice nuttiness in "gentle" brown beers, such as brown ales and porters, in amounts up to about 10-15% of the total. In my own experience, Victory® malt works very well in brewing bitters and IPAs, although it will darken the beer beyond normal style specifications if used at this sort of level (which I don't mind at all).

> "Debittered black malt is exactly what it sounds like, a highly-roasted, high-colored malt that does not give harsh or astringent flavors, although it does tend to add a roasty aroma . . ."

German melanoidin malt

German melanoidin malt can be thought of as a darker and more intense version of Munich malt. I have found the

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–Pete Dickson
Brewer, Sixpoint Brewery
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> "Belgian Special B will also add some mouthfeel to a beer, and can be steeped for use in extract brewing."

latter to be an excellent part substitute for pale malts in beers where I want a little more body than I can get from the pale. This indicates that melanoidin malt can do something similar, and one supplier suggests that it eliminates the need to carry out a decoction mash in brewing full-bodied lagers. But melanoidin's deeper color means that it needs to be used in smaller proportions than is possible with Munich malt — say 5–15% of the total. In extract brewing, this malt should be subjected to a partial mash, rather than just steeping it. It is excellent for red and Scottish ales, as well as for amber and dark lagers. For my money too, up to about 5% makes a nice addition to an English bitter ale grist.

Belgian Special B malt

Belgian Special B — I said I'd omit crystal malts from my list, but I snuck this one in because I like it. It is at the top end of the crystal malt color spectrum and can add nice red notes to both pale and dark beers. While it will impart a good deal of caramel flavor to a beer, I find this flavor somewhat less harsh than that from high color British crystal malt. It also offers other flavor notes, nuttiness and a rich raisin-like fruitiness. Belgian Special B will also add some mouthfeel to a beer, and can be steeped for use in extract brewing. At 5–10% of the grist it is good in amber ales and lagers, red ales, old and strong ales, and can add a little extra to stouts and porters. Use of Special B in pale ales and lagers is restricted by its high color, but I have used it to my advantage in IPAs, even though it makes them a little darker than style considerations dictate.

And with that, my personal tour of regional malts is done. Please do not tell me that I have omitted other candidates, because I know only too well that I have done so. I have tried to give guidelines for using these malts, but do not be constrained by them and do not hesitate to experiment. In fact, have you ever thought of selecting one of these malts and building the beer around that, rather than by starting off with a fixed style in mind and making the malt bill fit that style? That might be a good approach to developing your own unique house beer. BYO

Terry Foster is a frequent contributor to Brew Your Own *and writes "Techniques" in every issue.*

Alpha Isomerization

Acid compounds and reaction kinetics

by Chris Bible

Beer is an extremely complex drink. Several hundred different chemical compounds have been identified within a typical beer. Of these compounds, none are more dear to "hop-heads" around the world than the compounds derived from hop additions during the brewing process. Compounds derived from hops are vital to the organoleptic qualities of beer.

Flavor and aroma compounds in hops

Hops play several roles in the production of beer, but in particular they are crucial as a source of aroma (from the essential oils), flavor and bitterness (from the hop resins). Some of the more important compounds associated with hop aroma are shown in Figure 1.

Although the chemistry associated with hop oils and hop polyphenols is rather complicated, the chemistry of the compounds associated with the bitter-taste features of beer are well understood. The most important compounds associated with hop-derived bitterness are the α-acids. In a pure state, the hop α-acids are weak acids that occur as pale-yellowish solids. The α-acids, as they occur naturally within hops, exhibit very poor solubility in water, which is why they must be boiled. (The oft-repeated statement that un-isomerized α-acids are not bitter is false. Pop a hop pellet in your mouth for confirmation.) α-acids generally account for between 2 and 15% of the dry weight of the hop, depending upon the specific hop variety and the hop storage environment. (Higher alpha hops are being bred all the time.) The higher the α-acid content, the greater the amount of bitterness it will add to the beer.

> "The α-acids, as they occur naturally within hops, exhibit very poor solubility in water, which is why they must be boiled."

Alpha acid types

There are three different forms of α-acids in hops: humulone, cohumulone and adhumulone. These α-acids are molecularly similar, but differ from one another in their side-chain structure. It is generally believed that hop varieties with a lower level of cohumulone provide a more pleasing bitterness.

When energy is applied to these molecules during the boiling of the

figure 1

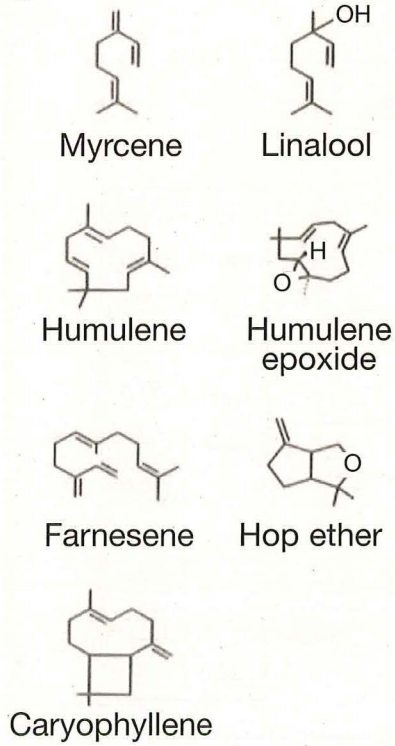
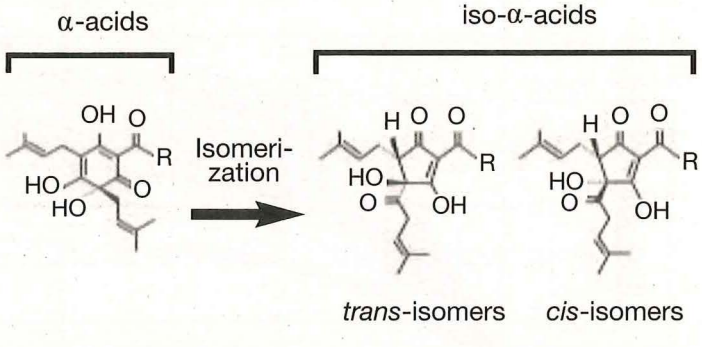


figure 2



R= $CH_2CH(CH_3)_2$	humulone	isohumulone
R= $CH(CH_3)_2$	cohumulone	isocohumulone
R=$CH(CH_3)CH_2CH_3$	adhumulone	isoadhumulone

wort, the α-acid molecules change their configuration. The number of atoms they contain stays the same, but their "shape" changes. α-acids are isomerized to form iso-α-acids. The iso-α-acids are much more soluble in aqueous solution than the α-acids. The isomerization reaction of these three α-acids to iso-α-acids is shown in Figure 2.

Each iso-α-acid exists in two isomers, cis and trans, which differ in the orientation of the side chains (the "-R" groups shown in Figure 2) relative to the rest of the components within the molecule. The six iso-α-acids differ in the quality and intensity of their bitterness.

The iso-α-acids are intensely bitter. The threshold value in water has been estimated 4 at 6 ppm. The concentrations of iso-α-acids within beers varies widely between beer styles. A concentration of approximately 15 ppm is typical in American lager beers, whereas iso-α-acid concentrations of up to 100 ppm can be found in the most bitter beer styles. The actual perception of bitterness during the consumption of the beer is influenced by complexation interaction of the iso-α-acids with residual sugars and other flavor components in the beer.

Alpha acid utilization

The isomerization reaction within the boil is not very efficient. Generally, no more than 50% of the α-acids are isomerized within a typical boil and less than 25% of the original bittering potential actually makes it into the beer. Wort density plays a role regarding how much of the original bittering potential actually makes it into the wort. In general, a higher wort original gravity (OG) means that less of the α-acids will be extracted from the hop and into the wort and will therefore not contribute to bitterness. Figure 3 (below) illustrates the theoretical relationship between OG and hop utilization.

The isomerization of the hop-derived humulones during wort boiling has been studied in great detail. The relative ratio of the isohumulone cis/trans isomers formed during the boil depends on the specific reaction conditions within the boil. The typical ratio of isomers that is formed during the boil is normally approximately 68:32 in favor of the cis-compounds. The cis-compounds are much more stable (half-life >> 5 years) than the trans-isomers (half-life ≈1 year). Over time, this change in the relative ratio of the cis/trans isomers that are present within the beer can have significant consequences on the taste and flavor stability of the beer. It is generally preferred to have the highest possible content of cis-isohumulones within the mixture of isohumulones in the beer.

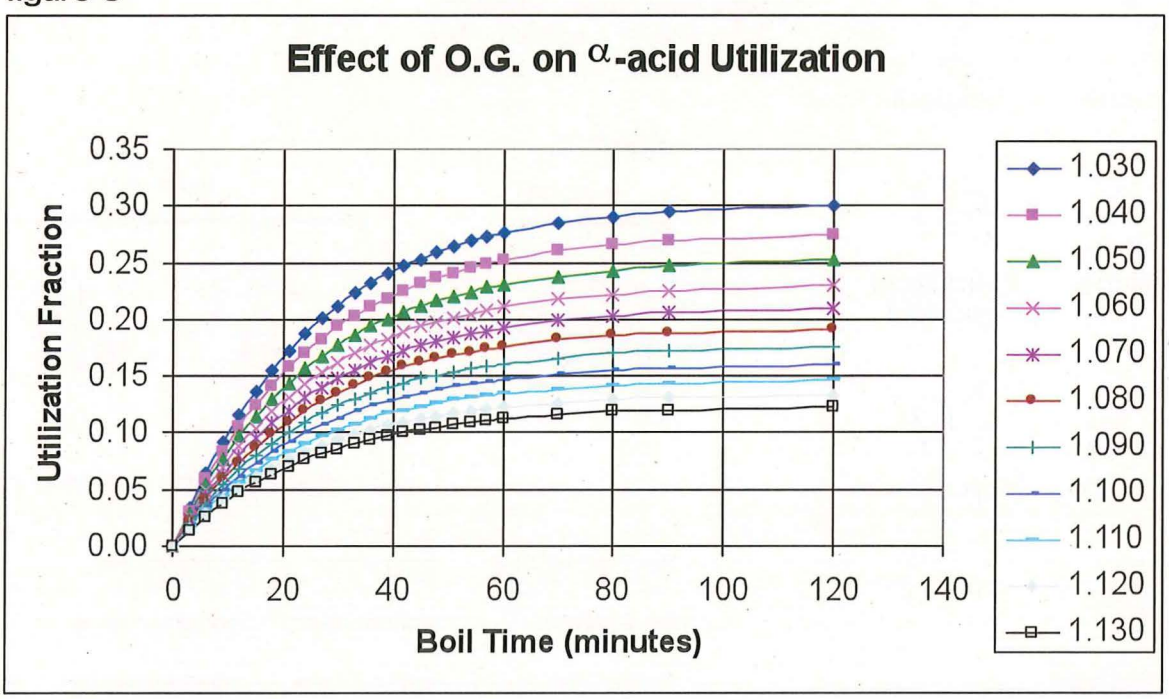
Isomerization reaction kinetics

In order to convert the α-acids extracted from hops into iso-α-acids, it is necessary carry out an isomerization reaction on the α-acid. An isomerization reaction is a chemical reaction in which the functional groups contained within an organic molecule undergo a rearrangement within the molecule.

The rate at which the reaction occurs is dependent upon many things. Two variables that are of primary importance to the reaction rate are temperature and concentration of the reactants. pH also plays a role. Researchers Malowicki and Shellhammer have studied the isomerization reaction rate. They examined hop α-acid isomerization kinetics at a buffered pH of 5.2 over a broad range of temperatures. The rate at which an isomerization reaction occurs can be modeled as a first-order reaction with the following equation:

$$-r_{\alpha\text{-acid}} = k[\alpha\text{-acid}]^n$$

figure 3



Where:

$-r_{\alpha\text{-acid}}$ = rate of conversion of α-acid to iso- α-acid (moles/liter-sec)

k = an experimentally determined, temperature-dependent, constant that is specific to the reaction in question (0.0153 1/sec at 212°F)

[α-acid] = concentration of α-acid within the wort (moles/liter)

n = a constant specific to the reaction in question (n = 1 for this "1st-order" isomerization reaction)

The reaction rate constant, k, is affected by reaction temperature. The effect of temperature on this parameter can be modeled with the following equation:

$k = Ae^{(-E/RT)}$

Where:

k = reaction rate constant at temperature, T (1/sec)

A = a constant, an empirically derived parameter, (1/sec)

e = the base of natural logarithms (~2.71828...)

E = activation energy for the isomerization reaction (36.375 kJ/mole)

R = universal ideal gas constant (8.314 J/mole-K)

T = absolute temperature (K)

Using data from Malowicki and Shellhammer, the value of the constant, A, can be determined. Using E = 36.375 kJ/mole (or, equivalently, 36375 J/mole), k = 0.0153 1/sec at T = 212°F (373K), and R = 8.314 J/mole-K, we can rearrange the earlier equation:

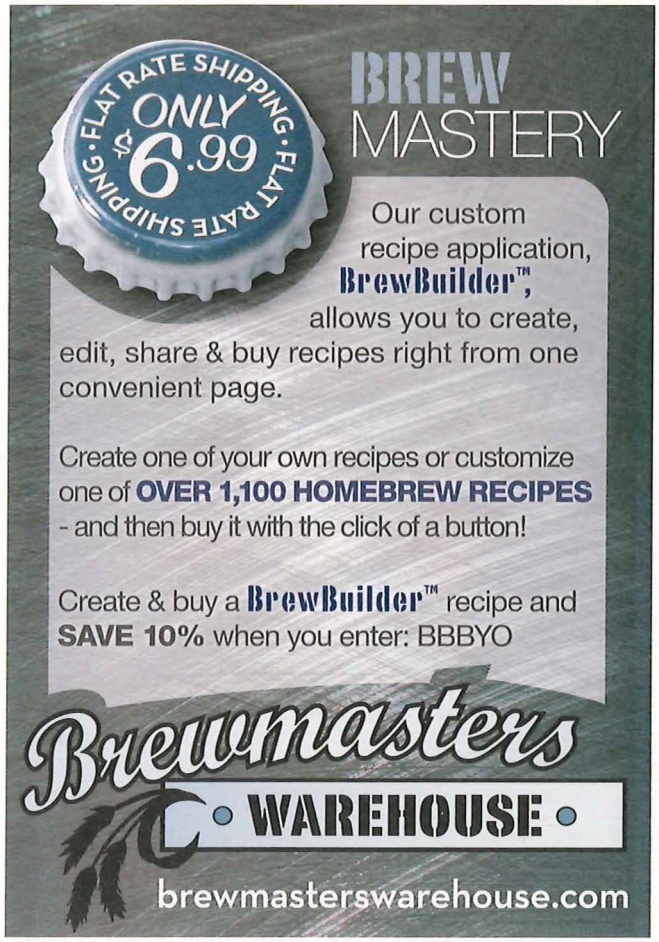
$$\ln k = \ln A - \frac{E}{R}\left(\frac{1}{T}\right)$$

and substitute these values into the rearranged equation in order to determine the value of A:

$$\ln(0.0153) = \ln A - \frac{36375}{8.314}\left(\frac{1}{373}\right)$$

Solving the above for A gives A = 1901. Now that we know the value of A, it is possible to determine the effects of temperature on the isomerization reaction rate constant, k. As we would expect, the rate constant k increases as temperature increases.

The researchers determined that at 70 °C (343K or 158 °F), less than 10% of α-acids were converted to iso-α-acids in 90 minutes. At 120 °C (393K or 248 °F), only 30 minutes were required for 90% conversion of α-acids to iso-α-acids. So, again as expected, higher temperatures are correlated with higher levels of isomerization.



Finally, the researchers showed that the amount of iso-α-acids increased over time. It is important to keep in mind that the experimental data that was used for all of the above calculations was derived from a laboratory scale system that consisted of purified α-acid extract in water; the research was not carried out in a wort solution. After 80 minutes of boiling in water, nearly 70% of the α-acids had been converted to iso-α-acids. In an actual wort solution, the α-acid isomerization reaction rate is lower than the rate that was determined in the laboratory setting with water. One reason for this difference may be the difference in pH between purified water (pH 7) and wort (pH 5.2–5.6). Note that commercial hop extracts are made in high pH (pH 10–11) solutions.

Conclusions

Increasing wort O.G. decreases the effectiveness of the extraction of α-acids into the wort.

The isomerization reaction for the conversion of α-acids to iso-α-acids can be modeled by a first order reaction rate equation.

The rate of isomerization of α-acids to iso-α-acids is strongly temperature dependent. Higher reaction temperatures result in a greater rate of isomerization of the α-acids to iso-α-acids. Higher temperatures lead to a more complete utilization-per-unit-time of the bittering compound precursors (α-acids) that are extracted from the hop during the boil.

The isomerization reaction is not fast. A significant amount of time at normal boiling temperature is required in order to achieve significant conversion of α-acids to iso-α-acids. This is one of the main reasons that boil times are much longer than the time required for wort sterilization.

So what can we do with this information? Well, if you were a large, commercial brewery that was trying to reduce energy costs and increase output, you might consider exploring the potential benefits of using an increased-temperature (high-pressure), reduced-time boil.

Also, perhaps the more detail-oriented homebrewers among us can use this understanding of isomerization kinetics to improve the accuracy of hopping rate calculations. This understanding could help to more-accurately achieve target concentrations of bitter compounds in wort by allowing the brewer to compensate for boiling-vessel temperature variation during heat-up and cool-down.

Lastly, and certainly most importantly, we can use this information to simply deepen our appreciation of the contributions that have been made by science to help us all brew better beer. BYO

Chris Bible is Brew Your Own *magazine's "Advanced Brewing" columnist.*

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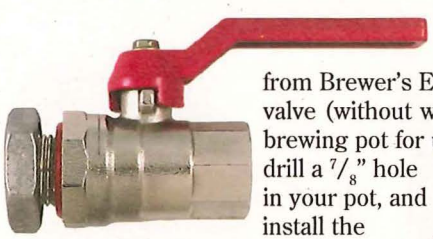

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Portable Kegerator

Take your homebrew to go

by Forrest Whitesides

Adding a kegging system to your homebrew setup is often a welcome addition (and relief) to brewers. You can save time that would normally be spent bottling, precisely control and adjust carbonation levels, and you do not need to wait on the natural carbonation process. Also, having draft beer around is just plain awesome, especially when you have friends and family over for gatherings.

The problem arises when you want to take your finely crafted draft beer on the road. You need to either use a counter-pressure filler to bottle from the kegs, or you can simply fill a growler from the tap and then consume the beer quickly (the carbonation is hard to maintain for more than a few hours). While the counter-pressure filler is a great tool, it deprives you and those who consume your beer of the true draft experience and it requires the use (and subsequent cleaning) of glass bottles. The remedy? Enter the portable kegerator.

Instead of dealing with bottle fillers and irksome bottling tasks, a more straightforward approach to transporting draft beer is to simply make a miniature version of your kegerator and take it with you to picnics, camping trips, parties, etc.

Like most hobby and DIY projects, you can go all out and spend a big chunk of change, or you can minimize and be thrifty. The project presented here shows options that span the spectrum of cost.

I stayed with a single-keg setup, as this is simpler and less costly than a two-keg setup. The same principles apply, so just scale up if you want to go with multiple kegs.

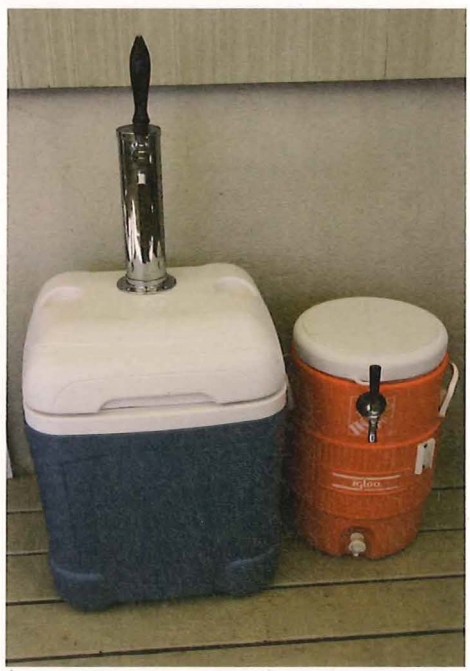
Also, I built this project in two different sizes — the first with a 70-qt (66-L) rolling picnic cooler, and the second with a 5-gallon (19-L) round cooler. The larger version includes a draft tower. Any big temperature differential between dispensing hardware and beer will cause foaming, and this can happen with this cooler build, especially if the tower is warm (like if the kegerator is out in the sun and the tower heats up). This is not a huge deal if you are using under-carbonated beer. However, if you're in a hot environment, the tower will heat up as it's not in contact with the ice in the cooler and all the metal that the beer comes in contact with will change the beer temperature, causing the CO_2 to come out of solution until the shank or faucet cools down. Depending on how hot it is, this may take a few seconds or it might take pouring up to two or three pints to settle down. Just keep that in mind if you experience foaming and try not to place the kegerator in direct heat if you can.

> "Having draft beer around is just plain awesome, especially when you have friends and family over for gatherings."

Parts and Supplies List

Here is the general list of what you'll need to make your own kegerator on the go:

- 3-gallon (11-L) keg
- Igloo Ice Cube Maxcold 70-qt. (66-L) roller picnic cooler OR 5-gallon (19-L) round Gott or Igloo cooler
- 5-lb CO_2 cylinder, or one Genuine Innovations CO_2 charger
- Dispensing hardware (For the big cooler, I used a Perlick single-faucet draft tower. I used a 3-inch faucet shank from Northern Brewer and a cheap faucet for the round cooler. You can choose other hardware based on your needs and taste).
- 10 feet (3 m) food-safe beverage tubing
- Keg lube
- Power drill with a hole saw bit and a spade bit



It is a breeze to take your draft beer to go with these easy-to-build portable kegerator designs.

1. KEG

The best keg size for this project is 3 gallons (11 L), although 2.5-gallon (9.5-L) kegs can work as well. Both sizes have the same diameter as their larger 5-gallon (19-L) cousins, but they are about 8 inches (20 cm) shorter. Because of the relatively small number of 3-gallon (11-L) kegs in circulation, buying new is generally only a few dollars more than buying used. The typical cost of a new 3-gallon (11-L) keg is around $100; used is around $85. For the extra $15 to $20, I'd recommend going with a new keg that you can be sure holds pressure and is clean.

I have two 3-gallon (11-L) kegs, one of which has the traditional hard rubber handles on the top, and the other which has no rubber on top and a single stainless steel handle. They are both the same height overall at the highest point (about 16.5 inches) but the one without the rubber handles is a bit easier to fit into small spaces, including the round cooler, because it is shorter and narrower around the outer top edges. The rubber-handle keg with the vinyl graphic Kegwrapz was graciously donated by Final Gravity Podcast (www.finalgravitypodcast.com).

2. CO_2 SOURCE AND DISPENSING HARDWARE

For the CO_2 source, you have two options: a small cylinder or a mini "keg charger" that uses small CO_2 cartridges. The keg charger is cheaper and smaller, but it does not provide a way to monitor or regulate the pressure in the keg. For cylinders, you can choose a 2.5-pound or 5-pound cylinder.

For the dispensing hardware, there are two options as well: a through-wall faucet shank or a draft tower. The choice will come down to a combination of cost and space available in the cooler. Get your cooler first and then measure before you buy your dispensing hardware.

You will also need a set of disconnects (gas and liquid) for the keg. If you plan to use the keg charger to push the beer, you must make sure that the gas-in disconnect has the MFL-style tubing connector, as this is what the charger threads into directly. Do not get the barb-style

3. INSTALLING THE TOWER

For installing the tower, mark off where you want it centered on the cooler lid and then drill the center hole for the beer line. Some towers have a short ⅞-inch shank at the end of metal tubing, while others have ⅜-inch ID tubing. A hole saw works great for the larger hole, while a spade bit is great for the smaller diameter. Fit the tower over the center hole and drop the beverage tubing through. Now mark the holes for the retaining/mounting bolts (the tower likely has four such holes), remove the tower, and drill the mounting bolt holes. My tower took #10-24 sheet metal screws, but yours may vary. I also added neoprene and metal washers on the inside, but this is almost certainly not necessary. The nuts alone will grip the semi-soft lid material adequately.

4. SHANK

If you want to go through the side of the cooler, use a ⅞-inch hole saw to make an opening that's just the right size for a faucet shank. Before drilling, put the keg (and cylinder, if applicable) in the cooler and dry fit the shank to make sure it will clear the top of the keg. A short shank (3 inches/8 cm is a good length for the round cooler) will have enough clearance to allow inserting and removing the keg without having to first remove the shank.

5. CONNECT AND TEST

Now that the dispensing hardware is fitted, you can connect all the tubing and get ready for a test run. Put the keg and CO_2 source in the cooler and attach the disconnects. NOTE: If you are using the keg charger, thread it to the gas-in disconnect but make sure you do not have a cylinder in the chamber. You are just adjusting the position of the charger and you do not want to have the charger loaded for this. Now, connect the rest of the tubing to liquid-out and gas-in sides. Like any kegging system, the right amount of line resistance is required to keep the beer from foaming too much as it is dispensed. Shoot for around 8–10 feet (2–3 m) of beverage tubing and then adjust as necessary. Close the cooler lid and make sure it fully and securely closes. If it does not, rearrange the tubing or move the position of the keg and CO_2 source to help the lid close more securely. If you still can't get the lid closed all the way, you may need to cut out part of the lid (see photo).

6. FINISHING UP

The Ice Cube cooler has a ton of room inside, so spacing should not be an issue. Since there was space, I went ahead with a 5-lb CO_2 cylinder. There is still plenty of room for ice as well as bottled water, soda, or packaged food. I've also seen other homebrewers fit two 3-gallon (11-L) kegs in an Ice Cube cooler, so that is also an option. If you go with a single keg, you'll want to load the cooler with ice or cold packs to keep things from shifting. The round cooler makes for a more compact option, and if you go with a shank it is by far the cheaper of the two projects, but it does have drawbacks. Unless you mount a small cylinder outside the cooler, the only thing that will fit inside is the tiny keg charger, and there is not much room left for ice. Additionally, you will likely have to cut out a portion of the lid, which will reduce the insulating properties of the lid. This may require the addition of additional insulation material to prolong the life of the small amount of ice the cooler can hold. BYO

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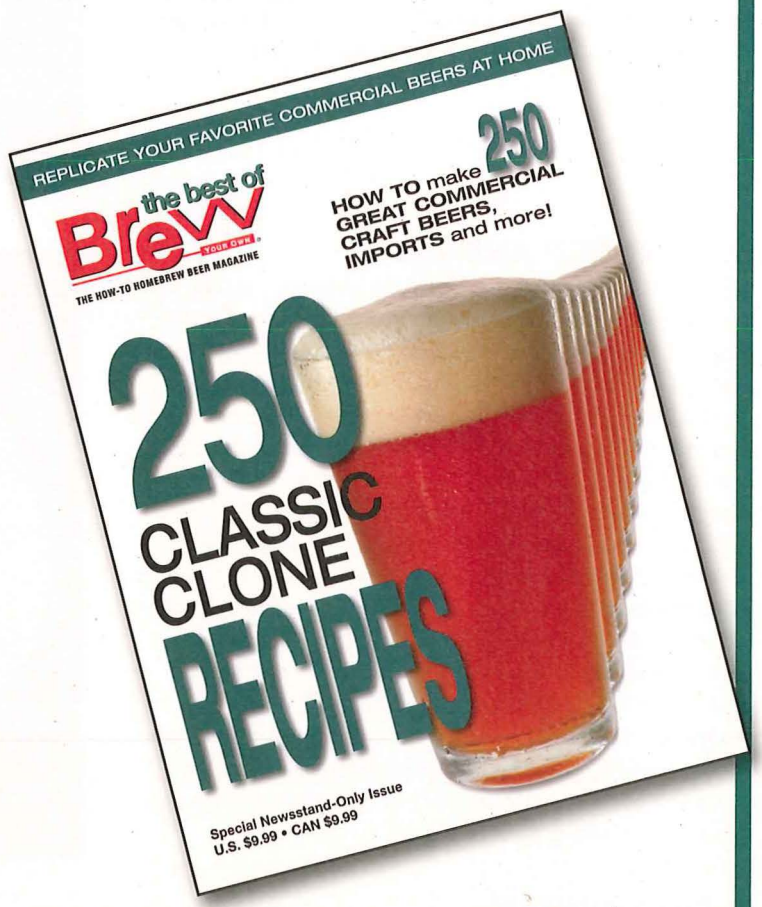

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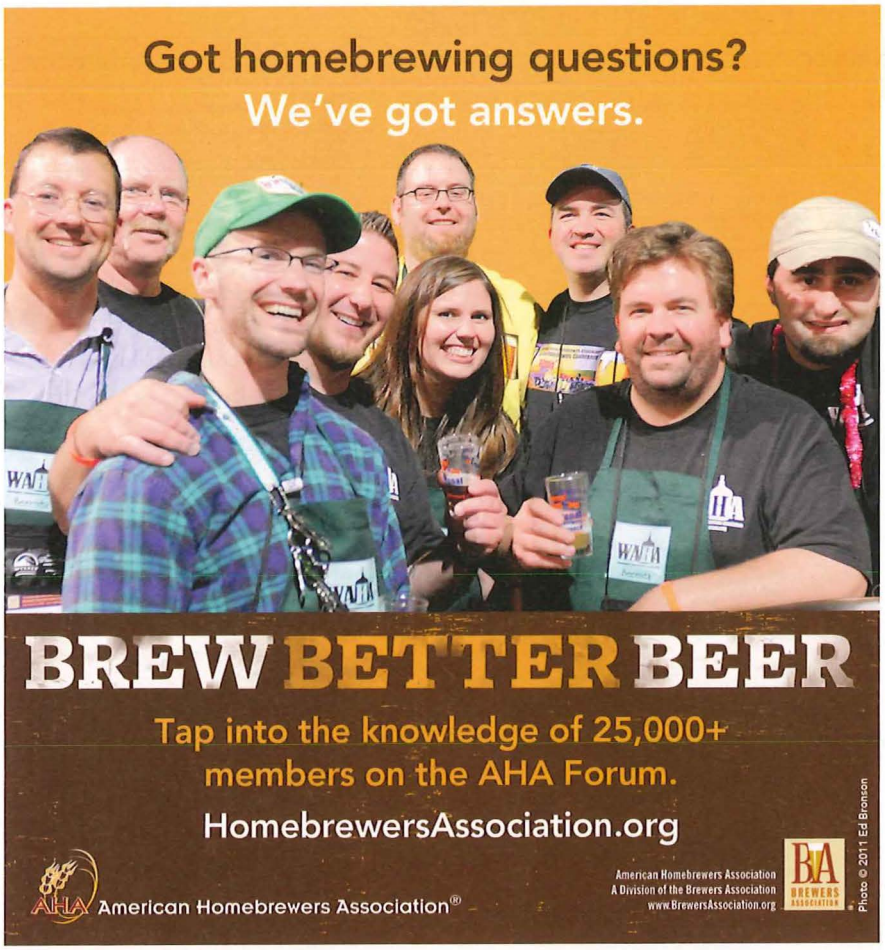

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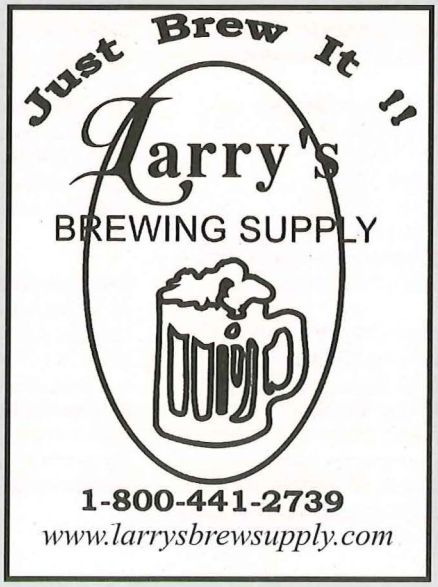

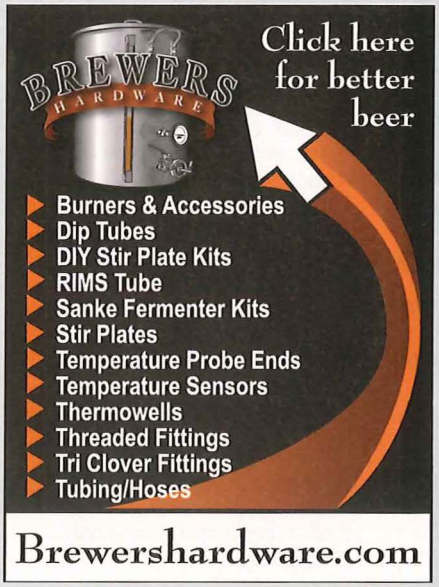

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BrewYour Own — THE HOW-TO HOMEBREW BEER MAGAZINE

How Do You Know?

Signs that you are a homebrewer

Every now and again, the editors at *BYO* like to test the wort and see just what homebrewers are up to. So we asked you to finish this sentence on Facebook: "You know you are a homebrewer when . . ." This is what we found:

> "In order to get the Christmas decorations out of the closet you have to first move bottles, fermenters, a stainless steel kettle and a wort chiller."

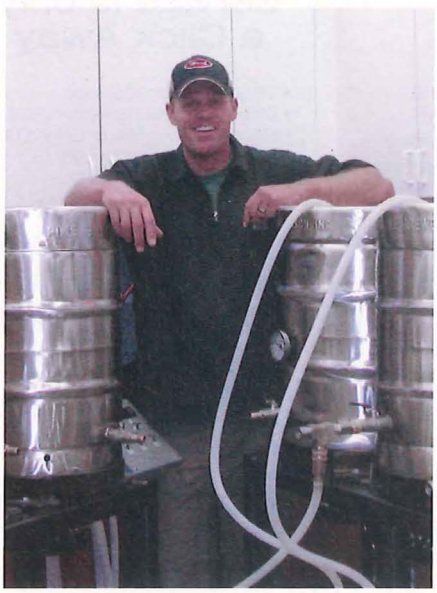

Photo by Brian Davis

How do you know you are a homebrewer? When you brew beer for everything from fantasy football drafts to an office party!

Some answers were brutally honest:

- it's more important to brew than buy Christmas presents.
- your four-year-old is on a first name basis with the owner of the home-brew shop.
- every vacation, road trip or errand turns into a quest for breweries, beer and beer equipment.
- you enjoy smelling bunghole emissions.
- you realize the most organized part of your life is your brewing records.
- new kegging equipment makes you squeal a like Girl Scout on a roller coaster.

Some answers addressed matters of space:

- you have 100 lbs. of eight different types of malt in your 500-sq-foot, one-bedroom apartment.
- you have 30 gallons of beer in your living room and you didn't buy an ounce of it.
- you're looking at a new house and the first thing you're looking for is the best place to brew.
- in order to get the Christmas decorations out of the closet you have to first move bottles, fermenters, a stainless steel kettle and a wort chiller.
- there are more refrigerators/freezers in your garage than cars.
- there is more brewing equipment in your garage than lawn mowing equipment!

There were practical responses:

- you correct the waiter on a style of beer.
- you have yeast slurries in the fridge.
- every time you're in the grocery store you look at the recycle codes on the bottom of every plastic bottle larger than 16 oz.
- you're making beer for everything from the fantasy football draft to the company holiday party.

And then there were the sentimental responses:

- you dream of brewing.
- you interpret the bubbling on the air lock as a manifestation of emotion from the yeasties (and also when you call yeast "yeasties").
- my husband comes home and the kitchen is a sticky mess, I smell like an alfalfa field, and my glasses are steamed up from putting my face into the wort steam to get a quick smell; but then he sees the HUGE smile on my face and suddenly it all makes sense to him!

Finally, there are the responses that indicated there is no turning back:

- you measure manhood by how many taps you have on your kegerator.
- you have more refrigerators and freezers devoted to beer than food.
- you've actually had to mop the ceiling after opening a beer.
- your friends come over for a bonfire, and sit in front of your kegs in the cellar all night.
- you hear a scream in the other room from your girlfriend and find out it's because the keg of IPA just blew.
- even your father decides your beer is better than commercial brews.

Thank you to all of our Facebook friends for having some fun with us and letting us know the signs of a true homebrewer. Join us next time by becoming a fan of Brew Your Own. *Go to www.facebook.com/BrewYourOwn and click on the "like" icon.* BYO

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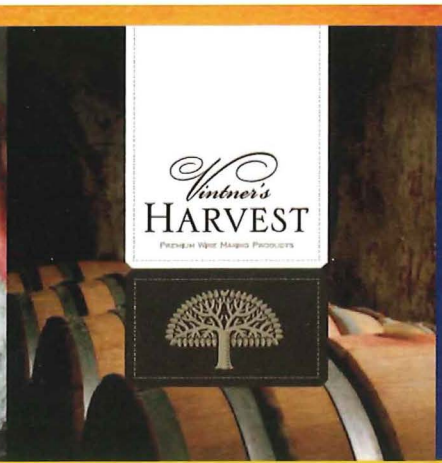

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