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DECEMBER 2002, VOL.8, NO.8

THE HOW-TO HOMEBREW BEER MAGAZINE

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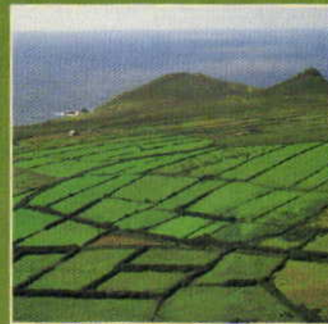



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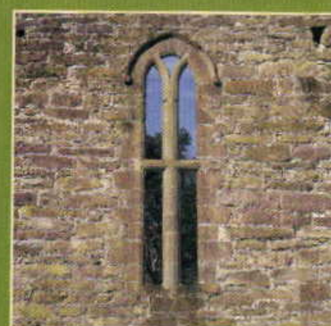
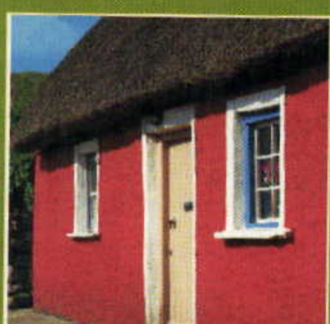
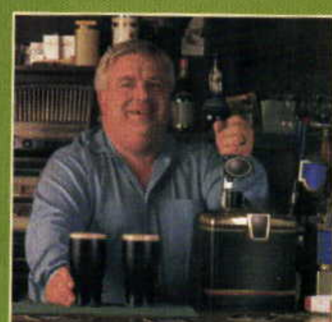





AMBER
BROWN ALE
DARK
LIGHT LAGER
LIGHT
EXPORT ALE
FAMOUS IRISH STYLE STOUT

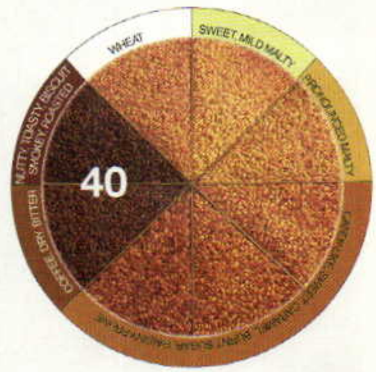
DECEMBER 2002
Volume 8 Number 8

Departments

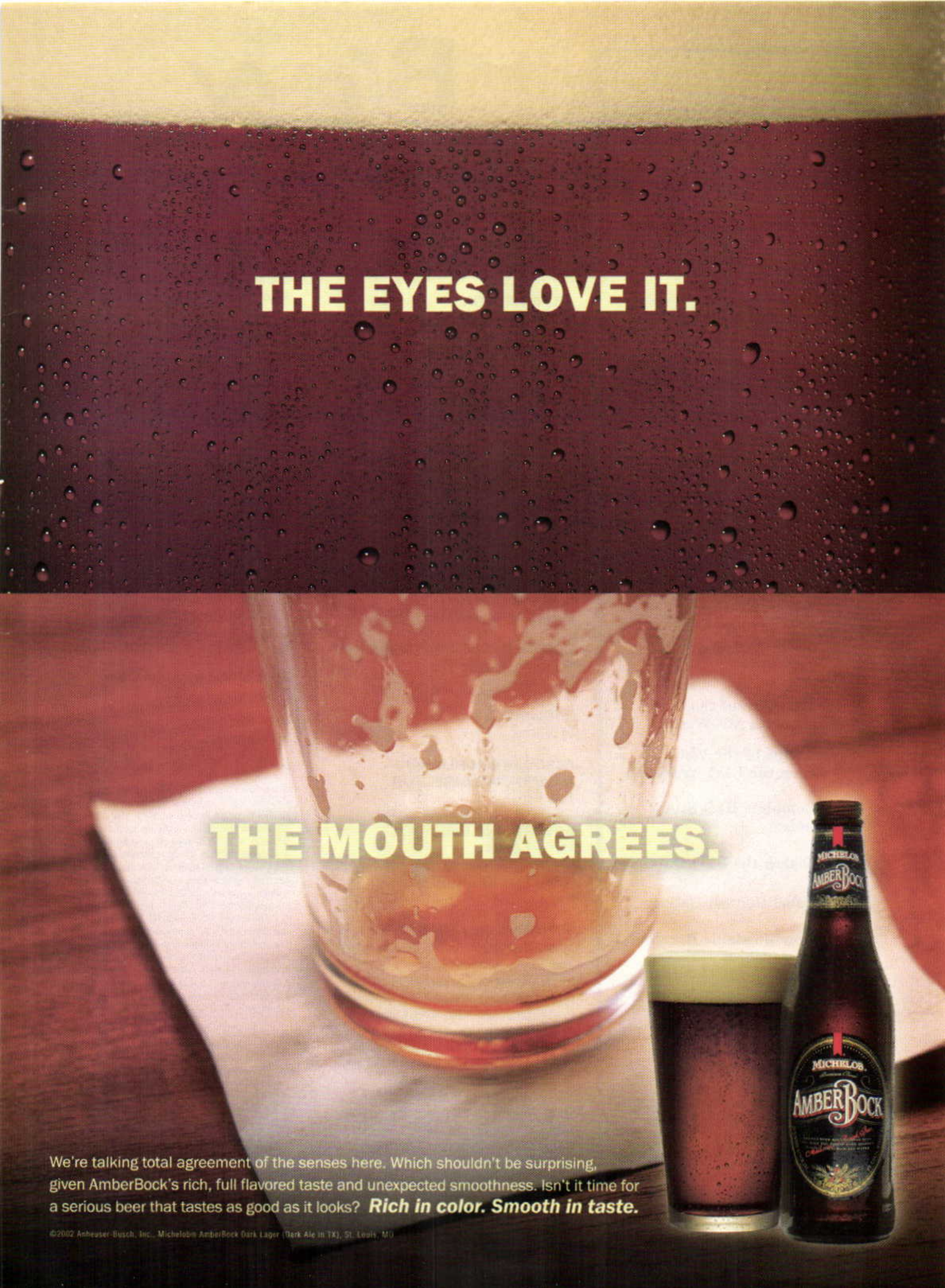
COVER art: **Shawn C Turner**

Brew YOUR OWN

Features



Where to find it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THE MOUTH AGREES.
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Brew YOUR OWN®

THE HOW-TO HOMEBREW BEER MAGAZINE

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Volume 8, Number 8: December 2002

THE beerkit to make superb beers without a hassle !

If you don't have the time nor the inclination to brew your beers starting from the raw grain, or perhaps you think that brewing is as difficult as brain surgery but you don't have a high opinion of beer from beer kits, we recommend you try a **BREWFERM** home brew kit. The results may well surprise you! **BREWFERM** use nothing but the finest ingredients in their kits, and their beers are tailored to demanding Belgian tastes.
Your own homebrewed Abdijbier, Tripel, Tarwebier, Grand Cru, Diabolo, ... 13 types in all ... without a hassle, thanks to **BREWFERM**!

- The only NO-BOIL kits using genuine Belgian recipes and ingredients, available in 13 different types
- Very straightforward to use
- Makes 9-15 litres of absolute TOP QUALITY BEER!

DARK ABBEY type for 9 l.
Starting specific gravity : 1.070 Alcohol content : 8 %.
One of the most well known Belgian specialties : an Abbey style beer with vinous character due to its high alcohol content. Deep amber, full flavoured with lots of malt aroma with caramel notes. Improves with long maturation times and can be kept for several years !

AMBIORIX type for 15 l.
Starting specific gravity : 1. 060 Alcohol content : 6,5 %.
Amber beer with a red copper tint. Slightly acidic palate at first but with a nice fruity aroma. Moderate hop bitterness. Comparable with the well known beer of Roeselare.

DIABOLO type for 9 l.
Starting specific gravity : 1.071 Alcohol content : 8 %.
Belgian specialty beer : Strong, golden coloured beer with a thick and long lasting head (lacy). Characteristic aroma of devil type Belgian beers, soft palate with a slightly sweet aftertaste. Improves with long maturation times and can be kept for several years !

KRIEK type for 12 l.
Starting specific gravity : 1.053 Alcohol content : 5,5 %.
Kriek is the best known of the famous Belgian fruit-beers, made by macerating cherries in beer. A slightly acidic, sweet aromatic beer with a red topper tint. Each kit contains pure cherry juice of at least 3 kg of cherries ! This beer gives you the perfect balance of fruitiness without tasting like grenadine as some commercial kriek's do.

OLD FLEMISH BROWN type for 12 l.
Starting specific gravity : 1.060 Alcohol content : 6 %.
A dark brown beer with a woody notes flavor a slight liquorice aftertaste that also compares with the Dutch Bock-beers.

CHRISTMAS type for 7 l.
Starting specific gravity : 1.065 Alcohol content : 8%.
Dark, strong and full-bodied Belgian beer, sweeter than Abbey style beers. Strong malt flavour and aroma. Improves with long maturation times and can be kept for several years !

WHEATBEER type for 9 l.
Starting specific gravity : 1.053 Alcohol content : 5%.
Very similar to the well known Belgian "Witbieren" : pale, opaline colour with low alcohol content. A real summer beer with a pleasant aroma, mild hops and a smooth malt character. Slightly acidic and thirstquenching. Based on an old recipe using barley, wheat, oat flakes and a secret herb mixture with coriander and sweet orange-peel.

GRAND CRU type for 9 l.
Starting specific gravity : 1.075 Alcohol content : 8%.
Gold opaline coloured, with strong flavour of grains and even bread. Very little hop aroma. Very mouthfull with light fruit notes and a pleasant sweetness. Also this kit contains wheat malt and a special herb mixture.

TRIPLE type for 9 l.
Starting specific gravity : 1.075 Alcohol content : 8%.
Triple is a well known, deep golden coloured, Belgian specialty. Due to its high malt contents it has a very pleasant aroma and taste, mouthfull, full bodied and even a bit herbaceous. High alcohol content.

FRAMBOOS type for 12 l.
Starting specific gravity : 1.053 Alcohol content : 5,5%.
FRAMBOISE or raspberry beer, is a Belgian specialty. Together with the BREWFERM KRIEK, this FRAMBOISE is the only fruitbeer kit available in the world. Each kit has an equivalent of 2 kilo of raspberries. This FRAMBOISE beer han a very delicate aroma and is ideal as a refreshing summer-beer or as a surprising aperitif !

PILSNER type for 15 l.
Starting specific gravity : 1.042 Alcohol content : 4,6 %.
Light, blond beer, with a moderate bitterness and dry finish, comparable with the commercial Lager or Pilsner beers. Low alcohol content.

GOLD type for 12 l.
Starting specific gravity : 1.053 Alcohol content : 5,5 %.
A real deluxe pilsner type with more malt flavor than the normal Lagers. Moderate hop bitterness. Comparable with the Scandinavian deluxe-Beers.

GALLIA type for 12 l.
Starting specific gravity : 1.055, Alcohol content : 5,5 %.
The latest addition in our range: A thirstquenching pale amber beer with a refined bitterness and a soft finish, a worthy alternative to the commercial Belgian ales.

THE beerkit to make superb beers without a hassle !

BREWFERM PRODUCTS

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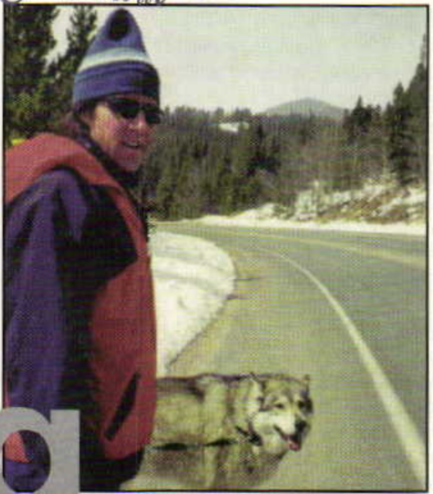


Glenn BurnSilver lives in Fort Collins, Colorado and has written about music, backpacking, backcountry skiing, travel and old bicycles for various publications. His BYO articles include "Chill Out: Tips for Cold-Weather Brewing" (January-February 2002) and "Out of Africa: Maasai Cucumber Beer" (January 2001). Glenn is a coffee achiever . . . as long as the coffee comes from beer. In "Brewing with Coffee" on page 26 of this issue, he describes how to put the roasty flavor of coffee beans into your next batch of homebrew.

The December 2002 cover is illustrated by Shawn C Turner, a freelance artist based in Sacramento, California. As owner of Somerset Words and Pictures, Shawn has used his formidable computer-design skills to illustrate dozens of articles for *BYO* over the years. He uses his middle initial — with no period, please — so you won't confuse him with that other Shawn Turner, who still won't pay his car stereo bill. Turn-ons include his family, playing the pennywhistle and getting paid to doodle all day long. Turn-offs include leaky roofs, especially when it rains, and those little stickers the grocery stores put on each piece of fruit. I mean, are you supposed to eat them?

Brew Your Own WINS!

The Quill and Tankard Awards are presented each year by the North American Guild of Beer Writers to honor the year's best beer writers. *Brew Your Own* is proud to announce that we swept the "brewing" category at the 2002 Quill and Tankard ceremony, held in Denver in early October. The gold medal went to Horst Dornbusch for his article on sahti ("A Mighty Finn Beer," December 2001). Horst is a professional beer writer and handles the "Style Profile" column in each issue. "Homebrew University" (September 2001), written by Chris Colby and Ashton Lewis, took silver. Chris is our managing editor and writes the "Techniques" column. Ashton is our technical editor and the head brewer at the Springfield Brewing Company in Missouri. Colin Kaminski of Beer, Beer and More Beer, a frequent contributor to *BYO*, took bronze with "Bring on the Heat" (November 2001). Did we mention that the two honorable mentions in the category — Chris Colby for "Make Me Sweat" (Summer 2001) and Marty Nachel for "Beer Made Easy" (May-June 2002) — also went to *BYO* authors? No? Well, we wouldn't want to brag.

Dornbusch

Colby

Lewis

Kaminski

Nachel

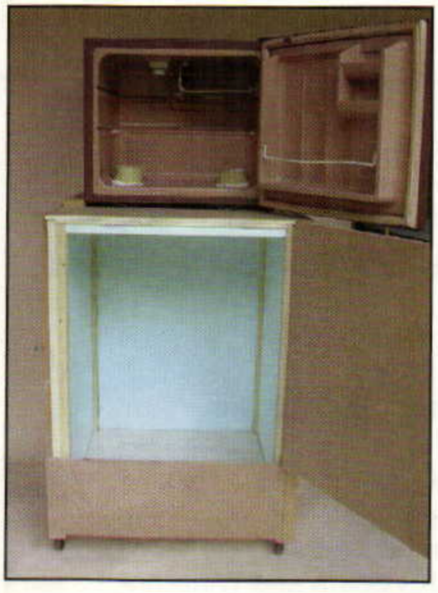
Boosting Brown Ale

In Horst Dornbush's article about brown ales (Style Profile, October 2002), he suggests adding spiced rum at priming time to add spice and a warm glow. The idea of a warmer, spicier ale appealed to me, as winters can get kind of cold in Michigan. In his book "Homebrewing for Dummies," Marty Nachel suggests using liqueurs as priming agents. This made me wonder — should I reduce the amount of priming sugar if I add rum?

Steve Kordecki
Muskegon, Michigan

Rum is liquor, not a liqueur. So, adding rum should not add an appreciable amount of sugar to your beer. As a consequence, you will not have to adjust your priming sugar. And just to be accurate, Horst recommended dark rum, not spiced rum. However, there's no reason you couldn't use spiced rum if you think it would taste good.

MDF: Acronym Explained



In the article about building a kegerator with a dorm fridge (Projects, September 2002), you use sheets of MDF to construct the box. Sounds good, but what the heck is MDF?

Tom Scalabrini
Sparta, New Jersey

Projects author Thom Cannell responds: "MDF stands for medium density fiberboard. It's a manufactured wood product available at home stores and lumber yards. It is always known as MDF, not its longer name. Like plywood, it is surfaceable; but unlike plywood, it is smooth on both sides and easily cut. It also paints better."

Whole or Pellet Hops?

Do the Replicator's recipes use whole hops or pellet hops? Also, what about the recipes in the rest of *BYO*?

Steve Dohm
Muskego, Wisconsin

All of the recipes in BYO use hop pellets unless otherwise specified. Pellets are the most convenient and widely available form of hops for the vast majority of homebrewers.

Headless Horseman Ale

I am trying to brew a high-alcohol beer. I recently made an oatmeal stout using extract and grains. The alcohol content was satisfactory at nine percent alcohol by volume, but the carbonation was minimal, with slightly less than a quarter-inch head. I primed the beer with two cups of dry malt extract per case of 12-ounce beers (8.5 liters of beer). Should I pitch more DME or could I add some dry yeast? I would like to increase head retention and head thickness. Also, I used champagne yeast to ferment and I found I had a slight fruity taste on the finish. Could this be the result of the yeast and will it go away with age?

Mykel Burkhart
via email

High-alcohol, bottle-conditioned homebrews typically have a few problems with head retention. First, alcohol itself helps break down a beer's head. This is why barleywines never have a big head on them. Second, the yeast in

RECIPE INDEX

the bottle may have problems fermenting the added sugar at bottling time. Adding fresh bottling yeast helps the carbonation go faster. I wouldn't add any more DME, however; it sounds like you're adding it at a high rate already.

Increasing the head on an extract beer, especially a high-gravity one, is difficult. Making a small partial mash that includes between 1/2 to one pound (roughly 1/4 to 1/2 kg) of wheat malt (per five-gallon or 19-liter batch) would probably help. Mash an equal amount of pale malt along with the wheat malt. You can add your specialty grains to the partial mash as well.

I don't know if the champagne yeast is responsible for the fruity taste; it may be that the high-gravity fermentation is responsible. Fruity, estery notes are common in high-gravity ales.

Since alcohol and head retention are at odds, you may want to experiment with your original gravity until you find a trade-off between "hooch" and head that is acceptable to you.

One Word . . . Plastic

I have been an avid homebrewer for just two years, but an avid hiker and backpacker for most of my life. When I first saw commercial beer in plastic bottles, my initial reaction was "yuck!" However, after two summers of packing glass-bottled ales up the mountain and empties back down, I think I see a limited use for those ugly plastic contraptions. Are these bottles available to the homebrewer? Is the bottling process involved appropriate for an intermediate brewer?

Dan Wold
Wapato, Washington

We don't know of a source of these bottles other than buying the beer. (None of the big Internet homebrew stores carry them.) However, if you have some lying around, you should be able to bottle-condition homebrew in them. Just clean them and their caps and sanitize them in a dilute bleach solution (1–2 ounces, or 30–60 mL, of bleach per gallon, or 3.8 liters, of water). Bottle as you would any homebrew, then re-seal the caps tightly.

Homebrew can be bottled in two-liter soda bottles for short periods. They are handy for taking homebrew to a party. However, two-liter bottles shouldn't be used for "long-term" beer storage (more than a few weeks) because oxygen may slowly leak through the plastic. The new plastic beer bottles are thicker, however, and might be closer to glass bottles in terms of offering an oxygen barrier. ■

THE BRITISH ARE COMING!

BYO extends a warm transatlantic welcome to our new readers in the **United Kingdom**. Thanks to a new agreement with wholesaler **Young's Homebrew Ltd.**, our magazine is now sold in 100-plus homebrew supply stores across the British Isles. As a result, from now on you'll notice metric equivalents in every issue. Cheers!

homebrew PROFILE

Medieval Brewer • James Brownlow • Palmdale, California


PHOTO BY JAMES BROWNLOW

Brownlow found a 16th-century beer recipe and gave it a 21st-century twist.

I began homebrewing in 1979 because I wanted to duplicate Anchor Steam beer. Four years ago I began to try my luck with all-grain brewing. Last year, I found a fascinating medieval beer recipe on the Web and jumped at the chance to recreate it. I used the original 1503 recipe and other sources to help me update this artifact for use today. *(For references, see box at end of story.)*

Here is the "olde" recipe:

To brewe beer x. quarters malte. ij. quarters wheet, ij. quarters ootos, xl. ll weight of hoppys. To make lx barrell[es] of sengyll beer.

Here is the modern translation:

To brew beer: Ten quarters malt, two quarters wheat, two quarters oats, and 40 pounds of hops for 60 barrels of single beer.

To start, I had to figure out the modern equivalents to the older measurements. A quarter was equal to eight bushels and a bushel, at the time, was equal to eight "gallons" of wheat — a slightly different gallon than that used to measure beer. Also, there were three different "pounds" for different uses: the Troy (12 oz. or 340 g), the Livre Avoirdupois (16 oz. or 453 g) and the Mercantile (15 oz. or 425 g). I went with the Livre Avoirdupois pound because it and the Mercantile were most often used in commercial operations. After converting 60 barrels to 2,637 U.S. gallons (9,984 L), I reduced the recipe to a 5-gallon (19 L) version.

Hops of yore probably had an alpha acid content of around 2–5%. Today's hops have increased bittering properties, designed to save money by reducing the amount needed per batch. With this in mind, I selected East Kent Goldings, a British noble hop with a relatively low alpha-acid content.

The malt used in the early 1500s was kilned with hardwood or dried-straw fires, instead of today's closed-kiln method. The resulting malt was called "brown malt." It is possible to buy brown malt today, but according to my research, this is usually a darker brown. In the recipe I've included instructions for making the appropriate brown malt. I used regular oatmeal and malted wheat.

I used a single mash to make this brew. English brewers used to conduct up to four mashes with an excessive initial amount of grain. The runoffs were used to make beers of decreasing strength that were then combined to achieve the desired strength. After the boil, I removed some "gyle" (unfermented wort) to use later for priming.

Overall, I was happy with the finished product. I had expected a taste similar to a porter or a dark ale, but it wasn't like that at all. I can only suggest that you try one yourself!

RESOURCES

Recipe and discussion on the Web:
www.people.cornell.edu/pages/bjm10/blort/Drake.html (includes an excellent discussion of the beer by Bryan Maloney).

Other books I consulted:

Designing Great Beers: The Ultimate Guide to Brewing Classic Beer Styles by Ray Daniels (Brewers Publications, 1996).

Scotch Ale by Greg Noonan (Brewers Publications, 1993).

The New Complete Joy of Home Brewing by Charlie Papazian (Avon Books, 1991).

reader RECIPE

1503 Beer
(5 gallon (19 L), all grain)
OG: 1.060 FG: 1.014

Ingredients:

5 lbs (2-1/4 kg) 2-row malt
2 lbs (0.9 kg) brown malt (see below)
1/2 lb (1/4 kg) lightly peated malt
2 lbs (0.9 kg) wheat malt
1 lb (1/2 kg) oatmeal
1.5 oz (42.5 g) East Kent Golding hops (5.5 AAU)
Wyeast London III (#1318)

Procedure:

Treat 4.0 gal. (15 L) purified water with 1 tsp. (5 mL) Burton salts to match the pH of English water. For brown malt, soak pale malt in water for 5-10 min., drain and spread on cookie sheet 1/2 inch (1 cm) deep. Bake at 250° F (120° C) for 30 min., then at 300° F (150° C) for 30 min. Bring the oven to 350° F (180° C) and check the color every 10-15 min. until the inside is tan. Combine malts and oatmeal for a single-infusion mash with strike water at 170° F (77° C) water. Maintain a temperature of 162° F (72° C) for two hours. Draw off wort and add 3.5 gal. (13.3 L) of 170° F (77° C) water to the grist. Mash. Draw off second runnings and combine with the first. Add hops and boil for 90 min. reducing to 5 gal. (19 L). Draw off 1 qt. (1 L) wort for priming (gyle) and 1/2 gal. (2 L) kraeusening wort, bottle in champagne bottles and refrigerate. Strain the balance into fermenter, pitch yeast and ferment at 63° F (17° C) for a week. Rack to secondary fermenter and add kraeusening wort. Ferment for 2 weeks at 63° F (17° C). Cold condition at 40° F (4.4° C) for 4-6 weeks before adding priming gyle and bottling. Store bottles above 68° F (20° C) for a week to condition, then allow to age for at least a month before tasting. (I aged my bottles for a year!)

homebrew IDEA

Holiday Cheer • David Houseman • Chester Springs, Pennsylvania

PHOTO BY DAVID HOUSEMAN

Houseman with his poster detailing the many brands of Belgian beer.

If you like to try different beers without having to drink an entire case, splitting cases with friends may be the answer. Around the holidays I like to share 24 cases of beer with 23 co-workers. We mix up the cases, so everyone ends up with a case that contains 24 different beers. You have to plan the purchase in advance through your local liquor store.

We like to use a theme when planning our annual case swap. Try using American beers, IPAs or ESBs. You can also plan the beer styles around specific meal themes, since beer and food go together so well. Another interesting suggestion is to plan a mixed case of classic style examples to help you get ready for the Beer Judge Certification Program (BJCP) exam. These guidelines can be found at www.bjcp.org.

There are a few things to consider when selecting the beers. Be sure you end up with 24 bottles of each beer, as case size often varies by brewery. Also, consider the bottle sizes, since you are going to be mixing cases. Too many oversized bottles can turn your repackaging job into a considerable headache. Last, but not least, remain flexible and knowledgeable about the beers and styles so that, if necessary, you can make last-minute substitutions intelligently and quickly.

Additionally, be sensitive to differences in taste: Don't just pick what you like. Remember, you're attempting to select a number of beers for a number of different tastes. Ideally, you would pick beers that no one has tried before and that everyone will like.

You can do some homework on each beer by checking the Websites for the breweries, or by using search engines to find references on beers, including reviews by other beer lovers.

Before you finalize the big purchase, get solid commitments by collecting the money ahead of time. When figuring the total cost, remember to include tax and delivery charges. Don't forget to ask for a volume discount.

Is it legal to mix and share cases of beer? You'll have to check the liquor laws in your state, but to be on the safe side, ensure that you make zero money on this transaction and make sure that everyone is well aware of that fact. You are simply facilitating the sharing of beer among friends. Good luck and happy holidays!

calendar

Nov 30 & Dec 7, 2002
12th Annual Happy Holiday Homebrew Competition
St. Louis, Missouri

This competition is sponsored by the St. Louis Brews homebrew club. The entry deadline is Nov. 30 and judging is Dec. 7. Coordinator Sean Sweeney can be reached at (636) 946-3027 (seansweeney@charter.net) or go to www.stlbrews.org. Fee: $5.

Dec 14–15, 2002
Kerstbier Festival
Essen, Belgium

Last year's festival drew more than 900 Christmas-beer fans to sample 75-plus different beers. Go to http://homw2.pi.be/gmarch/eng/kerst_eng.htm.

Jan 3 & 10, 2003
Big Beers, Belgians & Barleywines
Vail, Colorado

High Point Brewing is sponsoring this homebrew competition. The entry deadline is January 3 and the awards ceremony is on the 10th. The entry fee is $5. Contact Laura Lodge at BigBeersFestival@hotmail.com or by phone at (970) 524-1092.

Jan 11 & 18, 2003
8th Annual Big Bend Brew-Off
Tallahassee, Florida

This competition, sponsored by the North Florida Brewers League, is for all categories of beer, mead and cider. Larry Agee can be reached by phone at (850) 576-0540. The site for this competition is www.nfbl.org.

Did you know that the world's largest Christmas angel ornament was made of 2,946 beer bottles? (The bottles were capped and full). Created by artist Sergio Rodriguez Villarreal, the angel measured 18 feet, 3 inches high and 11 feet, 9 inches wide (roughly 6 m by 4 m). It was displayed in January 2000 on Alfonso Reyes Avenue in Nuevo Leon, Mexico. To see the beer angel, go to www.guinnessworldrecords.com and search for "angel ornament."

replicator GAELIC ALE

Dear Replicator:

On a recent trip to North Carolina I found an excellent selection of microbreweries. Highland Brewing Company topped my list with their Gaelic Ale and its perfect malt-to-bitterness ratio. How about a recipe?

Todd Bissell
Imperial Beach, California

I talked to brewer Tim Keck about Gaelic Ale. He agreed that the hop-malt balance gives this beer its smooth, supple taste.

Gaelic is a crossbreed of Scottish ale and American amber. It has the higher original gravity and intense maltiness of a Scottish ale, but the higher hop bittering level of a typical American amber. The yeast ferments to a low final gravity to bring the malt flavor into balance. Briess malts and American hops make this beer truly American! Tim ferments at cooler-than-normal temperatures (64° F or 18° C) to reduce esters.

You can get more information about Highland Brewing Company at http://www.highlandbrewing.com or by calling them at (828) 255-8240. They are located in Asheville, North Carolina, but appointments are required for tours.

Highland Gaelic Ale

(5 gal/19 L, extract with grains)
OG = 1.056 FG = 1.013
IBUs = 30-32 ABV = 5.6%

Ingredients

3.3 lbs. (1.5 kg) Briess light malt extract syrup
2 lbs. (0.9 kg) Briess light dry malt extract
1.5 lbs. (0.7 kg) Briess Munich malt (10° L)
0.5 lb. (0.23 kg) Briess crystal malt (60° L)
1 lb. (0.5 kg) Briess crystal malt (40° L)
0.25 lb. (113 g) Briess Extra Special malt

8 AAU Chinook hops (bittering hop) (0.75 oz. (21.3 g) of 12.0% alpha acid)
2.5 AAU Willamette hops (aroma hop) (0.5 oz. (14.7 g) of 5.0% alpha acid)
2.9 AAU Cascade hops (aroma hop) (0.5 oz. (14.7 g) of 5.8% alpha acid)
1 tsp. Irish moss
White Labs WLP001 (California Ale) or Wyeast 1056 (American Ale) yeast
0.75 cup of corn sugar for priming.

Step-by-step: Steep the crushed specialty malts in 3 gal. (11.4 L) of water at 150° F (66° C) for 30 min. Remove grains from wort. Add malt syrup, dry malt extract and bring to a boil. Add Chinook (bittering) hops, Irish moss and boil for 60 min. Add Willamette and Cascade hops at the end of the boil, and let steep for 2 min. When done boiling, strain out the hops, add the wort to 2 gal. (7.6 L) of cool water in a sanitary fermenter and top off with cool water to 5.5 gal. (21 L). Cool the wort to 80° F (27° C), heavily aerate the beer and pitch your yeast. Allow the beer to cool over the next few hours to 64-66° F (18-19° C), and hold at these cooler temperatures until the yeast has fermented completely. Bottle your beer, and age for two to three weeks.

All-grain option: Replace the light syrup and powder with 6.0 lbs. (2.7 kg) Briess pale malt and increase the Munich malt to 2.75 lbs. (1.25 kg). Mash all grains at 150° F (66° C) for 60 min. to achieve high fermentability. Collect enough wort to boil for 90 min. and have a 5.5 gal. (21 L) yield. Lower the amount of the Chinook boiling hops to 0.6 oz. (17 g) to account for higher alpha acid extraction of a full boil. The remainder of the recipe follows the same steps as the extract version.

homebrew basics

Specific Gravity Explained

What exactly is specific gravity? Technically speaking, it is the density of a liquid or a solid in relation to that of water. Because it is a ratio, specific gravity is a "dimensionless quantity," meaning that no unit indicator accompanies it. In beer, specific gravity is used to estimate alcohol content.

The specific gravity of pure water is 1.000 at 60° F (15.6° C). If you dissolve sugar in the water, the gravity or density of the water will rise. As yeast consumes the sugar in sweet wort and converts it to alcohol and carbon dioxide, the gravity of the wort drops.

Specific gravity is measured with a hydrometer, a glass instrument that contains one or more scales. The end of the hydrometer is weighted so that it floats upright. To measure specific gravity, fill a test jar with a sample of your beer and record the temperature. Then float the hydrometer in the beer. Give it a quick spin to dislodge any gas bubbles that cling to the glass. These can throw off the measurement. Read the specific gravity scale at the bottom of the liquid's curve, also called the meniscus. If you have a "triple scale" hydrometer, you can also see the potential alcohol level. If not, you can convert specific gravity to potential alcohol by using a simple chart or conversion formula that can be found in many homebrew books.

Brewers use gravity readings to track the progress of fermentation — in other words, to monitor the sugar level as it drops. Measure your "original gravity" before fermentation begins. "Final gravity" has been reached and fermentation has ended when the reading remains constant for three days.

Be sure to note the temperature of the beer. Nearly all hydrometers are calibrated at 60° F (15.6° C), so if your sample isn't this temperature you'll have to use a conversion chart. This usually comes with the instrument.

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Send ideas to edit@byo.com or 5053 Main Street, Suite A, Manchester Center, VT 05255. If your story gets published, you'll get a cool White Labs baseball cap and a groovy BYO Euro sticker.

A Big CHRISTMAS Beer

Greg Christmas brought one tradition along when he moved from Tennessee to Indiana — making some seriously big batches of homebrew. In the late 1990s, he and his Tennessee homebrew club began brewing 50–105 gallon (190–398 L) batches of homebrew on his huge setup *(photo 1)*. Now he brews them in Indiana. Greg is shown here in 2002 mashing in 320 pounds (145 kg) of malt with his mash paddle *(2)*. His mash tun has a propeller to aid in mixing, but this mash overloaded it. Christmas blessed a 1999 Samiclaus clone with a dose of the original Swiss beer *(3)*. (Samiclaus is the world's strongest lager at 14% ABV). Then he and his buddies raised a toast to their big brew *(4)*.

Lagering

Blend beer flavors by storing it cold

by Thomas J. Miller

Any homebrewer can explain the difference between lagers and ales: Ales are made with top-fermenting yeast and lagers are made with bottom-fermenting yeast. But lagering — the process of cold-storing beer over a period of weeks or months — means something far different to your finished product, and it has little to do with the single-celled organisms that turn sugar into alcohol and carbon dioxide. The word "lager" is the German verb "to store." Done correctly, lengthy conditioning at near-freezing temperatures can prove the difference between an average and an excellent brew.

PHOTOS COURTESY OF ALEC MOSS

BREWER: Alec Moss started homebrewing in 1979. He joined San Francisco Brewing Company as a brewer in 1988 and worked there for two years, then worked for Golden Pacific Brewing in Berkeley from 1990-1999. He has been with Half Moon Bay Brewing in Princeton-by-the-Sea, California since 2000, and has been working since then to get their brewing operations up and running. The restaurant has been operating for two years and the brewpub is scheduled to open sometime this fall.

The big reason to lager your beer, the main benefit homebrewers are looking for, is to soften and mellow the flavor. Lagering adds a degree of maturity to the beer. It blends the flavors of the malt, hops and yeast. The cold temperature works as a natural environment in which this happens.

Lagering is not only for lager beers, such as the Pilseners or Oktoberfests of the world. Ales — in particular, strong ales such as barleywine — can benefit from being aged at cold temperatures over a long period of time. For ales, the lagering process is usually called conditioning. The process is the same, but different words are used to describe it.

These bigger ales need a longer time for their complex flavors to blend and mellow. Lighter beers don't. In a light beer, you might want the hops to jump out at you, and in this case you might get away with a week or two of cold conditioning.

But say you make something like a barleywine. In barleywine, you have to add an enormous amount of hops to counterbalance all the malt that you used. Without sufficient conditioning, those hops will simply overwhelm the beer. Lagering, however, allows those hops to blend with the flavors of the malt. In the end, you can get a barleywine with incredible balance.

The correct temperature for lagering should be between 33–35° F (0.6-1.7° C). This temperature range is the same for lagers or ales.

Homebrewers will need a refrigerator or some other means to keep temperatures that low over a lengthy period of time. The minimum lagering period is one month. Otherwise, it really isn't worth it. You need to give the beer time. Remember that, at cold temperatures, things happen more slowly because the yeast metabolism and chemical reactions are slowed. So, time becomes your ally.

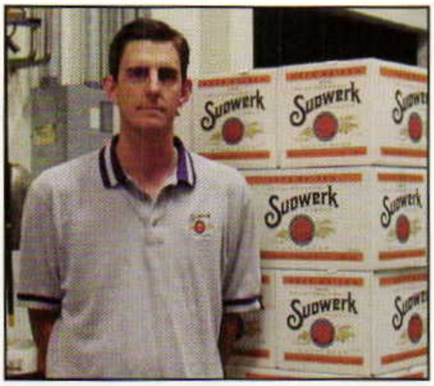
During lagering, a small amount of additional fermentation occurs slowly. Also, oxygen that was introduced during racking into the lager vessel is eaten up by the additional fermentation. In case you were wondering, the cold temperature prevents autolyzation of the yeast that settles out in the lager vessel. Autolysis is the break-

down of all or part of the yeast by self-produced enzymes.

Commercial brewers will let their beer lager as long as they can, though economics may determine the need for a shorter lagering period. They recognize the benefits that lagering imparts on the final product. On a larger scale, I'd say the minimum lagering period is something like two weeks. Things happen slower, though, in smaller batches — the kind you have to deal with at home. Exactly why this is the case, I don't really know. The bottom line is to aim for a minimum of one month when homebrewing.

Lagering is best achieved in bulk. You aren't going to get the same results cold-storing your beer after it has been moved to the bottle. Typically, lagering is done with some yeast present, as this allows for additional fermentation and oxygen take-up. For homebrewers, this probably sounds exactly like bottle conditioning. But the fact is that beer doesn't generally age well in the bottle (though it does better if there is a bit of yeast present). In fact, don't make the mistake of thinking that aging bottle-conditioned beer is the same as lagering. It isn't.

HALF MOON BAY BREWING COMPANY



BREWER: Rich Ellis worked as an assistant brewmaster at Sudwerk Privatbrauerei Hübsch in Davis, California from 1995–1997. From 1997 to March 2002, he was brewmaster of Sudwerk Sacramento. In March 2002, he became director of brewery operations for both locations. Ellis studied Fermentation Science at UC-Davis (while working full-time) from 1996-2001 and has passed two of the three exams the school gives. He will take the third next year.

Lagering plays a big role in improving the flavor of your finished beer. All of the beer's flavors blend and merge perfectly to create a wonderful, memorable and balanced palate.

Lagering (cold conditioning) can be done with beers other than the traditional lager beer. Think of German styles like kölsch, which are brewed with ale yeast but are conditioned cold like a lager. Plenty of pubs cold-condition their blonde ales. At Sudwerk, we also cold-condition our hefeweizen. Lagering also allows the beer to clarify before packaging, as there is a tendency for cold temperatures to precipitate chill-haze components.

In my opinion, the optimum temperature for lagering is 30° F (-1° C). Materials drop out much faster, the beer clarifies quicker, and the maturation of the beer is more pronounced. A few degrees warmer, and the efficiency of the process is drastically reduced.

When I homebrewed, I lagered in a refrigerator that had the temperature turned all the way down — it could freeze eggs. I conditioned the beer in Cornelius kegs with the down-tubes cut out of them. The down-tubes were cut one inch from the bottom of the keg. This allowed me to draw clear beer out of the Cornelius keg and leave the yeast sediment behind.

The key to lagering is to keep everything clean, clean, clean! During cold conditioning, you are giving anything foreign in your beer a four- to six-week incubation period. Despite the cold temperatures, wild yeast or bacteria can take hold and create off-flavors in your finished beer.

Finally, expose the beer to as little oxygen as possible anytime you transfer it. Although additional fermentation during lagering will eliminate much of that oxygen, oxidation remains a viable concern. In addition, don't use bleach for sanitizing. Any residuals can have harmful effects, especially in delicate styles. ■

Steep or Mash?

Boil intensity, yeast starters and first-wort hopping

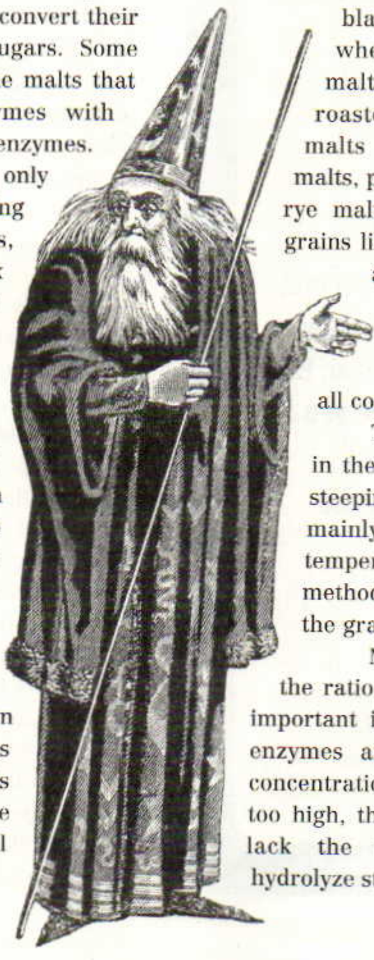
You're Soaking In It

I'm a novice homebrewer, but I have spent a considerable amount of time reading Brew Your Own and various how-to-homebrew books. One thing that continues to confuse me is this: What exactly is the difference between mashing and steeping? Don't both procedures basically involve soaking grain in hot water?

Sue Mullen Padula
Barrington Hills, Illinois

Mashing and steeping are very similar processes at first glance. Both involve soaking crushed grains in hot water. However, if you look more closely, there are some sharp contrasts between the two methods.

Mashing is a technique in which malted grains are soaked and amylase enzymes from the grains convert their starch to fermentable sugars. Some mashing methods combine malts that are very high in enzymes with starchy grains lacking enzymes. Other mashing methods only use malted grains. Mashing methods using adjuncts, such as rice or corn, work because enzymes from malt are able to move freely about in the mash once the malt has been crushed and wetted. The amylase enzymes cannot differentiate starch from malt or rice, and they go about their merry way breaking down (hydrolyzing) starch into fermentable sugars. The key to mashing is that the starch is broken down into fermentable sugars and special attention is given to controlling the mash environment — I'll get to that later.



Grains that are mashed include any pale malt, lightly toasted or kilned special malts (such as Munich malt) and raw cereal grains.

Steeping, on the other hand, is a method used to extract colors and flavors from certain types of specialty grains. Although the grains are soaked in hot water, the idea is not to have enzymes acting upon starch. Rather, steeping merely extracts compounds contained in the malt. The types of specialty malts ideal for steeping already have the starch converted to sugars during the malting process. These include the family of crystal or caramel malts — grain or malt that is roasted to such a high level that the starch molecules have been modified by heat to the point where malt enzymes don't do much to them. Roasted grains and malts include chocolate and black malt, roasted wheat, roasted wheat malt, roasted rye and roasted barley. Special malts such as Munich malts, pale wheat malt, pale rye malt and flaked cereal grains like barley, oats, corn and rice are not well-suited for steeping because these ingredients all contain a lot of starch.

The key differences in the actual processes of steeping and mashing lie mainly in the thickness, temperature, duration and method used to separate the grain from the liquid.

Mash thickness, or the ratio of malt to water, is important in mashing because enzymes are affected by the concentration of starch. If it's too high, the amylase enzymes lack the water needed to hydrolyze starch (hydrolysis is a term used to refer to breaking chemical bonds by the addition of water). If the mash is too thin, the enzymes are less heat-stable and are more susceptible to denaturation (enzyme destruction). Most mashes use between one and two quarts of water per pound of malt (~2 to 4 liters/kg). When it comes to steeping, thin is good and it is common to use ratios as high as six quarts per pound (~12 liters/kg). The thin steep not only improves the efficiency of steeping, it is also convenient since the steep water is usually used to dissolve malt extracts after the steeped grains are removed.

When it comes to mashing, the most critical variable to control is temperature. Different enzymes have peak activities at different temperatures, and some enzymes denature at just a few degrees higher than their activity peak. Brewers have named the various mash temperature rests for enzymes or their substrates because of this critical connection. We have the acid or phosphatase rest, protein rest, beta-glucanase rest, beta-amylase or fermentability rest, the alpha-amylase or conversion rest and the mash-off step. Few brewers include all of these temperature rests in their mash profiles, but mash temperature is always associated with enzymatic activity. These terms are moot when it comes to steeping. This is not to say that temperature is not an important consideration when steeping. Most agree that grain-steeping temperatures should be kept below about 170 °F (~77 °C) to avoid the extraction of astringent tannins from the malt husk.

Enzymatic reactions take time and most mashes last at least 60 minutes. Steeping does not require such a long time because the only thing happening is the dissolution of the malt solids. Fifteen minutes is more than enough time for steeping. The final step is separating the grains from the liquid. Most steepers use a nylon bag that is easily removed from the steep like a tea bag. Depending on the amount of grain steeped and the amount of water used, the bag is rinsed with hot water. Mashing requires the more involved method of separating the wort from the grains. This process is called lautering. Wort is separated from the solids in some sort of straining device — for example, a lauter tun — and is thoroughly rinsed with hot sparge water to extract as much wort as possible. This step is required in mashing because of the mash thickness. If the sparging were not used the specific gravity of the wort would be around 1.080, as compared to sparged gravities ranging from 1.040 and higher.

In summary, these are the key difference between mashing and steeping. To the extract brewer who uses steeping for specialty malts, mashing probably sounds very involved compared to steeping. However, the method of mashing is really not much more involved than steeping. It's just that there is a lot more going on, and more variations on brewing to explore, when mashing is entered into the homebrewing equation!

Roiled by Boiling Info

I'm a fairly new homebrewer who uses malt extracts. I'm still at the stage where I read quite a bit, absorb a bit less, and — as a result — become confused with seemingly contradictory information. For example, I've read that a strong rolling boil after adding the extract is imperative (215° F or 102° C is ideal, but not commonly attainable for homebrew setups, per an article in your June 2002 issue). Yet, your May 2000 article concerning boiling and evaporation stated that, by experimenting, one could adjust the flame to reduce evaporation to 8–10% per hour. Unless I'm misunderstanding, that would mean a lower temperature. According to my dial thermometer, I boil for 60 minutes at 210° F (99° C) over an outdoor gas burner and lose 1.5 to 2 gallons (5.7–7.6 L) of water to evaporation with the lid off. The lid is left off due to other articles I've read. Can you clear up this issue?

Ken Vagen
via email

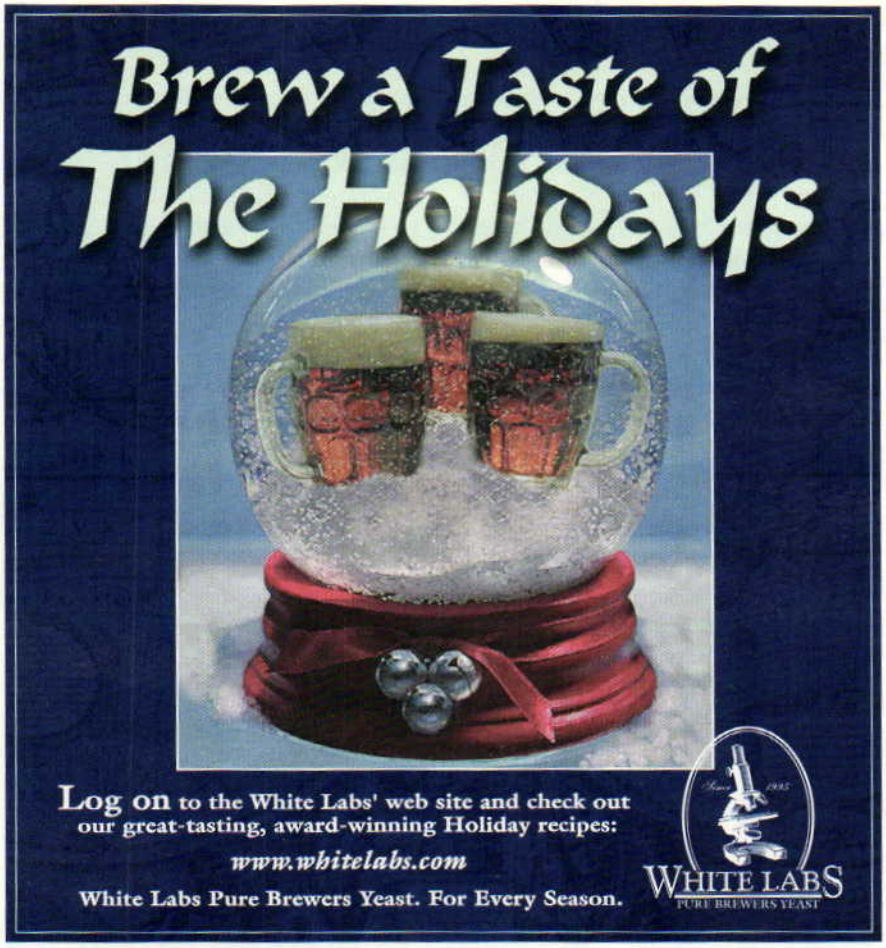
Thanks for bringing this contradiction to our attention. These statements are confusing because of an editorial oversight . . . that's jargon for a mistake! In Colin Kaminski's July-August 2002 article "How Clear is Your Beer," he states that "215° F (102° C) is recommended [for the temperature during boiling], but is not possible for many homebrewers." To clear things up, wort temperature during boiling is a physical property of the system and is affected by two variables: atmospheric pressure and wort concentration (specific gravity). By definition, the temperature of a boiling liquid is constant and can only be increased by increasing the pressure (for example, in a pressure cooker or a very deep pressure like a big commercial brew kettle) or by increasing the wort concentration.

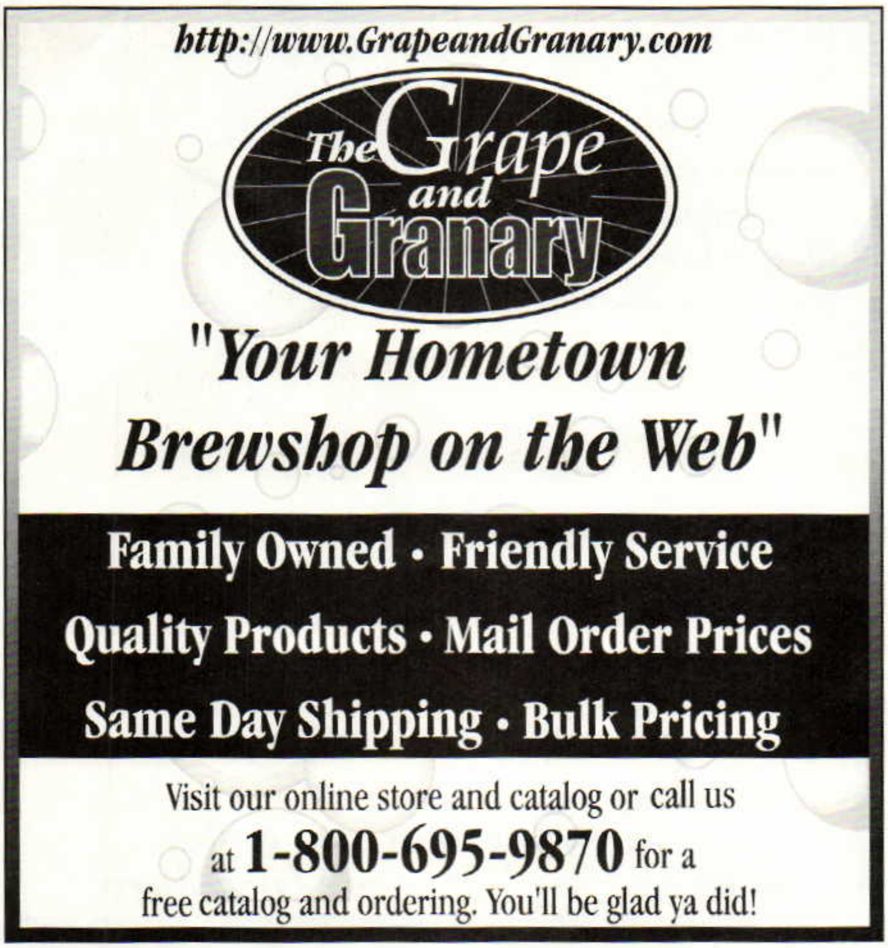
Let's back up and track the energy required to heat a liquid from room temperature to boiling. The first thing that happens is the liquid temperature begins to rise. This addition of energy is called "sensible heat" because it results in a measurable increase in heat energy. With pure water at atmospheric pressure, the temperature will increase to 212° F (100° C) and then cease to rise. If sufficient energy is added to this water, some of the water is transformed from a liquid at 212° F (100° C) to a gas (steam) at the same temperature. This is what we refer to as boiling and the energy required for this phase change is called the latent heat of evaporation. The latent heat of evaporation for water is very high and boiling requires a lot of energy input. It takes 4.2 kilojoules (KJ, a measurement of energy) to change the temperature of one kilogram of water 1° C, yet 2,260 KJ are required to change one kilogram of water at 100° C to steam at 100° C. That's a lot of energy!

So let's say you have a pot of wort at its boiling point of about 215° F (102° C) at atmospheric pressure (the temperature is higher because of the wort concentration). To get the water in the wort to boil, you must add 2,260 KJ for every kilogram of water that is converted to steam. As the rate of energy input increases (kilojoules per minute, for example), so does the intensity of the boil, because more water is turning into steam during that time period. The thing that does not change, however, is temperature, because liquids boil at a constant temperature. Adding more heat will not increase the temperature at which the wort boils. If this seems a bit confusing and awkward, it is!

We brewers want to boil the wort intensely enough to achieve our goals of hop acid isomerization, trub formation, sterilization, volatile removal (especially DMS), color development and concentration. What we don't want to do is to evaporate more than required because energy is expensive. Boiling vigor can be "tweaked" by adjusting the intensity of the flame to get the target evaporation rate that we are trying to hit.

Unfortunately, this method is not easy to control because it is hard to measure flame intensity — it would be a lot easier if wort temperature rose with boil intensity, but that just does not happen. In commercial breweries, this problem also exists, except most commercial kettles are steam fired. Some commercial brewers actually measure the mass flow rate of the steam going into the kettle and regulate boil intensity by adjusting the mass flow rate of steam into the kettle. When you adjust the flame on a propane burner you are controlling the flow rate of fuel to the flame and thereby controlling the flow of energy to the kettle. I think you are doing just fine with boiling outside with the lid off of your pot. I would not worry at all about





measuring the wort temperature during boiling, because you can tell by looking at the wort if it is boiling or not! You did not indicate your batch size, but if you are losing 1.5 to 2 gallons of volume (5.7 to 7.6 liters) in a five-gallon (19-liter) batch you are probably boiling too intensely. You don't really need to worry too much about the extra fuel cost incurred at home from this, but you may find that your beers taste better when you reduce the evaporation rate down to the 8-10% level, as excessive evaporation can lead to the formation of some unusual flavors.

Which DME is for Me?

When creating a yeast starter for pitching, is it favorable to use the particular type of dried malt extract (DME) that's used in the recipe? Or is there a standard DME that you recommend as a generic starter that remains neutral to the recipe's flavor? For example, should you use wheat DME when making a wheat-based beer or can you use extra-light plain malt DME as a neutral base? Or should you use the DME in proportion to the recipe when it uses multiple kinds of DME?

John T. Kirk
Houghton, Michigan

This question asks for opinions rather than any real facts. I can do that! Strictly speaking, any wort with a gravity ranging from 1.040 to 1.052 works well in starters with respect to growing yeast. But this can raise some real flavor questions if the starter and the wort the yeast is going into are very different. I typically use my palest standard wort (a wheat beer wort) as the starter for my yeast. My experience tells me that the flavor of this wort is light enough that the flavors of the other beers I brew will dominate any flavor contributed from the starter.

In general, some of things I would avoid in a starter wort are dark colors, malty flavors, high bitterness, late hop aroma and gravities higher than about 1.052. I personally would not get too worried about trying to make a special starter for every beer. This is my opinion and I know some brewers don't agree with this advice, but there is no absolute answer to this question. Another thing I like to do is to pressure-cook starters in some sort of container so that I have starter wort that I can conveniently use when I need it. Canning jars or laboratory media bottles work well for this.

I like making things easy for myself when possible and I typically steal a bit of wort from a batch and put it into media bottles instead of making a special batch just for starters. After the wort is in the bottle, I pressure-cook it with the lids loose for 20 minutes at 15 psi pressure. After 20 minutes, remove the pressure-cooker from the heat and allow the pressure to slowly fall. Once the pressure is down to 0 psi, remove the bottles or jars, tighten the lids and store at room temperature. This wort will remain preserved until needed.

Hoping for Better Hopping

I recently read an article regarding first-wort hopping that advises steeping a large portion of bittering hops in the wort before boiling. I am trying to get better hop flavors from my ales and wonder if this might be the way.

Jeff Potter
Dallas, Georgia

The first reference to so-called first-wort hopping was in the early 1990s in an article in the German beer publication *Brauwelt*. I believe this is where the term was coined, but brewers have been adding hops to wort in the kettle prior to boiling for a much longer time. Over the past 10 years, there have been many anecdotal references popping up in homebrew discussion groups pertaining to this technique. First-wort hopping involves adding a portion of the hops — often the additions typically added late in the boil — to the kettle as soon as wort from the lauter tun begins to flow to the kettle. The first-wort hops steep in the hot wort for the entire period of wort collection preceding the boil. *(See the February 2001 issue of Brew Your Own for more advice on first-wort hopping techniques.)*

The general consensus about this method is that the beer has a smoother bitterness compared to beers in which later hop additions are used. The reasons for this are unknown, however. Also, if first-wort hopping is used without either late-hop additions or dry-hop additions, the finished beer has — as one would expect — very little hop aroma because hop aroma is lost when these compounds evaporate from a pot of boiling wort. The *Brauwelt* article indicated a preference for the experimental pilsner beer made using first-wort hopping over the control pilsner made using bittering and aroma additions. This result may have been related to the panelists' personal preference, or lack thereof, for beers with pronounced hop aroma.

I find it difficult to interpret some of the commentary relating to this topic because of the confusing use of the words "flavor," "bitterness" and "aroma." Sensory scientists use the word "taste" to describe stimuli detected with tongue. "Aroma" refers to stimuli detected with the nose and "flavor" is the combination of taste and aroma. When the average person is eating or drinking and not really concentrating on whether they are tasting or smelling what is in their mouth, the overall sensory perception is combined by the brain into "flavor."

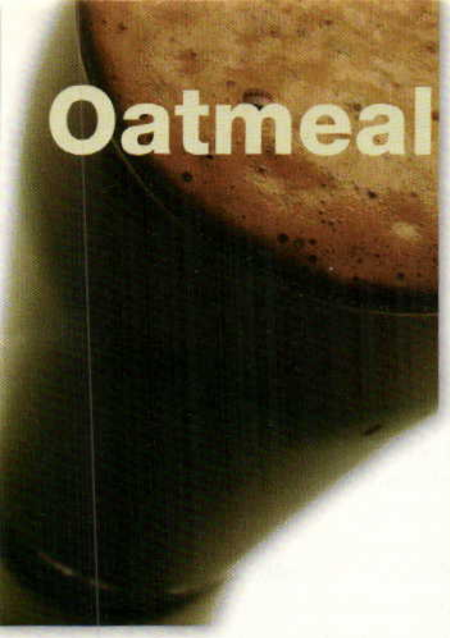
As it relates to first-wort hopping, most articles refer to an improvement in hop flavor. The same articles usually mention little hop aroma when hops are only added before the boil (first-wort hopped) or shortly after the beginning of the boil. These statements contradict one another; if the flavor improves, then the hop aroma component should also improve — perhaps these panelists thought the beer had a better hop flavor when they could not detect any hop aroma. However, using standard sensory terminology, this usually translates into an improvement in the hop taste (the bitterness of the beer) and no change to hop aroma, as compared to adding hops shortly after the boil begins.

Hops do add tannins to wort and hop tannins are known to add flavor to beer, especially when added late in the boil or as dry hops. One of the characteristics of late or dry-hopped beers is a grassy astringency coming from the plant portion of the hop cone. First-wort hopping may reduce the amount of tannins making their way into the finished beer because they react with proteins in the wort and precipitate. Incidentally, milk is added to hot tea because protein in milk binds with tannins in tea to reduce its astringency. Many authors have reported a decrease in hop utilization with first-wort hopping as compared to hops added shortly after the start of boiling. I don't have an explanation for this observation.

If you are looking for a rounder bitterness in your ales, try using low-cohumulone, low-alpha hops for bittering or try first-wort hopping. If you are looking for better aroma retention, try using more hops late in the boil, or as dry hops. Another key point regarding aroma hops is that the hops should be fresh and have a pleasant hop aroma to begin with.

Have any good information on first-wort hopping? If so, send in your experience and we will run it in our Mail column! ■

Do you have a question for Mister Wizard? Write to him c/o Brew Your Own, 5053 Main Street, Suite A, Manchester Center, VT 05255 or send your e-mail to wiz@byo.com. If you submit your question by e-mail, please include your full name and hometown. In every issue, the Wizard will select a few questions for publication. Unfortunately, he can't respond to questions personally. Sorry!



Oatmeal Stout

Black ale for a white Christmas

by Horst D. Dornbusch

OATMEAL STOUT by the numbers

OG (original gravity):	1.040–1.070
FG (final gravity):	1.012–1.018
SRM: (Standard Reference Method)	30–60
IBU: (International Bittering Units)	usually > 40
ABV: (alcohol by volume)	4.1–9.0%

OF ALL THE WORLD'S major beer styles, stout appears to be the one that's easiest to recognize, at least at first glance. Just give them a dark, roasty, heavy ale, and they'll exclaim, "By Jove, I think it's a stout!" Likewise, many brewers adhere to the erroneous perception that stouts are among the easiest beers to brew. The common argument holds that, once darkness and roastiness take over the fermenter, the fine-tuning in the grain, hops and yeast departments that leads to great beers in other styles is no longer necessary.

There is of course some truth to that argument, but if you want to make a really superior stout — especially a smooth, well-rounded outmeal stout — that argument can also lead to disaster. Burnt notes from roasted malts may be the signature flavor of a stout, including an oatmeal stout, but they are not the only flavors you should taste in a dark brew. In a sublime stout, you need to create an effective interplay between the robust immediateness of the roasted, acrid malts and the floral-aromatic reverberations of the hops. And don't kid yourself: In a dark brew this can be just as difficult as in a brunette or blonde beer.

In an oatmeal stout, perhaps more so than in other stouts, you also have to pay attention to the body. If the stout's substance comes across as cloying or syrupy, the beer's enjoyment might evaporate. Remember that complexity is also subtlety, even when you are putting together a hefty stout! On the palate, an oatmeal stout may be a heavyweight — however, if brewed with finesse, it can be truly elegant.

A Murky Start for a Dark Brew

The stout family in general, including the oatmeal versions, are all obscure in origin. They are also incredibly diverse in modern brewing practices. For these reasons, stout is a typical illustration of why one should never be dogmatic about the definition of a beer style. Just consider the many attributes by which different stout types are identified on the label. Stouts can come with any of the following prefixes, either individually or in combination: chocolate, cream, double, draught, dry, English, export, extra, foreign, genuine, imperial, Irish, milk, original, oyster, Russian, single, sweet or velvet. Did I get them all? I would find it very difficult to give clear and binding specifications for each of these stouts, and probably no two brewers could come up with the same set of specifications for the same substyle.

Nobody is quite certain about when stout as a style branched off from the generic ales of Britain and Ireland. The oldest references to stout date to the late seventeenth and early eighteenth centuries, but what the term really meant in those days, I would not dare to debate.

But we all agree on one point: As beers change in color from pale ales to brown ales to dark ales, there is a point on the color scale, however vaguely defined, at which we start calling beers

(continued on page 24)

RECIPES

Rhapsody-in-Black Oatmeal Stout

(5 gallons/19 liters, all grain)
OG = 1.070 FG ≈ 1.016
SRM ≈ 65 IBU = 65 ABV ≈ 6.9%

Ingredients

9.75 lbs. (4.4 kg) pale ale malt (3° L)
1.6 lbs. (0.73 kg) flaked oats (1.5° L)
1.4 lbs. (0.64 kg) chocolate malt
13 oz. (369 g) dextrin malt (such as Briess CaraPils)
9 oz. (255 g) black patent malt
9 oz. (255 g) caramel malt (60° L)
4 oz. (113 g) roasted barley
1 tsp. Irish moss
14.6 AAU East Kent Goldings hops (2.8 oz./79 g of 5.3% alpha acid)
1.5 oz. (43 g) East Kent Goldings or Fuggles hops (flavor)
2 packages of Wyeast 1028 (London Ale) or White Labs WLP005 (British Ale) yeast
0.75–1 cup DME or corn sugar (for bottling)

For a North American stout character, replace the East Kent Goldings and Fuggles with Galena, Cascade and Willamette hops, as follows:

12 AAU Galena hops (1 oz. (28 g) of 12% alpha acid)
2.5 AAU Cascade hops (0.5 oz. (14 g) of 5% alpha acid)
1.5 oz. (43 g) Willamette hops (flavor)

English Creamy Oatmeal Stout

(5 gallons/19 liters, all grain)
OG = 1.048 FG ≈ 1.011
SRM ≈ 60 BU = 30 ABV ≈ 4.7%

Ingredients:

8.0 lbs. (3.6 kg) pale ale malt (3° L)
9 oz. (255 g) flaked oats (1.5° L)
7.5 oz. (213 g) chocolate malt

more STOUT recipes

3.5 oz. (99 g) black patent malt (500° L)
1 tsp. Irish moss
6.7 AAU Fuggles hops
(1.6 oz./45 g of 4.2% alpha acid)
2 packages of Wyeast 1318 (London III Ale) or White Labs WLP002 (English Ale) yeast
0.75–1 cup DME or corn sugar (for bottling)

Shamrock Simple Oatmeal Stout

(5 gallons/19 liters, all grain)
OG = 1.056 FG ≈ 1.013 SRM ≈ 60
IBU = 55 ABV ≈ 4.7%

Ingredients:

6.4 lbs. (2.9 kg) pale ale malt (3–4° L)
14.5 oz. (411 g) roasted barley
10.7 oz. (303 g) flaked oats (1.5° L)
1 oz. (28 g) black patent malt (500° L)
2 lbs. (0.91 kg) corn sugar
12.5 AAU East Kent Goldings hops
(2.35 oz./67 g at 5.3% alpha acid)
0.75 oz. (21 g) East Kent Goldings or Fuggles hops (flavor)
1 tsp. Irish moss
2 packages of Wyeast 1084 (Irish Ale) or White Labs WLP004 (Irish Ale) yeast
0.75–1 cup DME or corn sugar (for bottling)

Step by Step

These recipes were formulated with an extract efficiency of 65%.

Compared to barley, oats have slightly more protein and slightly less starch. But they also have more than double the fat and fiber. So they contribute a desirable, body-enhancing oiliness and an undesirable, flavor-impeding harshness to the beer. Most commercial breweries, therefore, keep the oats portion in their mashes to no more than 5%, even though there are stouts available with an oats portion of around 20%. Taste is of course subjective, but if you want your oatmeal stout to be at once rich and elegant, go easy on the oats! Begin a single-infusion mash with a 152–154° F (67–68° C) rest for about an hour. Infuse the grain bed until about one inch (2.5 cm) of water rises above the top of the grain. Then raise the mash to 168-170° F (76–77° C) during the sparge.

Because oats have no husks and contain plenty of gums (beta-glucans), they can make for a denser mash than you are used to with a regular ale. This could naturally inhibit the free seepage of sparge water through the grain bed. So expect the run-off to last at least one and a half hours. The antidote to this problem is twofold: Do not mill the oats and do not mix them with the rest of the grain. Instead mash in without the oats. Then sprinkle the oats on top of the mash. Use a spoon or spatula to gently mix them with only the top layer of the grain bed. If you do get a stuck mash, in spite of these precautions, use a long knife to make careful incisions into the grain bed. If your equipment lets you, you can also underlet the grain bed with hot water. After underletting, however, recirculate the initial (re-started) run-off to keep any debris that you may have loosened from reaching the kettle.

Boil your wort for an hour and a half. There are two hop additions, one about 30 minutes into the boil, the other about 15 minutes before shutdown. For the Shamrock Simple Oatmeal Stout, dissolve the corn sugar at the end of the boil. For a drier oatmeal stout, you can dissolve an optional half a pound of corn sugar with any of the recipes. This will slightly bump up your beer's starting gravity and alcohol content.

Heat-exchange to 60° F (16° C), pitch the yeast, and hold the brew at that temperature through the fermentation and conditioning period of about six weeks. This keeps the diacetyl level low. Rack the brew once, after about three weeks. Then rack again before priming and packaging. Prime with 3/4 cup of corn sugar or DME for a less effervescent, old-style draft taste. Use an entire cup for more carbonation.

English Creamy Oatmeal Stout

(5 gallons/19 liters, partial mash)
OG = 1.048 FG ≈ 1.011 SRM ≈ 60
IBU = 30 ABV ≈ 4.7%

Ingredients:

10 lbs. (4.5 kg) pale malt extract
9 oz. (255 g) flaked oats (1.5° L)
7.5 oz. (213 g) chocolate malt (350° L)
3.5 oz. (99 g) black patent malt (500° L)
1 tsp. Irish moss
6.7 AAU Fuggles hops
(1.6 oz./45 g of 4.2% alpha acid)
2 packages of Wyeast 1318 (London III Ale) or White Labs WLP002 (English Ale) yeast
0.5–1 cup DME or corn sugar (for bottling)

Shamrock Simple Oatmeal Stout

(5 gallons, partial mash)
OG = 1.056 FG ≈ 1.013 SRM ≈ 60
IBU = 55 ABV ≈ 4.7%

Ingredients:

6.4 lbs. (2.9 kg) pale malt extract
14.5 oz. (411 g) roasted barley
10.7 oz. (303 g) flaked oats (1.5° L)
1 oz. (28 g) black patent malt (500° L)
2 lbs. (0.91 kg) corn sugar
12.5 AAU East Kent Goldings hops
(2.35 oz./67 g at 5.3% alpha acid)
0.75 oz. (21 g) East Kent Goldings or Fuggles hops (flavor)
1 tsp. Irish moss
2 packages of Wyeast 1084 (Irish Ale) or White Labs WLP004 (Irish Ale) yeast
0.75–1 cup DME or corn sugar (for bottling)

Step by Step

Crack the specialty barley and mix with the unmilled oats. Place the grains in a muslin bag. Immerse the bag in one to two gallons (7.6 L) of cold water. Heat slowly, over half an hour, to about 180° F (82° C). Steep for another half hour. Lift the bag out of the liquid. Dunk in and let drip repeatedly, as with a tea bag. Rinse slowly with two to three cups of cold water and discard.

Fill kettle to about three gallons (11.4 L) with water. Bring to a boil and take off the heat. Stir in the canned extract. Plain pale malt extracts from Alexander's, Briess, Edme, Coopers, Glen Brew, John Bull or Muntons are all OK. Bring to a boil and follow the instructions from the all-grain recipe from boiling to packaging.

Almost Extract-Only Irish Oatmeal Stout

(5 gallons/19 liters, extract)

OG ≈ 1.058 FG ≈ 1.016
SRM = variable
IBU = 55 ABV ≈ 5.4%

Ingredients:

- 4 lbs. (1.8 kg) Mountmellick hopped Irish stout malt extract
- 3.3–4 lbs. (1.5–1.8 kg) plain dark malt extract for ales (such as Alexander's, Briess, Coopers, Glen Brew, John Bull or Muntons)
- 1 lb. (0.45 kg) flaked oats
- 5–6 AAU East Kent Goldings hops (1 oz. (28.3 g) at 5.3% alpha acid)
- 0.5 oz. (14.7 g) East Kent Goldings or Fuggles (flavor)
- 1 tsp. Irish moss
- 2 packages of Wyeast 1084 (Irish Ale) or White Labs WLP004 (Irish Ale) yeast
- 0.75–1 cup DME or corn sugar (for bottling)

Step by Step

The color of this oatmeal stout depends on the choice of dark malt extract. To create your own extraction from the oats, bring about a gallon (3.8 L) of water to a boil. Turn off heat and let cool just a bit, for about 10 minutes. Stir the pound of oats into the water. Let the oats steep and hydrolyze for a couple of hours, while the porridge cools. Every now and again, stir your oatmeal soup. Then use a household sieve to strain your oatmeal liquid into the brew kettle. Add two gallons (7.6 L) of water to the oat tea and bring to a boil. Turn off the heat and add your two canned malts. Distribute the extracts evenly in the kettle.

Bring the mixture back to a boil and add the bittering hops. Continue to boil for about one hour. Add flavor hops and boil for another 15 minutes. Top the kettle off with enough cold water to reach the target gravity of approximately OG 1.058 (use your hydrometer). Then follow the all-grain instructions for the remaining steps in the procedure.

porters and stouts. It is on the darkest side of the beer style spectrum that you'll find the stouts — brews of remarkable variation in strength and profile. And somewhere amongst all these shady brews, there are also the oatmeal stouts.

Oatmeal stouts do not differ much from the other stouts, except for the obvious — they contain somewhere between five and 20 percent oats as a percentage of the grain bill. An oatmeal stout grain bill can be complex, often composed of five to seven grains, or it can be very simple. Most of the grain is two-row pale ale malt as a foundation. There is usually some roasted as well as flaked barley for color. These grains also contribute some chewiness and body from unfermentables. The complex grain bills often have some dextrin malt for residual sweetness. Then there is usually some black malt for color and signature flavor, and of course, some flaked oats for creaminess.

As a style, stout seems to smile upon extract brewers. For this blackest of black ales, many producers make preformulated malts in a can.

Given these variations in the grain bill, oatmeal stouts can be as heavy as a Russian imperial or as light as an Irish draught. Perhaps the best-known commercial oatmeal stouts in the New World are two English imports, Samuel Smith Oatmeal Stout from Tadcaster at 4.7% ABV and Young's Oatmeal Stout from London, which refuses to reveal its ABV on the label, but tastes to me like a five-percenter.

INGREDIENTS: Oats and More

You can make a stout with just about any water commonly available in the United States. Stouts are being made on every continent. Many American liquor stores carry stouts from all parts of Britain and Ireland, as well as from South Africa, Australia, the West Indies, Japan, the Asian subcontinent and Scandinavia. From this I conclude that water issues ought not to be too serious a concern for the North American homebrewer.

When selecting hops for an oatmeal stout, pretend that it is a pale ale. Just because the roasted malt flavors and the creamy body predominate, do not think that your choice of hops is unimportant. Nor should you over-hop just to create a contrast to the roastiness. You are looking for a pleasant harmony of tastes, not for a disagreeable cacophony. So, to give complexity to your brew, use top-quality, earthy, floral hops for both bittering and flavor. Well suited are East Kent Goldings, Fuggles, Styrian Goldings, Bullion, or even Hallertauer Mittelfrüh or Mt. Hood, for either addition. You could also try Magnum or Galena for bittering and Willamette or Tettnanger for aroma. Though many microbreweries use Cascade as their main hops in stouts, I find that Cascade in excessive quantities competes too vigorously with the complex grain flavors of a well-brewed oatmeal stout. Cascade hops can add greatly to a stout if no more than 20% of the bittering comes from it. But you make your own choices. After all, one man's meat is another man's poison.

Oatmeal stout wort tends to be heavy in unfermentables because almost one third of the grain bill may come from such grist varieties as flaked oats, chocolate malt, dextrin malt, black patent malt, caramel malt and roasted barley. Therefore, you should always clarify the wort in the brew kettle with Irish moss. This reduces the proteins and particulate in the finished beer.

For a fairly dry oatmeal stout, ferment with Wyeast 1084 (Irish Ale) or White Labs WLP004 (Irish Ale) yeast. For a medium dry finish use Wyeast 1028 (London Ale) or White Labs WLP005 (British Ale) yeast. For some residual sweetness, pitch Wyeast 1318 (London III) or White Labs WLP002 (English Ale) yeast. Given the heaviness of the stout, a good yeast cell count is important, so it is best to pitch two packages or a starter.

As a style, stout in general — though not the oatmeal variety in particular — seems to smile upon extract-only brewers. For this blackest of black ales, many producers make preformulated malts in a can. (The same cannot be said for the black lagers — the schwarzbier and the rauchbier.) Some of them are very Irish, such as the Mountmellick Famous Irish Stout Malt Extract. Others just say "Stout" on the can. Extract brewers become extract brewers primarily because they do not want to mess with grain, so you probably think stout's the style for you: Just grab your can opener and soon your kettle will be boiling, right? Well, maybe not. Unfortunately, all canned stout extracts come pre-hopped, and none of them are oatmeal stouts! This requires two concessions on the part of the extract brewer.

First, you will have to steep some oatmeal and strain it. *(For steeping tips, see "Homebrew University" in the September 2001 issue of BYO.)* The second compromise relates to the selection of your hops, because this choice was made by the extract manufacturer.

Given the heftiness of the oatmeal stout, for best results you will probably want to use about seven to eight pounds of malt extract. Sometimes a sugar product, such as corn syrup, is part of the content of the can. If so, expect the beer to be drier. ■

Horst Dornbusch is the author of "Prost! The Story of German Beers" (1997, Brewers Publications.)

BREWING

with coffee

to give your beer a jolt!

by Glenn BurnSilver

The National Coffee Association claims that 79% of the adult population of the United States drinks coffee regularly. But what those statistics don't reveal is how many get their coffee through the beer they drink. Of course, why would they even think to ask? Coffee isn't exactly the most popular beer flavoring, lagging way behind raspberries, cherries and even chocolate. For those who flavor their beer with coffee, however, the results can be very rewarding. A java-laced brew adds a rich aroma and delightful complexity, characterized by heightened mouthfeel, to any brew. It might not be the best drink for breakfast, but who's going to stop you?

There are two ways to get coffee flavors in your beer — with coffee or without. Most stouts and porters are brewed with highly-toasted barley malts, chocolate malts and black patent malts for flavor and creaminess. It is the deep roasting of these grains that give the darker beers hints of coffee-like flavors. That rich roasted taste and aroma lends itself naturally to coffee, which is also roasted to release essential oils and produce enticing flavors. Pyramid Espresso Stout is a good example of a coffee-flavored beer that relies on roasted malts, has a slight coffee flavor, but doesn't actually use coffee. But we are after the real thing, right?

coffee recipes

Coffee Imperial Stout
(5 gal/19L, all-grain)
OG: 1.067 FG: 1.016
IBU: 70 SRM: 35
Doug McNair, Redhook Breweries

Ingredients
8.0 lbs. (3.9 kg) 2-row pale malt
2.25 lbs. (1 kg) crystal (60–80° L)
1.5 lbs. (0.7 kg) wheat malt
1.25 lbs. (0.6 kg) chocolate malt
0.5 lb. (0.2 kg) roasted barley
0.5 lb. (0.2 kg) black patent malt
18.75 AAU Northern Brewer hops (bittering) (2.5 oz./71 g of 7.5% alpha acids)
1.5 oz. (42 g) finishing hops (Northern Brewer or Cascade)
15 oz. (445 mL) of espresso
Ale yeast (your choice)

Step by Step
Mash in all grains at 149° F (65° C). Hold until converted, about 1 hour. Mash off at 170° F (77° C) and begin lautering. Sparge to achieve eight gallons (30 L) of wort. Bring to a boil and add 2.5 oz. (71 g) boiling hops. Total boil is 70 minutes. After the boil, turn off the heat and add 1.5 oz. (43 g) finish hops for five minutes. Cool to 70° F (21° C) and ferment with ale yeast. Original gravity goal is 17.5° Plato (1.069 SG). Terminal gravity will be pretty high, approximately 1.016. Add espresso at end of primary fermentation, bottle and enjoy!

Buzz'ard Double Chocolate Espresso Stout
(5 gal/19L, extract with grain)
OG: 1.072 FG: 1.020
IBU: 56 SRM: 35
John Arthur and Glenn BurnSilver

Ingredients
8 lbs. (3.6 kg) Alexander's dark malt extract syrup
0.5 lb. (0.2 kg) crystal malt (120 °L)
0.5 lb. (0.2 kg) chocolate malt
0.5 lb. (0.2 kg) roasted barley
1 lb. (0.45 kg) Ghirardelli Select Brown chocolate powder
15 AAU Northern Brewer hops (2 oz./57 g of 7.5% alpha acids)
0.5 lb. (0.2 kg) espresso beans, fine ground, brewed to 1 gallon (3.8 L) of coffee
Wyeast 1056 (American Ale) yeast

Step by Step
Place grains in 2.5 gallons (9.5 L) of water, heat to 170° F (77° C), let sit for 25 minutes. Return to boil, dissolve extract. Return to boil. Add 1-1/2 oz. (43 g) hops and chocolate (add slowly and stir constantly so it doesn't stick and burn on the bottom). At 45 minutes add 1/2 oz. (14 g) hops. At 60 minutes, turn off the boil. Chill to 88° F (31° C) and add to carboy with 1-1/2 gallons (5.7 L) water. Pitch yeast (built up as a one-quart starter with DME) at 78° F (26° C). After primary is complete, rack to secondary, store in cool place (below 60° F or 16° C) for 45 days. Rack to bottling bucket, add one gallon (3.8 L) room temperature coffee and 3/4 cup bottling sugar. Stir well to mix and then bottle.

Mudhouse Stout
(5 gal/19L, all-grain)
OG: 1.052 FG: 1.014
IBU: 25 SRM: 35
Ashton Lewis, Springfield (Missouri) Brewing Company

Ingredients
8 lbs. (3.6 kg) 2-row pale malt
0.25 lbs. (0.11 kg) Hugh Baird crystal malt (50 °L)
0.25 lbs. (0.11 kg) Hugh Baird chocolate malt
0.50 lbs. (0.23 kg) Hugh Baird roasted barley
0.50 lbs. (0.23 kg) Weyermann Carafa III
4.1 AAU Nugget hops (bittering) (0.33 oz./10 g of 12.5% AA)
0.50 oz. (15 g) Cascade hops (flavor)
1.0 oz. (27 g) Cascade hops (aroma)
21 oz. (620 ml) fresh brewed coffee
White Labs WLP001 (California Ale)

Step by Step
Mash grains at 155–158° F (69–70° C) for 60 minutes. Sparge with water at 168° F (76° C) and collect enough wort so that you end up with 5 gallons (19 L) after boiling. Total boil is 90 minutes. Bring to boil, add Nugget hops for 70 minutes, and remove. At 60 minutes, add first Cascade hops. Turn off heat. Add second Cascade hops. Ferment at 64° F (18° C). Primary takes three days. Do a two-day rest at 64° F (18° C) after primary is complete, cool to 52° F (11° C) and hold for four days. Then chill to 32° F (0° C) and hold for at least one week. Coffee is added when the beer is down to 32° F (0° C). Add 21 oz. (620 mL) of fresh hot coffee, brewed from 1-1/4 oz. (35 g) espresso roast, to the cold stout. After a week, bottle.

The first issue that always arises when brewing with coffee is how potent that java flavor should be. This leads to a second question — how much coffee should be used? Naturally, it all depends on how strong a coffee flavor is desired. Using more coffee, of course, means more pronounced flavors and aromas. However, using too much might overwhelm the brew and leave you with a five-gallon batch of fizzy coffee. Using less coffee means more subtle flavors, but maybe without enough of the coffee characteristic coming through. Don't let worries about caffeine content keep you from using enough coffee. The caffeine in each glass of beer is so minute that before you could drink enough to get that java buzz, you'd most likely already be passed out from the beer.

The style of beer will also make a difference. As mentioned above, stouts and porters do very well with coffee, but also are strong-flavored as is. More coffee is required for a good balance. But if you seek to create "Pale Coffee Ale," less coffee might be in order so the classic pale ale flavors are not obliterated. Kavove Pivo is a coffee-flavored lager brewed at the Restaurace Pivovarsky Dum in Prague, Czech Republic, which proves it is possible to work with coffee and any style.

After reviewing dozens of recipes, it seems there is no right or wrong answer to how much coffee should be used, or for that matter when the coffee should be added. One five-gallon (19 L) recipe called for 50 one-ounce (30 mL) shots of espresso added to the wort before pitching. Another recipe listed eight shots added to the secondary. Both reported satisfactory tastes and results. Other recipes require anywhere from a quarter pound (0.1 kg) to 1-3/4 pounds (0.8 kg) of coffee, either whole bean, ground or brewed. The best thing to do is simply experiment, but keep an exact record — so when that world-class brew appears, you'll be able to reproduce it time after time.

Another consideration is that the type of coffee also plays a role in the flavors, mouthfeel, head retention and hops usage. Using a strong coffee such as espresso or French roast will provide a richer coffee essence, while lighter blends like Sumatra or Guatemala Antigua will bring out more subtle qualities. However, many of the darker roast coffees have a higher oil content brought on by excessive roasting. These oils will add "thickness" and creamy mouthfeel, but can reduce head retention. On the initial pour, the beer foams up but it very quickly dissipates. Using flavored coffees can also add interesting flavor notes and aromas. Chocolate mint or chocolate macadamia nut coffees work well with porters, adding sweetness and nuttiness to a brew. For an even more varied example, try a Southern pecan brown ale. Additionally, some coffees — such as Italian and French roasts — are very bitter. This will affect the amount of hops used. A good rule of thumb is to slightly decrease the hop content by five to eight IBUs and keep bitterness in check. Under-hopping will help control the bitterness while allowing coffee to contribute to the flavor structure. Of course, if you prefer bitter beers, then you may not want to decrease the amount of hops in your beer. It's up to you.

How Much Joe Adds the Right-Sized Jolt?

The next two entirely subjective questions are these: How and when should the java be added to the brew? This too depends on individual tastes. The "how" options are simple: whole bean, ground, crushed, brewed, specialty brewed (espresso) or in concentrated extract form.

When using beans in any form, it is best to place the beans in a grain bag, whether steeping the grains or adding them in the boil or fermentation. This makes racking easier — no clogged siphon tubes — and reduces the clean-up mess. A fine ground that is not bagged can get through the siphon tube. But, whether going to the secondary or bottle, these remains may add more coffee flavor than desired. If the bag is loose filled — that is, left with plenty of air space and not condensed — there should be a high surface contact ratio of beer to bean. Some brewers prefer to add the beans directly to either the boil or fermenting stages, thinking this will increase the coffee-ness of the beer, but actually it can be more difficult later when trying to get the grounds out of the spent keg.

coffee styles

COFFEE STYLES vary with growing regions (from Africa to India, Central America and beyond) and roasting styles (light, medium and dark). Here is a list of some of the more popular styles that may be helpful in choosing the right roast for your brew. There are many coffee blends that are available and worth trying. Remember, homebrewing is all about experimenting, so don't be afraid to try blending these coffees for your own special mix.

Light Roasted
Smooth, subtle flavors and aromas
Hawaiian Kona
Jamaican Blue Mountain
Indian Malabar
Ethiopian Sidamo

Medium Roasted
Richer body, slightly darker coffee taste and aromas
Guatemalan Antigua
Mexican Altura Pluma
Costa Rican Tarrazu
Brazilian Santos
Ethiopian Mocha Harrar
Columbian Excelsious
Colombian Supremo
Ethiopian Yirgacheffe
Haitian

Dark Roasted
Rich and thick, heavy "burnt" overtones with full coffee flavors
Kenya AA
Zimbabwean
Tanzanian Peabody
Indonesian Sumatra Mandheling
Yemen Mocha Mattarri
Dark Guatemala
Nicaraguan
Turkish
Italian Roast
French Roast

The state of the beans is also up for debate. Though whole beans are an option, some brewers prefer using coffee beans that have been lightly, medium or course ground, or crushed (ground just enough to break open the beans). Either way, this will increase the contact ratio and heighten flavors.

There is the belief among some brewers that using freshly-brewed espresso will add the best flavors to any beer. This relates to the special hot-water pressure process used to bring out the best in the bean and produce a powerfully small cup of joe.

For those without an espresso machine, the only other option is to brew a "regular" batch of coffee. This can be done with a machine or through a cold seep method. To do this, simply place the ground coffee into a grain bag and soak the bag in cold water for a couple of days.

Remember, this brew — however you make it — will eventually go into the beer. Have a sanitized container ready to hold the coffee until the time comes to add it to beer. Furthermore, it is best to find the freshest coffee available, and this does not include instant coffee or canned coffees like Folgers. These "freeze dried" coffees, though sealed quickly after being ground, cannot offer the freshness and superior flavors of gourmet coffees. Brewers have also reported this style of coffee can produce off-flavors in the beer.

Perhaps the easiest way to attain coffee flavors is through an extract. Moka Liqueur Extract, a coffee-flavored extract used to produce homemade Kalhua, is one possibility, while coffee oils are available at health food stores, though the oils may effect head retention. Homebrew shops may also carry extracts.

Though not commercially available, Starbucks developed an extract that would work well with their ice cream and Frappuccino drinks. Created from a Central American blend, it became the flavoring for the now-extinct Double Black Stout from Redhook Breweries in Seattle, Washington. The extract is derived from a cold-water concentrating process that is designed to bring out more of the positive side of the coffee and keep the bitterness in check. When added to an Imperial Stout recipe, the popular — though short-lived — brew was born.

"Being a Seattle brewer and lover of coffee, it seemed a logical extension to take the traditional use of high roasted malt in dark beers and replace some of those malt notes with coffee," explained Doug McNair, Redhook's master brewer and creator of Double Black Stout. "What we used was essentially a very strong coffee, not unlike an espresso, in concentration. As a homebrewer I would use exactly that — make some espresso, not necessarily with espresso beans, and add it during or after your primary fermentation."

Putting the Java in the Brew

Now we're back to the second question: when to add the coffee? It seems coffee can be added pretty much anytime: steeped with the grains at the start, during the boil, in the primary or secondary fermentation or just before bottling. With each method coffee flavoring will be attained, though there are some differences. With earlier additions, such as in the steep or boil, some overall coffee characteristics may be "washed out," resulting in a more subtle aroma and flavor in the finished beer. Later additions — in the primary or secondary fermenter — will lead to more robust coffee expressions, but may be overpowering for some beer drinkers.

One method is to slowly steep the coffee with the grains. This will allow plenty of time for the coffee flavors to reveal themselves. Some brewers claim this adds even more complexity while stifling some of the bitterness. Most brewers do agree that if coffee is added to the boil it should be near the end, the last 10 minutes. This allows the coffee enough time to "brew" with the wort and release its flavors. Even prebrewed coffee can be used at this time with good results. This is what Russ Klisch does for his "Lakefront Fuel Café Coffee Flavored Stout," produced at his brewery in Milwaukee. Klisch uses the cold-seep method with a secret blend from a local coffee shop. The coffee is then added "somewhere near the end of the boil."

"This was the biggest challenge in the project . . . to get a harmonious roast note from the coffee without picking up the harsh acidic flavors," added McNair. "I found that mash or kettle additions always picked up way too much harshness, not unlike that office pot of coffee that has been sitting around too long. We settled on doing the additions on the cold side in the cellars (secondary fermentation) and the results were much better — nice roasted characters blending with the roasted malt flavors to yield a complex multi-layered flavor profile."

As recommended by McNair, the coffee can be added to the primary or secondary. That allows the coffee flavors more time to merge with the beer and create the right characteristics. With that in mind, the extract, which should be mixed with three to four cups of brewed coffee, should not be added during the boil, but rather to the primary or secondary. There is also the option of adding brewed coffee right before bottling. The homebrew will have strong coffee notes and aromas that will develop during bottle conditioning. This also can be achieved with kegging. It may be possible to add whole or crushed beans to each bottle, but this can introduce bacteria that will spoil the beer.

Using coffee in beer should not increase fermentation or conditioning times. Like most beers, however, the longer the bottle conditioning, the more noticeable the brew flavors and characters. The beauty in creating coffee flavored brews, no matter which brewing method you follow, is the irresistible coffee aroma right off the top, the creamy head and a richly complex beer with delicious coffee hints in every sip. One final tip: for the ultimate in presentation, serve your coffee flavored beer as they do at Restaurace Pivovarsky Dum, with an espresso bean resting neatly on the foamy head. What could be more fitting? ■

Glenn BurnSilver is a freelance writer, backcountry adventurer, record collector and frequent BYO contributor.

MONSTER HOLIDAY BEERS!

brewing big beer for the end of the year

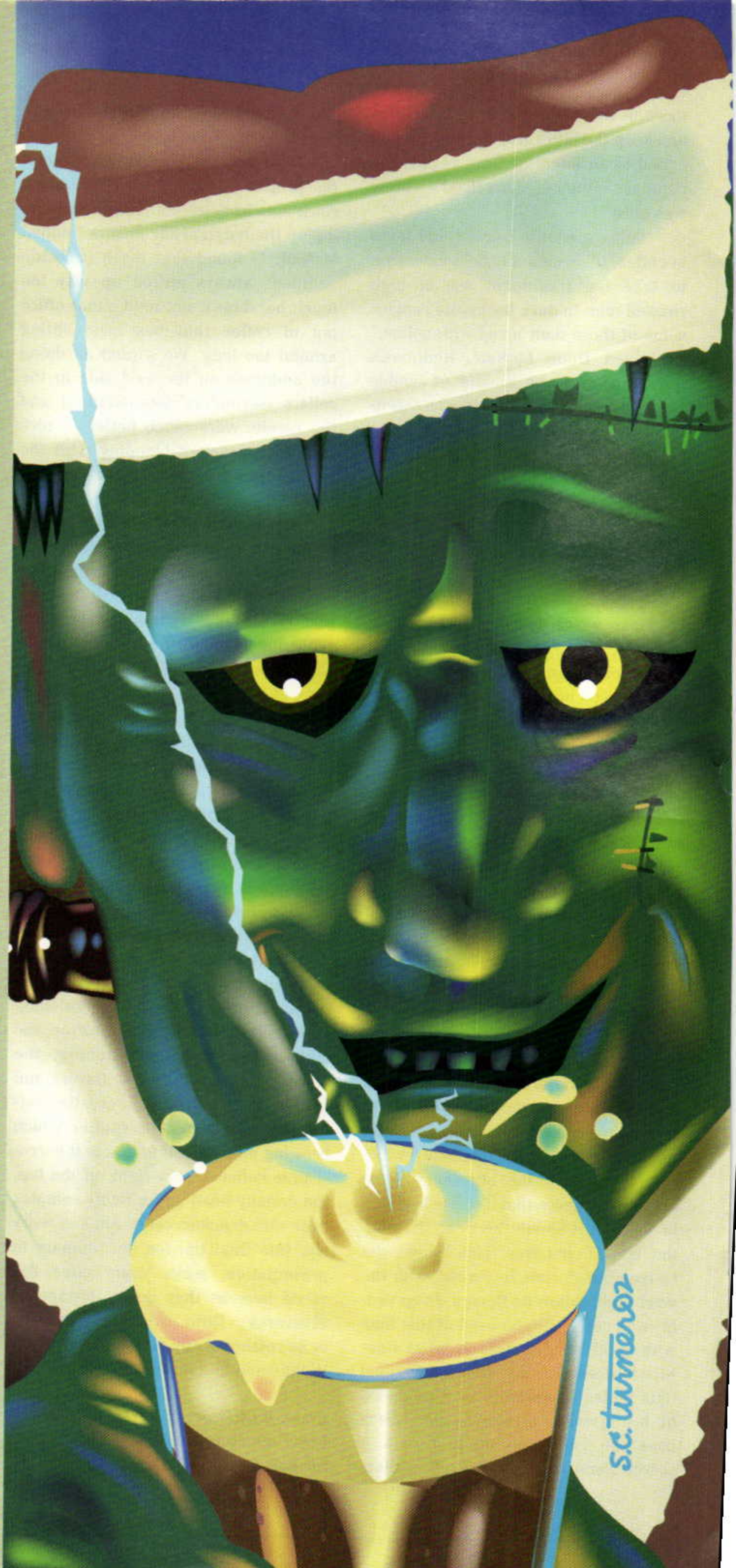
Well, the weather outside is frightful, and the fire is so delightful. And since you've no place to go ... well, then you'd better have some big winter beers in the fridge.

Although many "big beer" styles are available year-round, winter is the time when breweries release special holiday beers. Many of these winter seasonals are high-alcohol beers — monster beers that are bigger, maltier and have a bite that can't be found in your average-strength beer.

You don't need to be a mad scientist to make one, but successfully brewing a high-gravity beer involves much more than simply piling on the malt. Creating a monster beer requires skill and patience. Almost every stage of the brewing process must be modified. Most importantly, the brewer needs to pay special attention to taming the yeast during fermentation. If they are allowed to run amok, the resulting beer will be frightful indeed.

Characteristics of BIG BEERS

The characteristics of big beers differ from normal-strength beers in a variety of ways. Many of these differences are due to products made by the yeast during fermentation. Understanding the elements that are likely to be found in a high-gravity beer, and the brewing conditions that influence



them, will help you formulate your big-beer recipes and plan your brewing procedures with care.

Alcohol

First, and most obviously, the familiar sweet taste and smell of alcohol is a key part of the flavor profile of big beers. In some big beers, such as doppelbocks, the alcohol is noticeable but blends with the other flavors of the beer. In higher-alcohol beers, such as barleywines, the alcohol imparts a definite bite.

Normal-strength beers contain between 4 and 5.5 percent alcohol by volume (ABV). Most beer yeasts cannot tolerate alcohol levels over 12% ABV, so this puts an upper limit on beer alcohol unless special yeast strains or brewing procedures — such as freezing or distilling — are employed. The Beer Judge Certification Program (BJCP) style guidelines list the following alcohol levels for several styles of big brews: IPA (5–7.8%), wee heavy (6.9–8.5+%), English and American-style barleywine (8-12+%), Russian imperial stout (8–12+%) and doppelbock (7.5–12%).

The amount of alcohol in a beer depends on a variety of factors. Alcohol comes from the fermentation of wort sugars. So, the more sugars in the wort, the more potential alcohol in the final beer. However, several variables influence what percentage of the wort sugars are converted to alcohol.

In order to brew a high-alcohol beer, you need a yeast that will tolerate high alcohol levels. Some yeast strains are more alcohol-tolerant than others. Strains with low alcohol tolerance will begin fermenting a high-gravity wort, but will quickly drop out of solution, leaving many of the sugars untouched. Yeast manufacturers generally point out when a yeast strain is alcohol tolerant. However, be aware that some yeast strains are not labeled as alcohol-tolerant, yet still work well in high-gravity fermentations.

Attenuation is another important property to consider when selecting a yeast strain. Attenuation is the percentage of wort sugars a yeast strain will consume under optimal conditions. Highly attenuative yeasts leave less sugar behind and produce drier beers.

Monster Beer recipes

Santa's Claws

(5 gallons/19 liters, partial mash)
OG: 1.140 FG: 1.035 IBU: 52
SRM: 13 ABV: 14%

Have you been naughty or nice this year? Either way, prepare to face Santa's Claws. This recipe is an homage to Samiclaus, the famous Swiss holiday beer.

Ingredients

13.2 lbs. (6 kg) pale malt syrup
1.9 lbs. (0.86 kg) dried malt extract
1.25 lbs. (0.57 kg) 2-row lager malt
1.25 lbs. (0.57 kg) Munich malt
1.5 oz. (43 g) dehusked Carafa III malt
3.0 lbs. (1.4 kg) corn sugar
12 AAU Eroica hops (bittering)
(1.2 oz./34 g of 10% alpha acids)
2 oz. (57 g) Saaz hops (flavor)
3/4 tsp. yeast nutrient
White Labs WLP885 (Zurich Lager Yeast) or Wyeast 2206 (Bavarian Lager) yeast
3/4 cup corn sugar (bottling)

Step by Step

Make a 3.3-liter yeast starter of specific gravity 1.085 by boiling 1.6 lbs. (0.73 kg) dried malt extract in 3.3 liters of water. Cool overnight, shake to aerate and pitch your yeast to the starter six days before brewing. Place the crushed 2-row lager malt, Munich malt and Carafa malt in a nylon bag. Heat 4 qts. (3.8 L) of water to 170° F (77° C), then steep the malts in that water for 45 minutes at 150–152° F (66–67° C). Lift the grain bag out with a kitchen strainer. Rinse the grains with 4 qts. (3.8 L) of water at 165° F (74° C), add the dried malt extract, then fill the brewpot to the four-gallon (15 L) mark. Heat wort to boiling and begin boiling for one hour. Add the Eroica hops at the beginning of the boil. With 15 minutes remaining in the boil, shut off the heat and add the malt extract syrup, corn sugar, Saaz flavor hops and the yeast nutrient. Resume heating for the remainder of the boil. After the boil, cool the wort to approximately 60° F (16° C), then siphon it to your fermenter. Top off the fermenter to five gallons (19 L) with cold, aerated water. Aerate the wort and then pitch the sediment from the yeast starter. Ferment for four weeks at 52° F (11° C), then rack to secondary. Add 1 tsp. of fresh yeast. Let the beer condition for 45 more days. Gradually lower the temperature by 2° F (1° C) per day over the conditioning period until the beer is at 32° F (0° C). Bottle the beer with 3/4 cups of corn sugar and 1 tsp. bottling yeast. Let bottle condition for eight weeks.

Grendel's Barleywine

(5 gallons/19 liters, partial mash)
OG: 1.120 FG: 1.030 IBU: 63
SRM: 9 ABV: 12%

You might remember Grendel as the monster from Beowulf. However, the odds are somewhat better that you remember Grendel as the monster from the Cliff's Notes to Beowulf. Brewed correctly, this barleywine won't require any explanation.

Ingredients

13.2 lbs. (6 kg) pale malt syrup
2.3 lbs. (1 kg) dried malt extract
1.5 lbs (0.68 kg) 2-row pale ale malt
3/4 lb. (340 g) crystal (30–40 °L)
14 AAU Fuggles hops (bittering)
(3.5 oz/99 g of 4% alpha acids)
2.5 oz. (71 g) Fuggle hops (flavor)
0.5 oz (14 g) Fuggles leaf hops (dry hop)
1/2 tsp. yeast nutrient
1 tsp. Irish moss
Wyeast 1028 (London Ale) or White Labs WLP013 (London Ale) yeast
3/4 cup corn sugar (bottling)

Step by Step

Make a 2.8-liter yeast starter of specific gravity 1.085 by boiling 1.4 lbs. (0.64 kg) of dried malt extract in 2.8 liters of water. Cool overnight, shake to aerate and pitch your yeast to the starter five days before brewing. Place the crushed 2-row and crystal malt in a nylon bag. Heat 3 qts. (2.8 L) of water to 172° F (78° C), then steep the pale and crystal malt in that

story by chris colby • **illustration by shawn c turner**

water for 45 minutes at 152–154° F (67–68° C). Lift the grain bag out with a kitchen strainer. Rinse the grains with 3 qts. (2.8 L) of water at 168° F (76° C), add the dried malt extract, then fill the brewpot to the four-gallon (15 L) mark. Heat wort to boiling and begin boiling for one hour. Add the Fuggles hops at the beginning of the boil. With 15 minutes remaining in the boil, shut off the heat and add the malt extract syrup, flavor hops, Irish moss and the yeast nutrient. Resume boil. After the boil, cool wort to 80° F (27° C), then siphon it to your fermenter. Top off the fermenter to five gallons (19 L) with cold, aerated water. Aerate wort and pitch the sediment from the yeast starter. Ferment for two weeks at 68–72° F (20–22° C), then rack to secondary and add dry hops. Add 1/2–1 tsp. of fresh yeast. Condition for three weeks. Bottle with 3/4 cups of corn sugar and 1/2 tsp. bottling sugar. Bottle condition for six weeks.

Wight Xmas Winter Warmer

(5 gallons/19 liters, partial mash)
OG: 1.100 FG: 1.025 IBU: 35
SRM: 6 ABV: 10.3%

Wights are tormented undead souls who haunt graveyards, wallowing in their hatred of the living. Sounds like somebody could use a beer!

Ingredients

9 lbs. (4.1 kg) dried malt extract
3.6 lbs. (1.6 kg) 2-row pale malt
1/3 tsp. nutmeg
1/4 tsp. cinnamon
1/4 tsp. allspice
11.7 AAU Chinook hops (bittering) (1.1 oz./31 g of 11% alpha acids)
1 oz. (28 g) Cascades hops (flavor)
1/8 tsp. yeast nutrient
1 tsp. Irish moss
Wyeast 1056 (American Ale) or White Labs WLP001 (California Ale) yeast
3/4 cup corn sugar (for bottling)

Most beer strains exhibit apparent attenuations of between 68 and 77 percent. A strain with high alcohol tolerance need not be highly attenuative. Some Scottish ale strains can tolerate high alcohol levels, yet leave a considerable amount of sugar behind. This makes them perfect for wee heavies and other big, sweet beers. If you want to brew a big, dry beer, you'll want to select an alcohol tolerant and highly attenutive yeast strain.

The types of malts used also influence alcohol production, as malts differ in their fermentability. The sugars contributed to a wort by specialty malts, such as crystal malt, are typically less fermentable than those that come from pale malts. Usually, specialty grains contribute less than 20% of the wort sugars. Conversely, simple sugars like corn sugar, sucrose or glucose are entirely fermentable. Simple sugars can be added to levels of up to 20% of the wort sugars. Wort made from an all-grain mash is typically, though not always, more fermentable than an all-extract wort. Malt extracts vary wildly in their fermentability.

So, worts made with a lot of specialty grains, and few or no added simple sugars, will most likely end up somewhat sweet. Conversely, a wort made with few specialty grains but many simple sugars will be drier. Alcohol production also depends on how well you run your fermentation.

If your goal is to produce a very high alcohol beer, you would need to select an alcohol-tolerant, attenuative yeast strain. You would then need to pitch that yeast to a highly-fermentable wort; one made with a minimum of specialty malts and with many simple sugars. See the recipes for Santa's Claws, Troödon Tripel and Marfa Lights Malt Liquor for examples of styles that maximize — or at least emphasize — alcohol production.

Esters

Levels of fermentation by-products, such as esters, are likely to be elevated in a high-gravity beer. Esters are molecules that make a beer smell fruity or solvent-like. The degree to which esters are evident in the resulting beer depends on many factors. The higher the gravity and the higher the fermentation temperature, the higher the ester levels. Other fermentation by-products, such as higher alcohols (fusel oils), are also increased at high gravities and temperatures. In some styles, such as barleywines, these products are an accepted part of the styles. In others, such as doppelbocks, brewers attempt to minimize them.

Sweetness

Most big beers contain more residual malt sugars than ordinary beers because the yeast stop fermenting at a higher final gravity. In some big beers, brewers use extra means to lower the final specific gravity. These methods include adding champagne yeast after primary fermentation. Using more fermentable adjuncts also yields a drier beer. For example, some Belgian brewers add Belgian candi sugar to boost the alcohol content — but not the body — of many of their big beers. The sweetness of a big beer is also accentuated by alcohol, which tastes sweet.

If your goal is to brew a high-alcohol beer with some residual sweetness, choose an alcohol-tolerant, but lowly-attenuative yeast. Pitch this yeast into a wort with a reasonable amount of sugars from specialty malts, and few simple sugars. See the recipes for Nessie's Wee Heavy and Monkey Man IPA for beers that have a sweet finish.

Bitterness

There are essentially two ways brewers deal with the sweetness of big beers. They can accentuate the maltiness of the beer or attempt to balance the sweetness with hop bitterness. In high-gravity worts, however, hop bitterness is harder to extract than it is in normal worts. So, making a bitter big beer takes a little extra effort. See the recipe for Grendel's Barleywine or

Monkey Man IPA for an example of a big beer with a bitter edge.

Carbonation

Most homebrewers bottle condition their beers. When bottle conditioning a high-alcohol beer, the yeast may have trouble fermenting the bottling sugars since high levels of alcohol inhibit yeast. Hence, most bottle-conditioned big beers exhibit a low level of carbonation. Kegged beers can, of course, be carbonated to any level desired. Most big beers, however, are lightly carbonated, containing less than 1.8 volumes of carbon dioxide (CO_2).

Head

The head on a high-alcohol beer is usually thinner and less lasting than the head on a normal-strength beer. Head retention is decreased by the presence of ethanol and higher alcohols (fusel oils).

Brewing BIG BEERS

Successfully brewing a big beer requires making modifications to almost every step in the brewing process. Some of these modifications, such as adding more hops, are simple for a homebrewer to accomplish. However, the most important step — managing a good fermentation — will take considerable effort.

When brewing normal-strength beers, you can sometimes compensate for a shortfall in one aspect of your procedure by modifying other aspects. You can, for example, pitch more yeast if your aeration is inadequate. In the biggest beers, however, you have little room for error. Even small shortcomings can have large, negative consequences.

The most common flaw in big homebrews are fermentations that stop short — the yeast simply don't chew through enough of the sugars. This leaves a cloying, sickly-sweet beer. Excessive fermentation byproducts, such as fruity esters and solvent-like fusel oils, are also common defects.

Step by Step

Make a 2.4-liter yeast starter of specific gravity 1.085 by boiling 1.2 lbs. (0.54 kg) of dried malt extract in 2.4 liters of water. Cool overnight, shake to aerate and pitch your yeast to the starter five days before brewing. Place the crushed 2-row pale malt in a nylon bag. Heat 5 qts. (4.7 L) of water to 168° F (76° C), then steep the 2-row pale malt in that water for 45 minutes at 148–150° F (65° C). Lift the grain bag out with a large kitchen strainer. Rinse the grains with 5 qts. (4.7 L) of water at 165° F (74° C), add the dried malt extract, then fill the brewpot to the four-gallon (15 L) mark. Heat wort to boiling and begin boiling for one hour. Add the Chinook hops at the beginning of the boil. Add the flavor hops, Irish moss and yeast nutrients with 15 minutes remaining. After the boil, cool the wort to approximately 80° F (27° C), then siphon it to your fermenter. Top off the fermenter to five gallons (19 L) with cold, aerated water. Aerate the wort and then pitch the sediment from the yeast starter. Ferment for two weeks at 68–72° F (20–22° C), then rack to secondary and add spices in a sanitized (boiled) muslin bag. (Optional: You may want to add 1/2–1 tsp. of fresh yeast at this time.) Let condition for two more weeks. Bottle the beer with 3/4 cups of corn sugar and let bottle condition for four to five weeks.

Troödon Tripel

(5 gallons/19 liters, partial mash)
OG: 1.095 FG: 1.023 IBU: 23
SRM: 6 ABV: 10%

Troödons were close relatives to velociraptors, the ferocious flesh-eating dinosaur stars of "Jurassic Park." But troödons have something velociraptors never had — a cool umlaut in their name.

Ingredients

9.13 lbs. (4.14 kg) dried malt extract
0.75 lbs. (0.34 kg) 2-row Pilsner malt
1.5 lbs. (0.68 kg) Vienna malt
3.5 lbs. (1.6 kg) Belgian candi sugar
7.7 AAU Spalt hops (bittering)
(1.7 oz./48 g of 4.5% alpha acids)
1/4 tsp. yeast nutrient
Wyeast 3787 (Trappist High Gravity) or White Labs WLP099 (Super High Gravity) yeast
3/4 cup corn sugar (for bottling)

Step by Step

Make a 2.2-liter yeast starter of specific gravity 1.085 by boiling 1.1 lbs. (0.5 kg) of dried malt extract in 2.2 liters of water. Cool the starter overnight, shake to aerate and pitch your yeast to the starter five days before brewing.

Place the crushed 2-row Pilsner and Vienna malt in a nylon bag. Heat 3 qts. (2.8 L) of water to 170° F (77° C), then steep the Pilsner and Vienna malt in that water for 45 minutes at 150–152° F (66° C). Lift the grain bag out with a large kitchen strainer. Rinse the grains with 3 qts. (2.8 L) of water at 165° F (74° C), add the dried malt extract, then fill the brewpot to the four-gallon (15 L) mark.

Heat wort to boiling and begin boiling for one hour. Add the Spalt hops at the beginning of the boil. Add the Belgian candi sugar and yeast nutrients with 15 minutes remaining.

After the boil, cool the wort to approximately 80° F (27° C), then siphon it to your fermenter. Top off the fermenter to five gallons (19 L) with cold, aerated water. Aerate the wort and then pitch the sediment from the yeast starter. Ferment for eight to ten days at 68–72° F (20–22° C), then rack to secondary. (You may want to add 1/2–1 tsp. of yeast at this time.) Condition for ten to 14 more days. Bottle with 3/4 cups of corn sugar and condition for three to four weeks.

Chupacabra Chicha Grande

(5 gallons/19 liters, all-grain)
OG: 1.085 FG: 1.021 IBU: 8
SRM: 4 ABV: 8.75%

Chicha is a corn "beer" made from jora *(malted corn) or* muko *(masti-*

cated corn). Chupacabra Chicha Grande is named for the chupacabra (or goat sucker), a Puerto Rican folk monster that attacks small animals and even made a guest appearance on "The X Files." This chicha grande recipe uses common ingredients and normal all-grain brewing procedures.

Ingredients

9 lbs. (4.1 kg) flaked maize
6.25 lbs. (2.8 kg) 6-row pale malt
2.1 AAU Saaz hops (bittering)
(0.6 oz./17 g of 3.5% alpha acid)
3/4 tsp. yeast nutrient
Wyeast 1056 (American Ale) or
White Labs WLP001
(California Ale) yeast
Wyeast 3278 (Belgian Lambic
Blend) yeast and bacteria

Step by Step

Make a two-liter yeast starter of specific gravity 1.085 by boiling 1 lb. (0.45 kg) of dried malt extract in two liters of water. Cool overnight, shake to aerate and pitch both yeasts to the starter three days before brewing. Store starter at 72–80° F (20–27° C).

Mix flaked maize and water to make five gallons (19 L). Heat this mixture to 165 ° F (74° C), then stir in the crushed 6-row malt. Mash maize and grains at 152° F (67° C) for 45 minutes, stirring every five minutes. Add boiling water to boost temperature to 158° F (70° C) for 5 minutes, then add more boiling water to bring temperature to 168° F (76° C) for 5 minutes. (Don't bother with an iodine test, you shouldn't expect to convert all the starch.) Recirculate briefly, then begin running the wort off slowly. Collect wort slowly, about 30 ounces every 5 minutes, to prevent a stuck mash. Collect six gallons (23 L) of wort.

Boil the wort for one hour, adding the Saaz hops with 45 minutes remaining in the boil and the yeast nutrients with 15 minutes left

Brewing a big beer is a challenge, but — if you follow the recommendations below — you can create a monster.

Wort Production

Brewing a big beer begins with making the wort. For extract brewers, this step is straightforward. Simply stir your malt extract into your brewing water, and prepare for the boil.

For all-grain brewers, wort production is a bit more difficult. When brewing a normal-strength beer, an all-grain brewer mashes the grains in hot water, then rinses the grain bed with sparge water to extract the malt sugars. When brewing a high-gravity beer, a brewer must alter his usual procedures to boost the specific gravity of the wort he runs off from his grain bed. First of all, begin with a mash that is as thick as possible. The thicker the mash, the higher the gravity of the first runnings. Overly-thick mashes lead to poor conversion, however, so don't drop below 1.25 quarts (1.2 L) of water per pound (0.45 kg) of grain.

Second, omit or limit the sparge and collect only the early, higher-gravity runnings from the grain bed. In a normal gravity beer, the grain bed is sparged and progressively lower gravity wort is run off. Usually, the brewer quits collecting wort when the runnings drop below 1.010, or thereabouts. For higher gravity beers, brewers frequently stop collecting wort at much higher gravities (1.020 or higher). This lowers the brewer's extract efficiency since some of the sugars are not extracted from the grain bed. However, the wort is not diluted by the late, low-gravity runnings. Even with a thick mash and a truncated sparge, the wort collected may still be too low in gravity for the biggest beer styles. If this is the case, the wort will have to be condensed by a long boil.

There is one simple way for all-grain brewers to avoid the low efficiencies and extended boil times required with straight all-grain brewing of a high-gravity beer. If you spike your all-grain wort with malt extract, you can mash and sparge as you normally do, then simply make up the difference by adding malt extract.

The Boil

For extract brewers making a big beer, a couple modifications to their usual boiling procedure will lead to a better beer. Extract brewers normally boil a concentrated wort, then dilute the wort to working strength with water prior to fermentation. However, boiling a concentrated wort can lead to problems with wort darkening and lower hop utilization. Wort darkening causes the wort to take on reddish tones from carmelization.

Thicker worts also suffer from lowered hop utilization. Lowered hop utilization means that a given amount of hops will cause less bitterness in a high-gravity beer than it would in a normal strength beer.

In a high-gravity beer, both these problems will be exaggerated. Thus, extract brewers should try to boil as large a volume of wort as possible, to minimize the density of the concentrated wort. One option to consider is making a smaller batch of beer. If you have a five-gallon (19 L) brewpot, you can make a three-gallon (11 L) batch of beer and perform a full-wort boil. You can use your normal fermenter for primary fermentation and a three-gallon carboy — available at most homebrew stores — for secondary fermentation.

All-grain brewers will start their boil with a wort that is larger in volume, but lower in specific gravity, than they want. Therefore, they will need to extend their boil time to reduce the volume and concentrate the wort. To do this, some homebrewers boil their wort as long as three hours. This extended boil time will have a variety of consequences. The wort will darken during the extended boil, and hop utilization will be decreased. You can compensate for wort darkening by lowering the amount of dark grains in your recipe. To compensate for lowered hop utilization, you can add more hops, use hops with a higher alpha-acid rating, or boil the hops longer.

Adding yeast nutrients during the boil may help with your fermentation, especially if a lot of simple sugars were used in the boil.

Cooling and Aeration

For ales, the normal temperature range for fermentation is 68–72° F (20–22° C), and for lagers it's 50–55° F (10–13° C). Some homebrewers like to start their fermentation warm (usually 5–10° F above the recommended temperatures), then let them cool at the first signs of fermentation. Other homebrewers cool their worts all the way down to fermentation temperature before pitching the yeast. For normal-strength beers, there are pros and cons to both positions.

When brewing a big beer, however, there are two good reasons why you should cool your wort down to fermentation temperature (or slightly below) before pitching your yeast. High-gravity fermentations heat up quickly from the action of the yeast. Starting a fermentation hot only means you have to expend more energy cooling it down during fermentation.

Another characteristic of high gravity worts is that they do not absorb as much oxygen during aeration as normal worts do. Yet, the yeast still need oxygen for a healthy ferment. You can use the fact that cold wort absorbs more oxygen than warm wort to help out in this respect. You can partially compensate for the effect of high gravity on oxygen solubility by cooling the wort down to fermentation temperature (or slightly below) before aerating.

When racking the beer to the primary fermenter, homebrewers have an option that may help out their fermentation. When making a high-gravity beer, you can carry a little more trub than usual over to the fermenter. Trub is the protein and lipid "goo" that settles out of the wort after the boil. When brewing a normal-strength beer, most

in the boil. After the boil, cool the wort to 68° F (20° C), aerate and pitch the whole yeast starter. Ferment for five days at 68–72° F (20–22° C), then rack the chicha to secondary. Let it condition for three days, then bottle (without bottling sugar). Allow the chicha to bottle condition three to four days, then invite the crew over and enjoy. If you made it right, the chicha will be slightly sour, cloudy and still fermenting! Refrigerate any bottles not consumed by one week after bottling.

Nessie's Wee Heavy

(5 gallons/19 liters, partial mash)
OG: 1.085 FG: 1.030 IBU: 25
SRM: 15 ABV: 7.5%

This malty brew, almost as dark as Nessie's namesake loch, is a tasty Scottish beer. After a few Nessie's Wee Heavies you'll be claiming you saw a monster . . . under your kilt!

Ingredients

9.9 lbs. (4.5 kg) pale malt syrup
2.7 lbs. (1.2 kg) 2-row pale ale malt
1.5 oz. (43 g) chocolate malt
1.5 oz. (43 g) roasted barley
6.7 AAU Northen Brewer hops
(0.88 oz./25 g of 7.5% alpha acids)
1 tsp. Irish moss
Wyeast 1228 (Scottish Ale) or
White Labs WLP028 (Edinbourgh Ale) yeast
1 cup dried malt extract (for bottling)

Step by Step

Make a two-liter yeast starter of specific gravity 1.080 by boiling 0.91 lbs. (0.41 kg) of dried malt extract in two liters of water. Cool overnight, shake to aerate and pitch your yeast to the starter four days before brewing. Store starter at 68–72° F (20–22° C).

Place the crushed 2-row pale malt, chocolate malt and roasted barley in a nylon bag. Heat five quarts (4.73 L) of water to 177° F (81° C), then steep the malts in that water for 45 minutes at 158–162° F (70–72° C). Lift the grain bag out with a large kitchen strainer. Rinse the grains with 5 qts. (4.7 L) of water at 160° F (71° C), then fill the brewpot to the four-gallon (15 L) mark. Heat the wort to boiling and begin boiling for one hour. Add the Northern Brewer hops with 45 minutes remaining in the boil. With 15 minutes left in the boil, shut off the heat. Add the malt extract syrup, stir well, then resume heating.

After the boil, cool the wort to approximately 68° F (20° C), then siphon it to your fermenter. Top off the fermenter to 4.5 gallons (17 L) with cold, aerated water. Aerate the wort and then pitch the whole yeast starter.

Ferment for ten days at 60° F (16° C), then rack to secondary and let condition for ten more days. Bottle the beer with one cup of dried malt extract and let condition for three weeks.

Monkey Man India Pale Ale

(5 gallons/19 liters, partial mash)
OG: 1.075 FG: 1.019 IBU: 60
SRM: 13 ABV: 7.75%

The "monkey man" that has terrorized the Indian capital this past year is thought by skeptics to be an example of people's collective imagination. This hasn't stopped the Indian government from issuing a 50,000-rupee ($1,067) reward for its capture. Before poking around the alleys of New Delhi in search of the monkey dude, you might want to first shave, then fortify yourself with this big, hoppy India pale ale.

Ingredients

6.6 lbs. (3 kg) pale malt syrup
1.2 lbs. (0.54 kg) dried malt extract
2 lbs. (0.91 kg) 2-row pale malt
1.0 lb. (0.45 kg) biscuit/Victory malt
0.75 lbs. (0.34 kg) crystal (30–40 °L)
12.6 AAU Chinook hops (bittering)
(1.14 oz./32 g of 11% alpha acid)
2.5 oz. (71 g) Fuggles hops (flavor)
1.5 oz. (43 g) Fuggles leaf hops
(dry hops)
1 tsp. Irish moss
Wyeast 1968 (ESB) or White Labs
WLP002 (English Ale) yeast
3/4 cup corn sugar (for bottling)

brewers attempt to minimize the amount of trub in their fermenter. If left in contact with beer for too long, trub can cause off flavors. However, trub can also serve as a source of molecules that your yeast would otherwise need oxygen to produce.

If you normally limit the amount of trub in your wort, shoot for allowing 20–30% more trub into the fermenter than you normally would. If you do carry over some extra trub, be sure to rack your beer to secondary immediately after primary fermentation has ceased (or slowed significantly).

Fermentation

In my opinion, the most important consideration when making a good high-gravity homebrew is running a good fermentation. The difference between a well-fermented beer and a poorly-fermented beer is noticeable no matter what style of beer you brew. However, the differences become more and more noticeable at higher gravities. There are several keys to running a good fermentation.

For starters, you need to pitch an adequate amount of yeast. In a high-gravity fermentation, the yeast have a big job ahead of them. There are many sugars to consume and the yeast will have to finish the job in a high-alcohol environment, which inhibits yeast activity. As a consequence, the brewer needs to ensure there are enough healthy "workers" to complete this Herculean task.

There are several ways you can get enough yeast for pitching. You can build a yeast starter. For a five-gallon (19 L) batch, make a two-liter starter with starter wort of the same gravity as the beer to be brewed. Alternately, you can make a larger starter at a lower gravity. A one-gallon jug (3.8 L) with an airlock works well for starters. You can also use three-liter soda bottles.

If you don't want to make a starter, you can save yeast from a previous beer or get it from an outside source, such as another homebrewer or brewpub. For a normal five-gallon (19 L) batch, you would need about one cup of yeast solids. For a big beer, you will need more, up to two and half cups for a very big barleywine. The amount of yeast needed (at least roughly) scales with starting gravity.

If you're making a big beer, you will probably have selected an alcohol tolerant strain for pitching. Keep in mind, however, that selecting an alcohol tolerant yeast is not a substitute for pitching an adequate amount of that yeast. A small amount of yeast will lead to a poor fermentation, regardless of the characteristics of that yeast. On the other hand, if you aerate thoroughly and pitch enough yeast, your fermentation will likely go well.

After pitching the yeast, you must control the temperature during fermentation. The activity level of the yeast cells depends on the temperature of the wort. Yeast "work" faster at higher temperatures. But yeast activity itself produces heat. Without something to remove the heat being produced in the fermenter, the fermentation can run out of control. Excessively hot fermentations produce higher ester levels and more fusel oils. With normal strength beers, placing the carboy in an environment a few degrees below fermentation temperature does the trick. The wort temperature may climb a few degrees at the peak, but it basically stays within a reasonable range. With higher-gravity beers, however, the temperature can rise sharply during fermentation, so you may have to apply some extra cooling to keep the temperature from rising out of control. Placing your fermenter in a container — such as a garbage can or large picnic cooler —with cold water is a simple, effective way to cool a fermenter.

If the temperature is controlled during fermentation, a high-gravity beer will take longer to ferment than a normal-strength beer. A simple rule for estimating the length of an ale fermentation is that it should last one day per each two degrees Plato of the wort. (One degree Plato equals four specific gravity points.) Lagers take roughly twice this long. To give an example, this rule would predict that a barleywine (1.100 SG, 25° Plato) would take 12.5 days to ferment. Obviously, the actual amount of time will depend on a number of variables, including temperature and yeast strain. However, this rule should at least allow you to guesstimate when you will need to rack the beer for conditioning.

Conditioning

After primary fermentation has finished, rack the beer to your secondary fermenter for conditioning (often called secondary fermentation).

If you want your beer to be as dry as possible, you can perhaps knock the final gravity down by a point or two by adding a small amount — 1/2 to 1 teaspoon — of fresh yeast during conditioning. The fresh yeast may be able to consume some of the wort sugars that the yeast from the primary fermentation could not. The better your primary fermentation went, the less effective adding yeast to your secondary fermenter will be. You can add the same strain you used for primary fermentation, or another yeast. Some homebrewers add wine or champagne yeast at this time. These yeasts can ferment beer to a lower gravity than most beer yeasts can. If you do add fresh yeast at this stage, leave your beer at fermentation temperatures for a few days to let the yeast work.

Once your beer has stopped fermenting (or refermenting, if yeast has been added), begin cooling it for the conditioning stage. A period of cold conditioning will help the beer fall clear and let the green beer flavors and aromas mellow. If you are brewing a lager beer, the recipe will probably specify the details of how to lager. It is typical to decrease the temperature of the beer by 2° F (1° C) per day, then let it age at under 40° F (4° C) for about 90 days. For ales, conditioning regimens vary. At a minimum, you can cool the beer down to around the low end of the fermentation range — or slightly below — and let it sit for about as long as primary fermentation lasted. Alternate, you can cool the beer to below 40° F (4° C) and let it sit indefinitely. As you might expect, heavier beers usually benefit from longer conditioning times. If cooling an entire carboy is problematic for you, you can package the beer and let it condition in bottles or a keg. However, some brewers feel that cold conditioning in bottles is not as effective as bulk conditioning.

Packaging

All of the normal options for packaging are possible for big beers. Most homebrewers bottle condition their homebrews. This can be tricky with big beers because the high alcohol content can impede the yeast in the bottle, leading to undercarbonation. One way to ensure maximum conversion of the added bottling sugar is to add fresh, healthy yeast to your bottling bucket. You don't need much — about one teaspoon of yeast per five gallons (19 L) should do the trick — to ferment the small amount of bottling sugar. It also helps to give the yeast some added time to ferment the bottling sugar. For high-gravity beers, let the bottles sit for two weeks at room temperature before moving them to cold storage.

Many homebrewers put their barleywines in small six-ounce (177-mL) bottles (sometimes called "nips"). Smaller bottles means more time spent bottling. But, for many, they provide a more reasonable serving size.

If you want a monster in your fridge for the next holiday season, you will need to head down to your basement laboratory a few months earlier to provide enough time for fermentation and conditioning. On the other hand, if you start brewing now you can have a merry, scary Valentine's day. ■

Chris Colby haunts the graveyards of Bastrop, Texas. Wait, did I say graveyards? Sorry, I meant bars.

Step by step

Make a two-liter yeast starter of specific gravity 1.075 by boiling 0.81 lbs. (0.37 kg) of dried malt extract in two liters of water. Cool overnight in refrigerator, shake to aerate and pitch your yeast to the starter three days before brewing.

Place the crushed 2-row pale malt, biscuit or Victory malt and crystal malt in a nylon bag. Heat 5 qts. (4.7 L) of water to 174° F (79° C), then steep these malts in that water for 45 minutes at 154–156° F (68° C). Lift the grain bag out with a large kitchen strainer. Rinse the grains with 5 qts. (4.7 L) of water at 165° F (74° C), stir in the dried malt extract and then fill the brewpot to the four-gallon (15 L) mark. Heat wort to boiling and add Chinook hops. Begin boiling for one hour. With 15 minutes left in the boil, shut off the heat. Add the malt extract syrup, flavor hops and Irish moss, stir well, then resume heating. After the boil, cool the wort to approximately 80° F (27° C), then siphon it to your fermenter. Top off the fermenter to 4.5 gallons (17 L) with cold, aerated water. Aerate the wort and then pitch the whole yeast starter. Ferment for seven days at 68–72° F (20–22° C), then rack to secondary and add dry hops. Let condition for seven to ten more days. Bottle with 3/4 cup corn sugar and let bottles condition for three weeks.

Marfa Lights Malt Liquor

(5 gallons/19 liters, partial mash)
OG: 1.072 FG: 1.018 IBU: 15
SRM: 5 ABV: 7.3%

Marfa, Texas is home to the Marfa Lights, unexplained lights that often appear in the night sky. True UFO believers swear that Marfa is an extraterrestrial contact zone. Skeptics point out that if extraterrestrials did travel millions of light years to visit Texas, they'd probably go to Sixth Street in Austin and party with Jenna Bush instead.

You've heard of CAPs (Classic American Pilseners), right? Well, this beer is a CAMeL, a Classic American Malt Liquor.

Ingredients

3.3 lbs. (1.5 kg) extra light malt syrup
3.4 lbs. (1.5 kg) dried malt extract
2.5 lbs. (1.1 kg) 6-row pale malt
0.5 lb. (0.22 kg) flaked maize
3.3 AAU Hallertau hops (bittering)
(0.83 oz./24 g of 4% alpha acids)
1/4 tsp. yeast nutrient
1 tsp. Irish moss
Wyeast 2272 (North American Lager) or White Labs WLP840 (American Lager) yeast

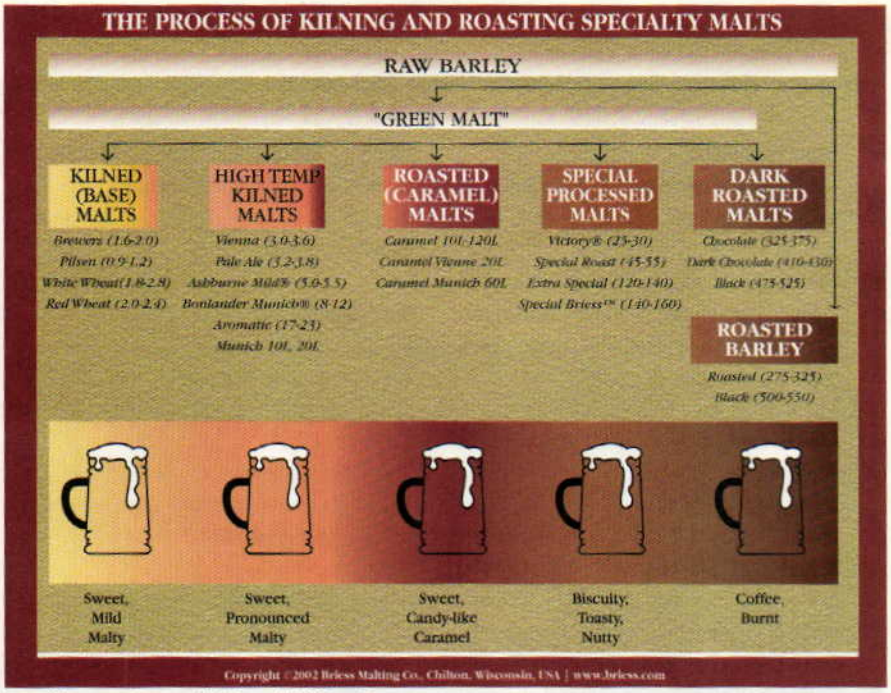
Step by Step

Make a two-liter yeast starter of specific gravity 1.072 by boiling 0.80 lbs. (0.36 kg) of dried malt extract in two liters of water. Cool overnight, shake to aerate and pitch your yeast to the starter five days before brewing. Store starter at 60–65° F (16–18° C). Place the crushed 6-row pale malt and flaked maize in a nylon bag. Heat 3 qts. (2.8 L) of water to 170° F (77° C), then steep the malt and adjunct in that water for 45 minutes at 150–152° F (66° C). Lift the grain bag out with a large kitchen strainer. Rinse the grains with 3 qts. (2.8 L) of water at 165° F (74° C), stir in the dried malt extract and then fill the brewpot to the four-gallon (15 L) mark. Heat wort to boiling and add the Hallertau hops. Begin boiling for one hour. With 15 minutes left in the boil, shut off the heat. Add the malt extract syrup, Irish moss and yeast nutrients, stir well, then resume heating. After the boil, cool the wort to approximately 60° F (16° C), then siphon it to your fermenter. Top off the fermenter to 4.5 gallons (17 L) with cold, aerated water. Aerate the wort and pitch the whole yeast starter.

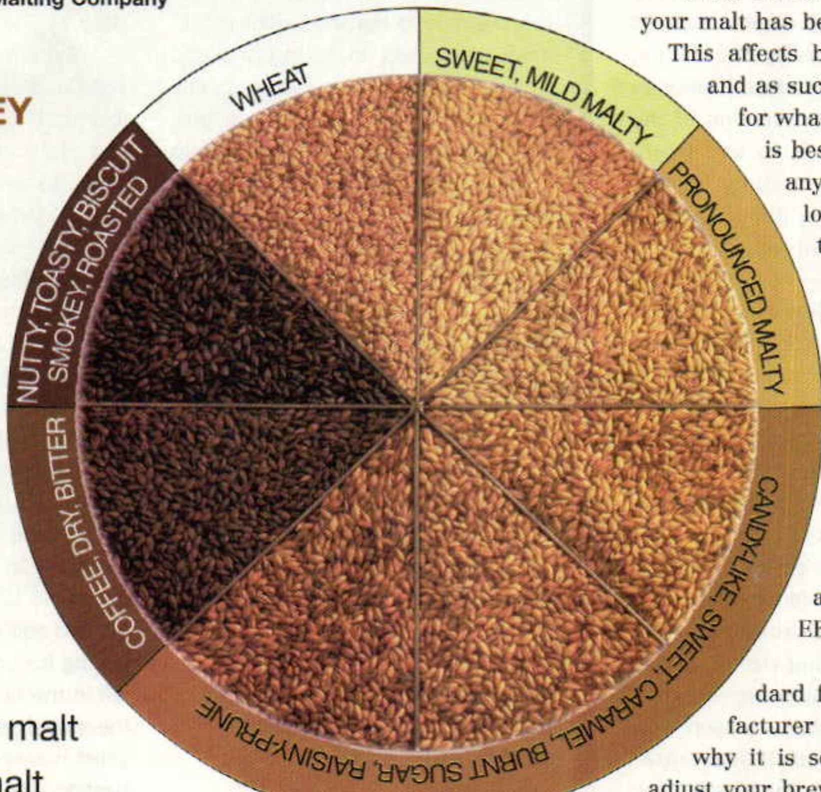
Ferment for ten days at 52° F (11° C), then rack to secondary and let condition for 30 more days. Lower temperature until the beer is at 32° F (0° C). Keg and serve ice cold.

EXPLORING and UNDERSTANDING malt ANALYSIS

by Kelly Kuehl



graphics courtesy of **Briess Malting Company**



MALTED BARLEY is a biological product, so it varies from year to year and batch to batch. This can affect your recipes and brewing procedures. You can learn the specifics of your malt by reading the malt analysis sheet.

Whether you brew at home or at the office, the more you know about the malt you use, the better and more consistent your beer will be. No two batches of malt are exactly alike and the only sure way of predicting the malt's impact on your beer is to know how to read a malt analysis sheet. The information available for different malts varies with suppliers. Some only supply a typical malt analysis. Other malting companies offer a lot-specific analysis.

At the minimum, every lot analysis sheet should list color, moisture content, extract and protein levels.

Color of the Malt

Color reflects the level to which your malt has been kilned or roasted. This affects both color and flavor and as such is a good indication for what type of beer the malt is best suited. The color of any malt will vary from lot to lot due to production differences, crop variation and barley variety. In the United States, color is expressed in degrees Lovibond. In Europe, color is measured according to the standards of the European Brewing Convention and is expressed as EBC units.

Colors are not standard from one malt manufacturer to the next. This is why it is so important that you adjust your brewing not only according to the color reported on the lot analysis, but also to the flavor contribution that an individual malt will bring to your batch of beer.

Moisture Content

Moisture content in malt generally reflects the quality of the malting itself. Malt with high moisture content may have been poorly malted or kilned. Malt moisture content that falls within the 3.5–6% range is acceptable. Malt

Sample MALT ANALYSIS

	Barley Type	Barley Variety	Assortment 7/64 Min.	Assortment 6/64 Min.	Assortment Thru Max	H20 % Max.	Color ASBC Deg. Lov.	Protein Max. Sol	Protein Max. Total	Protein Max. S/T	Extract Dry Min. FG	Extract Dry Min. CG	F-C Diff. Max.	D.P. Min. Dg. Lint.	Alpha Amly. Min.	Mash Odor	Viscosity Max	Clarity Degree Visual
Schreier Two-Row Pale	2-Row	Various	55	35	2.0	4.5	1.5-2.5	5.5	12.0	50.0	80.0	79.0	1.5	110	50	Aro	1.50	Clear
Schreier Six-Row Pale	6-Row	"Robust, Excel"	45	40	1.5	4.5	1.5-2.1	6.0	13.0	45.0	78.0	77.0	1.5	150	40	Aro	1.50	Clear
Cargill Pils	2-Row	"Harrington, B1215"	70	25	1.5	4.5	1.4-1.7	5.0	11.0	50.0	80.0	79.0	1.5	110	50	Aro	1.50	Clear
Cargill Euro Pils	2-Row	Manley	70	25	1.5	4.5	1.5-2.0	5.0	11.0	50.0	82.0	81.0	1.5	125	55	Aro	1.50	Clear
Cargill Special Pale	2-Row	"Harrington, Stein"	60	35	1.5	4.5	3-4	5.0	11.5	45.0	79.0	78.0	1.5	100	45	V Aro	1.50	Clear
Cargill Red Wheat	Wheat	Hard Red Spring	45	40	2.0	4.5	2.5-3.0	7.0	15.0	45.0	80.0	79.0	1.5	140	40	Bread	1.50	Sl Hazy
Cargill White Wheat	Wheat	Soft White Winter	75	20	2.0	4.5	2.0-3.0	6.5	12.0	45.0	82.0	81.0	1.5	110	37	Bread	1.60	Sl Hazy
Cargill Unmalted Wheat	Wheat	Hard Red Spring	75	20	1.5	11.5			12.0									
Cargill Munich	2-Row	Harrington	60	35	1.5	4.5	8-11	6.5	11.5	45.0	80.0	79.0	1.5	100	50	Aro	1.60	Clear
Cargill Euro Munich	2-Row	Stratus	70	25	1.5	4.5	5-9	6.0	11.0	55.0	81.0	80.0	1.5	70	60	Aro	1.40	Clear
Cargill Two-Row Caramel 60	2-Row	Moravian*	60	35	1.5	4.5	55-65		12.5		70.0					V Aro		
Cargill Caramel 10	6-Row	"Robust, Excel"	40	40	2.0	4.5	8-15		12.5		78.0					V Aro	1.60	Clear
Cargill Caramel 20	6-Row	"Robust, Excel"	40	40	2.0	4.5	17-25		12.5		78.0					V Aro	1.60	Clear
Cargill Caramel 30	6-Row	"Robust, Excel"	40	40	2.0	4.5	25-35		12.5		70.0					V Aro	1.60	Clear
Cargill Caramel 40	6-Row	"Robust, Excel"	40	40	2.0	4.5	35-45		12.5		70.0					V Aro	1.60	Clear
Cargill Caramel 60	6-Row	"Robust, Excel"	40	40	2.0	4.5	50-65		12.5		70.0					V Aro		Dark
Cargill Caramel 80	6-Row	"Robust, Excel"	40	40	2.0	4.5	70-85		12.5		70.0					V Aro		Dark

** Moravian is a registered trade mark of the Adolph Coors Brewing Company, Golden, Colorado*

CHART COURTESY OF CARGILL MALT

with a moisture content over 6% is more susceptible to mold and off-flavor creation. As a general rule, you do not want to have pay for extra water in your malt.

At the same time, malt that is too friable (too low in moisture) can easily shatter. Pay close attention to the malt you receive from your supplier to make sure that it is within an acceptable range. You cannot dry moist malt out in the oven as you would risk further damaging the malt, specifically killing the enzymes and potentially discoloring the malt.

Extract Potential

Malt analysis sheets usually list several indicators of extract potential, including FG, CG and the F/C ratio. Fine-grind (FG) extract percentage indicates the maximum soluble yield possible from the malted barley. The higher the FG extract, the more soluble the malt will be. Typical FG is approximately 80%. These numbers are usually given on an as-is basis. This means the malt includes moisture as opposed to a dry-basis analysis. This is more useful since brewers weigh out the malt with its moisture intact.

Coarse-grind (CG) extract will give you a good indication of what the grain underwent during malting and it will typically more closely approximate actual brewhouse results. CG Extract should be around 78%.

The fine/course (F/C) difference indicates the modification of the malt, how far the sugars in the barley have been modified during malting. "Steely" malt destined for a step-mash should have a targeted fine-coarse difference of 1.8–2.2% while "mealy," well-modified malt is best suited for an infusion mash and will have a targeted difference of 0.5–1.0%. Steely and mealy are used to describe the appearance of the endosperm (the very tip of the malt kernel). As a brewer, you will want to know how well the malt will crush and how accessible the endosperm will be to mash enzymes. The better and more extensive the malting, the higher percentage of mealy kernels.

Protein Level

Protein is important because it is largely responsible for run-off difficulties in the brewhouse and haze in the finished beer. When brewing all-malt beer, it is preferable to use malt with a total protein level of less than 13%. Higher level of proteins can lead to haze in your finished beer.

Soluble protein is the amount of protein available in soluble form, expressed as a percentage of malt weight. In other words, this is the percentage of protein that will dissolve into the water during the mash. The greater the modification of the malt, the higher the proportion of soluble protein. The better the protein modification, the fewer problems you should have with protein-related difficulties. Typical soluble protein levels for base malt should be in the 5% range.

The S/T ratio is the ratio of soluble protein to total protein. This is an important indicator of malt modification. Malts with an S/T ratio of 36–42% are best used in a decoction mash because they are undermodified. Typical S/T ratios for base malt should be in the 50% range and can be used in any kind of mash.

Diastatic power (DP) expresses the levels of starch-reducing enzymes in the malt. A DP rating of 125 °Litner is typical in North American base malt. British ale malts are usually rated at 45° Lintner while lager malts are often rated at 65° Lintner.

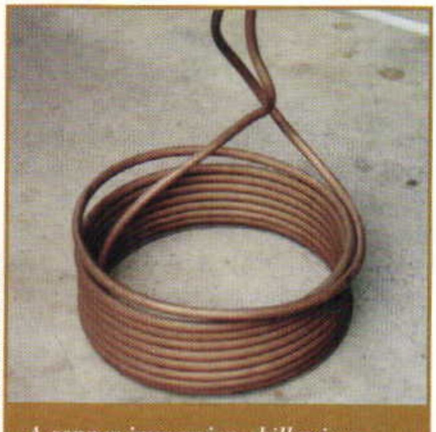
By understanding and utilizing the basics of malt analysis sheets, you are well on your way toward brewing more consistent beer. ■

Kelly Kuel is Director of Sales for Mid-America Brewing Supply. He is the former sales manager for the specialty malts division of Cargill Malt.

Steal the Heat

A guide to fast, effective wort cooling

by Chris Colby



PHOTOS BY CHRIS COLBY

A copper immersion chiller is a quick, effective way of cooling your wort. It is also easy to clean.

SOME HOMEBREWING procedures are complex while others are simple. However, just because a process is simple doesn't mean that it is not important. Wort cooling is a procedure that is conceptually simple, yet very important to beer quality. Unfortunately, since wort cooling is straightforward and comes near the end of the brewday, many homebrewers pay little attention to this step.

Reasons to Chill Wort

After the boil, wort needs to be cooled for a variety of reasons. The wort needs to be cool enough for the yeast to survive and perform well at making beer. Most ale yeasts work best between 68–72° F (20–22° C); most lager yeasts work best at 45–57° F (7–14° C). In addition, to prevent shock from a rapid change in temperature, the temperature difference between your yeast culture and wort should be less than 10° F (-12° C) at pitching.

There are reasons other than yeast health for wort chilling. Wort cooling causes solids, called the cold break, to form and fall out of solution. When wort is transferred from the kettle to the fermenter, this break material is left behind.

Wort cooling also slows dimethyl sulfide (DMS) production. DMS is a volatile substance produced in some worts, mostly those made from lager malts. DMS smells like cooked corn and is usually considered a beer fault, although it is noticeable and intentional in some commercial beers.

Quickly cooling the wort also slows growth of some wort contaminants. Once the wort drops below 160° F (71° C) or so, there are many bacteria — known as wort spoilers — that can quickly grow and produce off flavors in wort. Quickly moving the work to fermentation temperature and pitching the yeast minimizes the impact of these bacteria on your beer.

Starting Warm

Many homebrewers start their fermentations "warm." Instead of cooling the wort all the way down to fermentation temperature, they stop cooling 5 to 10 degrees Farenheit (3 to 6 degrees Celsius) short and then pitch their yeast. The usual reason given is that a warm wort provides for a fast start, which will help the yeast colonize the wort faster and crowd out any stray bacteria. When deciding whether to start warm or not, there are a couple things you should consider.

A warm wort will lead to a faster start for the yeast. But it will also propel any bacterial contaminants to grow faster as well. Since bacteria can divide faster than yeast, you really aren't gaining any leverage by starting warm.

Many flavor-active molecules are produced early in the fermentation while the yeast are multiplying. These molecules are produced in much smaller numbers later when the yeast cells have reached their maximum density and are fermenting, but not dividing. Thus, starting a fermentation warm can lead to more fermentation by-products in your wort. If you are striving to make a "clean" tasting beer, starting at fermentation temperature is more advisable. Starting warm also means that more potential cold break material remains dissolved in the wort. Some of this material can contribute to chill haze in your finished beer. Homebrewers have a few options when it comes to wort chilling.

Topping Up With Cold Water

Extract brewers typically boil a concentrated wort, a wort smaller than the volume of the batch. After the boil, water is added to make the batch full-size. For example, the brewer may boil three gallons (11 L) of wort, then add two gallons (7.6 L) of water to make a 5-gallon (19 L) batch of beer.

Obviously, the water used for topping up can absorb a good deal of heat. To increase the "cooling power" of this water, it can be refrigerated overnight. Make sure the water containers are clean and sanitized and that the containers can be sealed. Water stored in a refrigerator can pick up flavors from food if it is not in a sealed container.

Before mixing this water with your wort, aerate the water thoroughly. You can do this by vigorously shaking the container for 45–60 seconds, or you can use a fish-pump aeration device or oxygen tank. Cold liquids can hold more gas than warm liquids, so aerating your cold topping-up water can help greatly with overall aeration.

When mixing cold water and hot wort, add the cold water to your fermenter first, then slowly add the hot wort. Stir the wort with a clean, sanitized spoon as you mix the two. Never add hot wort to a carboy before the cold water, as the heat can crack it.

One disadvantage of transferring hot wort into cold water without chilling it first is you carry all the potential cold break into the fermenter. If you want to get rid of this break material, you can initially transfer the wort to cold water in a sanitized bucket and wait for 15 minutes or so for the break material to settle out. Then, you can siphon the clear wort to your primary fermenter.

In the Sink

A five-gallon or smaller wort can easily be cooled by submerging your brewpot in a sink. This transfers heat from your wort to the water. To do this, put a cover on the brewpot after the boil, place the pot in a sink and fill the sink with cold water. To speed cooling, swirl the water in the sink every couple of minutes and change the water in the sink every five to seven minutes. Also, stir the wort with a clean, sanitized spoon every time you change the water. These two things will keep cold water next to the outside of the pot and hot wort next to the inside of the pot.

Once the brewpot has cooled to the point where you can comfortably touch it for a few seconds, put some ice in the sink and fill it with water. You will need a total of about three to four pounds of ice per gallon of wort to cool it quickly. The exact amount depends on how cold your wort is when you begin icing it. Keep changing the cooling water and adding more ice every time the ice melts. Begin checking the temperature of your wort — with a clean, sanitized thermometer — once the brewpot is cool to the touch. Once the wort is cooled to your target temperature, transfer it to your fermenter.

Even if you add some cold topping-up water to your wort, cooling the brewpot in a sink or tub is a good idea. If hot wort is splashed around, it can darken significantly. This can occur even if you are pouring the hot wort into cold water, especially if you're pouring it through a funnel. Whatever you do, don't pour hot wort through a strainer — this will definitely darken the wort and leave your beer prone to quick staling. And finally, hot wort can cause scalds — so anytime you cool it before moving it anywhere, the better off you will be.

I always cool any wort — even the wort I make for yeast starters — before transferring it. This ensures that my light-colored worts (or starter worts) stay light-colored and I don't risk scalding myself. Cooling the wort before transferring also allows you to separate the wort from some of the cold break material.

If you are cooling your wort in the sink plus adding topping-up water, you don't need to cool the wort all the way down to fermentation temperature. Simply cool the wort to the point where you can comfortably touch the brewpot for a few seconds, then transfer the wort to your fermenter.

Immersion wort chiller

It's possible to cool five gallons or more of wort in a sink or bathtub, but it would take awhile. Plus, you would need to carry the wort to the water and this could be dangerous. Luckily, homebrewers have a safe, effective way of cooling a wort without having to move it — with an immersion chiller.

An immersion chiller is a metal coil — usually copper — that is placed in hot wort. It has tubing or hoses running from both ends. Water running through the coils absorbs heat and carries it out of the wort. When used correctly, an immersion chiller will cool a wort much faster than cooling the brewpot in a kitchen sink.

Counter-flow wort chillers are more difficult to clean than immersion chillers, but they can cool your wort more quickly. Cold water runs through the outer tube.

To use an immersion chiller, place the clean chiller in your wort about 15 minutes before the boil is done. The heat from the wort will sanitize it. Hook one end of the chiller tubing to your water source and place the other end in a sink, near a drain or anywhere that can accept hot water. You may need to weight down the "out" end so it stays put.

After the boil, turn on the water to the chiller. Using a clean pot holder or barbecue mitt, grab the top of the chiller and swirl it through the wort a few times to start the wort circulating. (Don't let the pot holder touch the wort.) The circulating wort will flow past the chiller coils and keep cold wort from collecting around them. Swirl the wort every five minutes or so. Putting a lid on the kettle slows the cooling slightly, but it prevents airborne contaminants from falling into your wort. Once the outside of the kettle is cool to the touch, take the temperature of the wort every five minutes or so with a sanitized thermometer. When your wort is cooled, transfer the wort to your fermenter.

Counter-Flow Chiller

Another way to cool your wort is with a counter-flow chiller. A counter-flow chiller is essentially a tube within a tube. Hot wort flows into the chiller and travels through the inner tube. Cold water flows in the opposite direction through the outer tube. As the wort moves through the chiller, it encounters ever-colder water and continually transfers heat to this water. Some chillers are made out of copper while others are made with nylon tubing run through a garden hose. Copper conducts heat much better than tubing, but is also more expensive.

Counter-flow chillers are commonly attached to a valve on the kettle. After the boil, the water is turned on and the valve is opened. Hot, clear wort flows into the chiller and cooled, cloudy wort exits the other end. A counter-flow chiller will quickly cool your wort down to pitching temperature, but the wort that comes from it will be cloudy. The wort is cloudy because it contains all the precipitated cold break solids. To get rid of this, you can direct your wort from the chiller to a sanitized bucket first. Once the break material has settled to the bottom of the bucket, you can transfer the wort to your fermenter and pitch the yeast.

The temperature of the wort exiting the chiller depends on a number of factors. Colder water temperatures, longer chiller lengths, more turbulence within the chiller and a slower flow rate of the wort increase the "chilling power" of the chiller. If you measure your wort temperature as it exits the chiller, you can change the wort flow rate with a tubing clamp to hit your target temperature.

One concern many homebrewers have with counter-flow chillers is that they cannot see the inside of the chiller to see if it's clean. Running hot water through the wort line of the chiller immediately after use will help keep it clean. Follow the hot water with a cleaning solution. To sanitize, you can run sanitizing solution through the wort line or boil the entire chiller. If you boil, fill the chiller with water first, place it in your kettle and heat the water to boiling. Don't dunk a cold chiller into boiling water as that can cause air inside to expand rapidly, and spray hot water from the tubes (and potentially damage the chiller).

Following cooling, you will need to aerate your wort and pitch your yeast. Some brewers have built aeration stones into the wort outflow tubing on their chillers for aeration.

Quick wort chilling — followed by cold break separation, if needed — will give your yeast cool, clear wort to live, grow and ferment in. ■

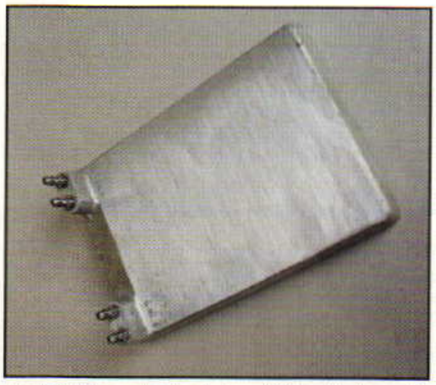
Chris Colby is the managing editor of Brew Your Own magazine.

TapAFridge

Serve cold homebrew from a warm keg

story and photos by Thom Cannell

The TapAFridge is an electric jockey box. It allows you to serve one or two cold homebrews from a warm keg.



A stainless-steel plate chiller designed to rapidly cool warm beer from two different beer lines.

Now that I've built the ultimate DraftErator (Projects, September 2002), I've realized I have a greater need to keep one or two beers on tap, as opposed to the four or five the DraftErator holds. What I need is an electric "jockey box" that chills and dispenses one or two beers — not a whole party's worth. Something that takes up so little space that even my spouse will say "Well done, oh fearless homebrewer," or at least, "OK, you can make this one. It will fit in our home."

Dorm refrigerators are inexpensive and often found used for as little as $25. In my college-saturated neighborhood, chain stores sell them for $90 new. That's the source of coldness. A stainless steel chill coil adds $75 to our project. It may not be cheap, but it will be effective.

Concept

Let's assume you've got a keg of warm beer and a thirst for cold homebrew. A cooling coil immersed in 45 °F (7 °C) water would really help out in this situation. A 50' (15-1/4 m) chill coil of 3/8" inner diameter tube holds a volume of 36 ounces (1 L), so dispensing a normal evening's pints is no problem. The third or fourth rapidly-dispensed beer will require the exchange of 25 °F (14° C) of heat (70° F/21° C keg to 45° F/7° C serving.) What we need is a place for the heat to go. My idea is to keep the coil immersed in a bucket of water inside the mini-fridge. This heat sink will be continually "recharged" by the refrigerator's compressor.

Materials

So the essential elements of our project are: mini-fridge, chill coil, bucket of water and — of course — the necessary tap handle or handles and keg connections.

Two suitable beer-cooling devices are available from leading mail-order homebrew suppliers. (I found mine at Beer, Beer & More Beer.) One is a 50-foot (15-1/4 m) coil of stainless steel tubing; the other is a cold plate. Cold plates are solid plates of aluminum with stainless steel tube woven inside. Their advantage is size — they're flat — and their ability to rapidly cool beverages. If you look into a commercial jockey box, you'll usually find a cold plate, not individual coils. It's your choice, but if I were making a two-beer dispenser, I'd choose the chill plate.

For the single-beer version, a copper coil would not be advisable because the beer will remain inside the coil between servings.

Modifying the Fridge

Begin by acquiring a mini-fridge. Our ex-dorm budget-buy has a cavity that is polygonal, 16" (40.6 cm) across the front, 10" (25.4 cm) deep on the left and 7" (17.8 cm) deep on the right. It's

The chiller plate sits in a water bath cooled by the fridge. The bath is made from a stainless steel sink.

The TapAFridge can also be equipped with a stainless steel coil, but only one beer can be dispensed.

The plastic molding on the refrigerator door must be removed to make room for the water bath and chiller.

The plastic molding on the refrigerator door is replaced with a panel made of thin masonite.

To drill holes throught the fridge door and masonite for the tap, I had to chuck my hole saw to a hand drill.

10" (25 cm) tall below the combination ice tray and evaporator coil. (It's the evaporator coil that provides cooling.)

Mini-fridge doors have molded plastic shelves to hold a couple of beverage bottles and a few eggs. For increased interior room, this molded plastic has to be removed.

Pulling straight out on the sealing gasket should reveal the screws used to hold the inner panel. The gasket should wrap around and over this panel. Removing the door makes this easier; look under any plastic cover plate for the hinge screws. You may also be able to make the door open opposite by removing both hinges and replacing them opposite.

Remove the screws and remove the gasket. If your fridge is used, you'll likely need to clean the gasket. Now is the time to soak it overnight in some dilute cleaning solution (I use PBW). If the gasket is ultra-stiff or in soggy shape, now is the time to replace it. You'll find these gaskets at local appliance repair shops. Cut a panel of thin masonite, plastic or aluminum sheet to the size of the just-removed molded panel and use the panel as a template for screw holes. (For this purpose, thinner is better as it's easier to reinstall the gasket.) Cut the panel and drill screw holes. If you're using a permeable material like wood or masonite, seal it with a penetrating sealer to prevent it from delaminating. Reinstall the gasket by wrapping it around the new panel and replacing the screws with longer #10 x 3/4" screws if you are using 1/8" masonite.

The Cooling Apparatus

Once you've modified the door, you'll need to fit a bucket. (Leave the door off for now, we have a tap handle to install.) I was lucky and had a salvaged stainless steel lab sink. I could have cut and silver brazed it to fit more precisely, but that was too much effort. Instead I cut the rolled lip off the portion to be modified and bashed it with a hammer. If you use a cold plate, you'll want something that maximizes the size and depth of the heat sink. If you don't have a lab sink, look in any restaurant supply store for a similar container. Some restaurant stores will offer used pans at a savings.

Once you have a bucket that will fit, determine where your tap handle and liquid line will be installed — front, top or side. This will depend on the tap handle or handles you buy. I put a single tap into the front of the fridge. A second will follow.

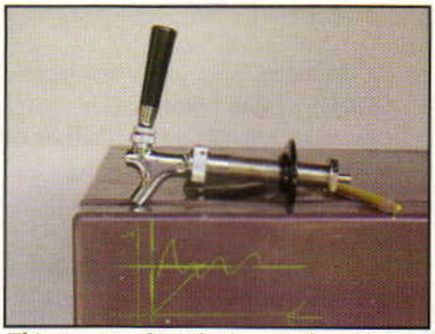
Hole drilling proved difficult. Most home drill motors — at least all of mine — have a maximum drill shank size of 3/8" and that is smaller than either a typical 1" drill bit or 1" hole saw. Unfortunately, I discovered this after purchasing a 1" hole saw! (Hole saw kits usually start at 1-1/4" and are meant for installing door hardware.)

I took a 1/4" drill and drilled through the steel door panel and the masonite. Then I inserted that drill into the hole saw (it serves as a pilot) and chucked the hole saw into an antique hand drill, a "brace." It worked perfectly and I drilled the steel, then the masonite.

The next step is to drill a 1/2–5/8" hole for 3/8" inner diameter liquid beer line. I drilled those holes at the rear after careful inspection to ensure no power or coolant lines were in the area. Typically, the sides of a dorm fridge will be free of either as well.

Our photos show both the stainless steel coil and chill plate. For a single beer, just connect a hose from your keg to the coil, then from the coil to the spigot nipple. (Shanks are available in various lengths. I'm going to return the 4" shank to my homebrew store and get 2" shanks.) Be certain to use Oetiker or other clamps unless you want to have a blow-off accident and end up with a keg of beer on the floor!

If you choose to use a two-product chill plate, take a look at the supplied connectors. You'll want to use two



This tap needs to be inserted on the side of the fridge. Other styles must be mounted on top.

Use Oetiker clamps on all connections, like the flared fittings on this chill plate. This will prevent leaks.

CLEANING YOUR LINES

Included in the Homebrew Cleaning Kits from Five Star Chemicals is a nifty piece of advice — Eight Rules for Cleaning and Sanitizing — which we've excerpted.

- You can only sanitize equipment that is already clean.

- Dirty equipment will always contain bacteria.

- Sanitizers are not cleaners. Sanitizers are used only as the final procedure.

- Plus: More is not better, so dilute according to directions . . . more heat and longer contact time make better and easier cleaning . . . all surfaces must be directly soaked or hand-cleaned with cleaners and directly soaked with sanitizers.

These are rules, not advice. The single most controllable problem in brewing is sanitation. For first-cleaning of your lines and chill coil or chill plate, a five-minute soak with Five Star PBW (or your favorite cleaner) should be followed by a five-minute soak with Star San sanitizer.

Thereafter, repeat this procedure every two weeks. If you have a significant investment in taps or just a serious beer geek's love for having perfect beer on tap, Five Star has a Tap Cure Kit ($21.95) with everything necessary to clean even the nastiest beer lines and taps. You might choose to order their BLC (Beverage Line Cleaner), a one-step line and tap cleaner that's part of the kit.

For more information look under the Master Brewers section (new generation products) on the Web at www.fivestarchemicals.com.

wraps of Teflon sealing tape or food-grade pipe dope to plumb them in. Connect the fittings to the beer line and spigot. Ours came with flare fittings instead of barb fittings. Again, absolutely use clamps anyplace beer lines connect to the device.

The final phase is absolutely crucial. You have to clean the system. (See the "Cleaning Your Lines" sidebar for directions.) It is imperative that you clean your beer lines often, particularly when the beer in your keg is not refrigerated to 38° F (3.3° C). An infection in your tap will readily travel throughout the lines and coils and infect your keg. Or maybe you really wanted a tingly-tart Berliner Weisse IPA? I know it can happen; I was fortunate that my infected beer was a German-style wheat beer and the additional lemon flavor went well with Szechuan and Mexican food. ■

Thom Cannell writes the Projects column in each issue of BYO.

Ferment & Flavor

Alcohols, aldehydes, esters and sulfur compounds

by Steve Parkes

During fermentation, yeast cells degrade sugars into alcohol and carbon dioxide. However, other minor pathways are also active and yeast produce other compounds while a beer ferments. In the previous article in this series we discussed diacetyl. Now we will turn to other compounds and the often inter-related ways in which they are produced.

Higher alcohols are a very important beer flavor. They are essentially more complex forms of alcohol than the simple, neutral-flavored ethanol that accounts for most of the alcohol in beer. Ethanol is a two-carbon molecule whose formula is C_2H_5OH. Higher alcohols are simply alcohols with more carbon molecules. For example, propanol (C_3H_7OH) has three carbon molecules and butanol (C_4H_9OH) has four. (Higher alcohols also have more hydrogen molecules, as the hydrogens are attached to the "carbon skeleton" of the molecule.)

Higher alcohols are volatile and intensely flavored. At elevated levels, they may impart intensely fruity or solvent-like characters to beer. The balance between the levels of higher alcohols and esters is an important factor in determining the beer's drinkability. Higher alcohols are implicated as the cause of hangover headaches.

Organic acids are part of the background flavor of beer. Yeast require amino acids to build new proteins and enzymes within the cell. If we've done our job in wort production, and the maltsters did theirs in the malthouse, then there should be plenty of them available in the wort. However, some are more easily absorbed by yeast than others.

Yeast absorb most of the amino acids they need directly from the wort. They are also able to produce many of the amino acids needed for growth from other, more easily-absorbed amino acids, using transamination reactions. Yeast will remove the amino group from an amino acid and attach it to an organic acid already inside the cell, creating a new amino acid. This leaves the original amino acid without an amino group and now is an oxo-acid or a keto-acid. This molecule can be converted into an aldehyde by the loss of a CO_2 molecule, and then reduced to a higher alcohol. A particular amino acid will eventually produce a particular higher alcohol following transamination and reduction. The formation of higher alcohols reduces the potential toxicity of the oxo-acids and at the same time regenerates important cofactors needed for other reactions.

The presence of surplus of a particular amino acid in wort may inhibit the formation of the corresponding higher alcohol; likewise, a shortage of a particular amino acid in the wort will lead to over-production of its corresponding higher alcohol. Too many amino acids in the wort can lead to increases in higher alcohol production, as the yeast grows healthily. The faster yeast grow, the more rapid is the production of amino acids and the more oxo-acids — and hence higher alcohols — are produced.

Since some of the total oxo-acid contents within the cell are also derived from carbohydrate metabolism, some higher alcohol production is coming directly from carbohydrate metabolism. Around 80% of the higher alcohols are formed during primary fermentation, and — unlike vicinal diketones or aldehydes — they will not be removed during maturation.

Flavor-Active Fermentation By-Products

Name	Concentration (mg/L)	Flavor (threshold in mg/L)
Vicinal diketones		
2,3 butanedione (diacetyl)	0.06	butterscotch, butter (0.15)
2,3 pentanedione	0.01	honey (0.90)
Higher alcohols		
propanol	10-40	alcohol (600-800)
2 methyl propanol (isobutanol)	10-30	alcohol (180-200)
2 methyl butanol (active amyl alcohol)	5-15	alcohol, banana (40-130)
3 methyl butanol (iso amyl butanol)	40-50	alcohol, banana (40-130)
2 phenyl ethanol	30-40	rose, bitter, medicinal (10-80)
Aldehyde		
acetaldehyde	1-3	green apple (8-15)
Esters		
ethyl acetate	8-70	solvent-like (33)
3 methyl butyl acetate (isoamyl acetate)	0.4-6	banana (1.6)
ethyl hexanoate	*	apple (123)

Data from Lewis and Young, "Brewing" (1995, Chapman and Hall) and Fix, "Principles of Brewing Science" (1999, Brewer's Publications). Concentration values are representative values from commercially-produced beers. *Unknown

Factors Increasing HIGHER ALCOHOLS IN BEER

The production of higher alcohols is influenced by many variables that the brewer can control. Most of these variables are linked to yeast growth.

Higher fermentation temperatures encourage yeast growth, so if the temperature is increased then amino acid synthesis increases. More amino acids mean a larger pool of higher alcohol precursor molecules in the cell.

A vigorous fermentation with lots of bubble formation encourages movement and mixing in the fermenting wort. Good motion in the fermenter encourages yeast growth.

Intensive, early wort aeration encourages yeast growth. This is especially important when a large-scale brewer fills his fermenter with repeated wort additions. Several wort additions has the effect of extending the yeast's active growth phase since each addition of aerated wort adds new oxygen to the fermenter.

When amino acids are in short supply in the wort, then yeast will use the transamination reactions to produce its own amino acids. Worts with reduced levels of amino acids have a variety of causes, including the two below.

Higher wort gravities, above 13° P, encourage good growth even though the amount of amino acids in that wort may not be proportionally higher. So, more amino acid production may be needed in higher-gravity worts.

A very high proportion of non-malt adjuncts dilutes the amino acid content of the wort. Brewers using malted barley with high levels of protein (6-row) may use up to 50% adjunct in order to dilute the amino acid content of the wort. Belgian beers brewed with a lot of sugar in the kettle have a lot of higher alcohols, although this may be more directly related to the higher fermentation temperatures that are employed by brewers in Belgium.

Yeast will tend to grow until there are a certain density in the wort. If you pitch a lower number of yeast, then they will grow more to reach that level, increasing the higher alcohol level.

Factors Decreasing HIGHER ALCOHOLS IN BEER

Having top pressure on the early phase of fermentation decreases higher alcohol production. Carbon dioxide (CO_2) pressure early in the fermentation will inhibit the reactions that result in CO_2 production. The step that results in aldehyde production produces CO_2.

So, in summary, higher alcohol levels are important to beer flavor. Large breweries interested in limiting higher alcohols in their beers are skilled at manipulating wort qualities to control their production. Too few amino acids in wort will force yeast to manufacture rather than directly utilize amino acids, which in turn will result in an increase in higher alcohol production. Too many amino acids in the wort will also produce surplus higher alcohols. In general, all-malt beers made with relatively low-nitrogen barley will have sufficient amino acids to produce a well-balanced beer. High nitrogen barley malts require dilution with adjuncts to prevent excessive solvent-like character in the beer.

ALDEHYDES

Aldehydes are similar to ketones, but they contain a double-bonded oxygen on the outermost carbon in their structure. Complex aldehydes are found in beer from the pathways that lead to higher alcohols. However, the most common aldehyde in beer is acetaldehyde, an intermediate in the fermentation pathway.

Green beer flavors are simply the flavors associated with young beer. Acetaldehyde and diacetyl are considered green beer flavors because, as a beer ages in the presence of yeast, they disappear. Acetaldehyde is excreted by the cell in the first three days of fermentation and is considered a green beer flavor. Like diacetyl (and other vicinal diketones), acetaldehyde can be removed by healthy yeast during the maturation phase.

Acetaldehyde has a flavor threshold of around 15 ppm in beer. Acetaldehyde formation is generally favored by conditions of high metabolism coupled with low growth. It is "leaked" from the cell because yeast can only convert it to alcohol when sufficient amounts of a particular cofactor are present. This compound is sometimes limiting and acetaldehyde is excreted to keep the glycolytic pathway moving forward. Zinc appears to be a cofactor in the conversion of acetaldehyde to ethanol, so trace amounts of this metal are required for conversion. Carbon dioxide pressure can lead to toxic levels of the gas in yeast cells, which changes their permeability and affects their ability to convert acetaldehyde to ethanol. Early wort aeration will result in healthy, active yeast that are capable of converting acetaldehyde to ethanol.

LIPIDS AND ESTERS

Esters are the class of compounds responsible for fruity flavors and aromas in beer. Some beers taste like bananas, apples, strawberries or pineapple and esters are largely responsible for that. They are a major component of the flavor profile of ales rather than lagers, and I once read a technical journal that advocated using ester level as a way to differentiate between ales and lagers now that modern fermentation practices make the traditional definition somewhat obsolete. The traditional definition revolves around yeast strain and yeast reclamation, which in this day and age are similar. So, in ales esters are a desired characteristic, while lager brewers see them as a fault.

Lipids (particularly unsaturated fatty acids and sterols) are formed early in fermentation to provide material for membrane production. As the need for lipid production ends, the intermediates still being produced may be shunted off to form esters.

Esters are a combination of alcohols and fatty acids, the most common of which is ethyl acetate. Under fermentation conditions, the simple combination of alcohols and fatty acids will occur very slowly, if at all.

The reaction is catalyzed by CoEnzymeA, which will attach to the fatty acid and "activate" it. CoEnzymeA (sometimes shown as CoASH to denote an open sulfur group) carries small fatty acids around the cell, where they participate in important reactions. When attached to a fatty acid the complex is known as Acyl CoA.

During fermentation acetic acid forms the specific Acyl CoA known as Acetyl CoA, which is involved in many reactions. Since Acetyl CoA is the most common acid and ethanol is the most common alcohol, the most common ester produced during fermentation is ethyl acetate. This ester has a characteristic nail polish aroma. Beer contains around 60 different esters, but only a few are important to beer flavor and aroma. To understand the factors that affect ester formation, we must look at the compounds that are the key precursors in ester formation.

Acetyl CoA is required by the cell for the production of fatty acids, phospholipids and sterols, key components in cell membranes. As we have already seen, high yeast metabolism will lead to more higher alcohols, as by-products from the transamination of amino acids. High yeast metabolism, coupled with relatively slow growth (i.e. high-gravity worts) will also lead to an excess of Acetyl CoA. Since the yeast cell does not now have high requirements for fatty acids and phospholipids, this leads to a bottleneck in the pathway that results in AcetylCoA or Acyl CoAs combining with higher alcohols to form esters. It is important to note that proper aeration of the wort, especially several hours after the start of fermentation, will result in lower ester production as more of the AcetylCoA or Acyl CoA is diverted for the production of unsaturated fatty acids and sterols for new cell material.

So as long as lipids are being formed for membrane production, ester production is inhibited. So, esters generally develop later in the primary fermentation. It is advantageous for yeast to form esters since it provides a method of removing some toxic long-chain fatty acids from the cell. It also allows the cell to regenerate CoEnzyme A to catalyse other reactions. High-gravity brewing — brewing with worts of high gravities (often over 18° P) that then are diluted post-fermentation — causes an increase in ester production, which causes flavor problems with subsequent dilution. This is probably due to the decreased solubility of oxygen in stronger worts and hence proportionally less yeast growth. This can be helped by introducing more oxygen to the fermenting wort to encourage more yeast growth.

Factors Influencing ESTER FORMATION

The researchers and the literature are divided on the issue of ester formation and its relationship to temperature. Logically it would seem that increasing the fermentation temperature would increase the rate of yeast growth, and therefore decrease the availability of acetyl CoA for ester formation, but experiments have frequently shown that esters actually are increased at higher fermentation temperatures. One experiment showed that changing the temperature from 59°F (15° C) up to 77° F (25° C) increased the measured esters by 75%. There are several theories that attempt to explain this paradox.

Ester production is increased by increasing the gravity above 18° P, increasing the attenuation limit, restricting wort aeration, restricting yeast growth, increasing fermentation temperature and decreased motion during fermentation. Conversely, ester production is decreased by lower gravity, increased wort aeration, decreased attenuation limit, decreasing fermentation temperature, increased pressure during primary fermentation and underpitching.

SULFUR COMPOUNDS

Sulfur compounds are responsible for some of the most dramatic beer flavors. Some of the most aromatic aroma compounds have minute flavor thresholds and so, even though they are present in small quantities, can dramatically effect a beer's flavor.

Sulfur compounds have their origins in the ingredients we use. Sulfate, sulfite and sulfide ions in the water, and sulfur compounds present in malt and hops, can all lead to sulfur flavors in the beer. Some, such as the frequently encountered DMS, have their origins in the malthouse or the brewery. Others, such as the skunky 3-methyl-2-butene-thiol, are formed from the reaction between light and hop compounds in the package.

Of the compounds actually formed during fermentation there are two main compounds of interest.

Hydrogen sulfide (H_2S) is the aroma of rotten eggs. Its flavor threshold is only around 4–10 parts per billion but it may be found in beer at levels of 200 parts per billion. At low concentrations, it rounds out the flavor of pale lager beers but at higher concentrations is definitely an off flavor. Some yeast strains are prone to producing more H_2S than others, and lager brewers in Europe may base their choice of yeast strain on the amount of sulfur it produces. Growing yeast cells require sulfur for amino acid production, protein structure, and CoEnzymeA formation. Sulfate ions in wort are actively taken up by yeast and biochemically reduced to hydrogen sulfide. Once the need for those certain sulfur containing amino acids is met, the excess H_2S is excreted from the cell. If the wort is lacking any nutrient, that may affect yeast growth then sulfur may be produced in excess.

Luckily, H_2S is very volatile and is removed with evolving carbon dioxide during fermentation. Capping a fermentation vessel too early can trap H_2S in beer, and higher fermentation temperatures can increase the levels. Some commercial brewers experience problems when they increase batch size as they expand production. Taller tanks can cause a pressure differential at the tank base and increase sulfur production. Wort spoiling micro-organisms can also produce copious amounts of H_2S.

Sulfur dioxide (SO_2) is the drying, struck match flavor and aroma sometimes found in beer. It is rare that it should be detectable in American beers although it is more common in English beers. In the UK, commercial brewers add it to beers as a preservative. It is able to mop up excess oxygen in solution and that is the primary mechanism, but it can also react with, and bind to, compounds that may eventually create stale flavors.

Sulfur dioxide can combine with aldehydes in wort to form compounds that survive processing. This prevents the aldehyde oxidizing further to stale flavors. However, if this comes into contact with air during storage it can oxidize back to sulfate and the aldehyde, which in turn reacts with a higher alcohol to produce trans-2-nonenal, the compound responsible for the cardboard taste in stale beer.

Sulfur dioxide can also be liberated from yeast cells when the growth cycle goes awry. It can be added to beer inadvertently along with isinglass finings when these finings are used as a preservative.

Dimethyl sulfide (DMS) is a troublesome flavor in beer. It can vary in intensity from cooked corn to cooked vegetables, cabbage, onion, even garlic. In Pilsner lagers, it adds a fullness and roundness to the flavor, and some pale American pilsners benefit from a fresh corn-like aroma. It has its origins in malt and is removed from beer by aggressive and volatile wort boiling.

Wort spoiling bacteria can produce DMS should there be a delay in starting primary fermentation. Once it is in the wort, though, it cannot be removed by yeast. Some may be scrubbed out of the beer with escaping CO_2 during fermentation. DMS may be oxidized to the non-volatile DMSO during kilning of the malt and this can be reduced by yeast back to DMS in the fermenter.

Mercaptans are an extremely volatile class of compound with flavor thresholds measured in parts per trillion. They are often only detectable by the human senses, being below the sensitivity of some laboratory instruments. They are thio-alcohols, which is a compound similar to an alcohol but with an active sulfur group. They may resemble cabbage, stewed vegetables, drains and rotting vegetables, and are produced by yeast during the production of amino acids and also released into beer when yeast cells autolyze.

Sulfur compounds are an area of brewing chemistry in which a great deal of work still needs to be done. As they are so difficult to detect and measure it may be some time before we are more aware of the mechanisms of their formation. Luckily, experience has shown us how to deal with them. Their volatility enables us to remove them using purging with CO_2 gas. ■

Steve Parkes is the owner and lead instructor of the American Brewer's Guild. He writes about the science of brewing in every issue of BYO.

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Smoked CAP

...and a dead bird to go with it

by Drew Avis

The unlucky homebrewer, just before the cereal burns and the bird goes splat.

It was the best of times, it was the wort of times. Let this brew session cheer you up next time you think you're having a bad day. What follows are my brew notes.

"Thought it would be fun to finally brew a CAP (Classic American Pilsner). Was considering brewing a Classic Canadian Cream Ale (sometimes mistakenly called a CACA by Americans who forget who actually invented the cream ale), but had a fresh pack of Saflager 34/70 that I was eager to try out. The second beer of this two-beer batch was going to be a porter of some description, made with my handy Ringwood yeast.

"Woke up late. Still had to mill the grain. Checked the starter. It was DOA. Rats. At least I had some S-04 kicking around as a backup. First time doing a cereal mash. Mixed 2 pounds of milled grain and 3 pounds of cornmeal, added the water, put it on to cook while the main mash rested at 140° F. It was like porridge. I learned a lesson: If you don't stir the pot, that burnt, smoky smell is the corn porridge burning on the bottom. Rats. Stir stir stir. Maybe it will end up being a RauchCAP. Cool.

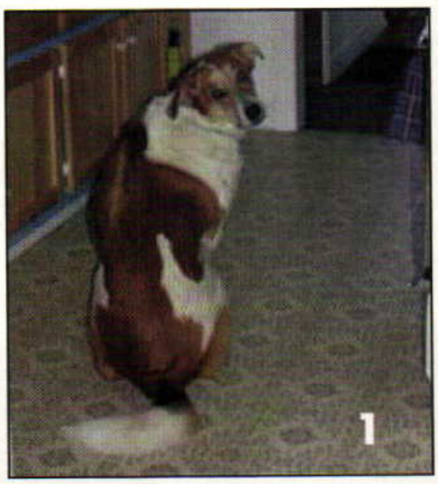
"Added the cereal mash to the main mash. Rest, do an iodine test. Not converted. Rats. Wait another 30 minutes. Still starch. Wait 60 minutes. Still starch. Screw it. Dump in a teaspoon of amalyse enzyme and start the recirculation. Stuck like a pig. Rats. Dump the mash into a bucket, clean the floating false bottom (I'm taking that thing on my next sailing trip instead of a life jacket), replace, put mash back in tun. Recirculation is *very* slow. Manage to clear the runnings, take the first few liters to boil down (trying to get a nice caramel flavor in the porter), start to collect the CAP. Go to the basement to mill the specialty grains for the porter. Hear large explosion from upstairs. Run upstairs expecting to see something bad. Large bird has hit the back window and shattered it. Unrelated to brewing, but still, rats.

"Start RauchCAP boiling, add specialty grains to mash for porter, recirculate, sparge. Boil. Treat CAP pot with a few drops of 'anti-foam' and it proceeds to boil over. Rats. Maybe it needs a few more drops? Add several drops to the porter. It then boils over. Rats. Wonder — did I get 'extra-foam' solution instead? Smoky CAP smell now disguised by smoky burnt malt smell. Chill, collecting chiller water in spare carboys to use in laundry. Start racking chilled wort to fermenter. Notice that I'm racking to uncleaned, unsterilized carboy instead of clean, sterilized carboy. Rats. Remember that spare carboy has been stored uncovered next to cat box in the basement these many months. Swear uncontrollably. She-who-must-be-obeyed suggests I take up meditation instead of brewing. I suggest she take her suggestion and do something unspeakable with it. Relationship teeters on edge of abyss until I suggest she walk the dog and promise kitchen will be sparkling clean when I'm done.

"At least the worts tasted OK. The CAP was not as burnt as I expected. Pitch yeasts. Embark on epic kitchen cleanup with extreme mopping session. Come back from bathroom to discover dog standing in the middle of wet floor. The next morning everything is bubbling, including the DOA starter.

"A few weeks later, the Bird Splat Porter is on tap and tastes great, and when I racked the Kitty RauchCAP to the secondary, it tasted fine as well. But isn't this hobby supposed to be relaxing and fun?" ■

A version of this disturbing diatribe originally appeared on the Web in the HomeBrew Digest.



1) Unsanitized dog in the middle of my clean kitchen. 2) My foam mess in all its glory. Good thing you can't smell a photo. 3) You'd think the birds would eventually learn the mechanics of a window (or at least pay for repairs).

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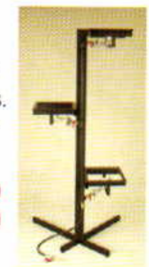
Starting at $400.00

Coffee Roasting Starter Kits
Roast your own fresh coffee at home. Starter Kits ranging from $99.99 to $399.99 (shown). Green beans as low as $3.85/lb. Makes a great gift.

Tap-A-Draft Starter Kit
$59.95

All-Grain Brew Stands
Stands for creating all-grain systems. Comes with three, high-output burners running off one regulator.

New
5 gallon $565.00
10 gallon $595.00



Filtering Kits
Regular $39.00
Stainless Deluxe $65.00
Extra Filters $3.95

Stainless Drip Trays
6" wide $29.50
13" wide $49.00
13" w/backsplash $69.00 (pictured)

Customizable Brew Sculptures
5,10, and 20 gallon sizes with tons of options available.

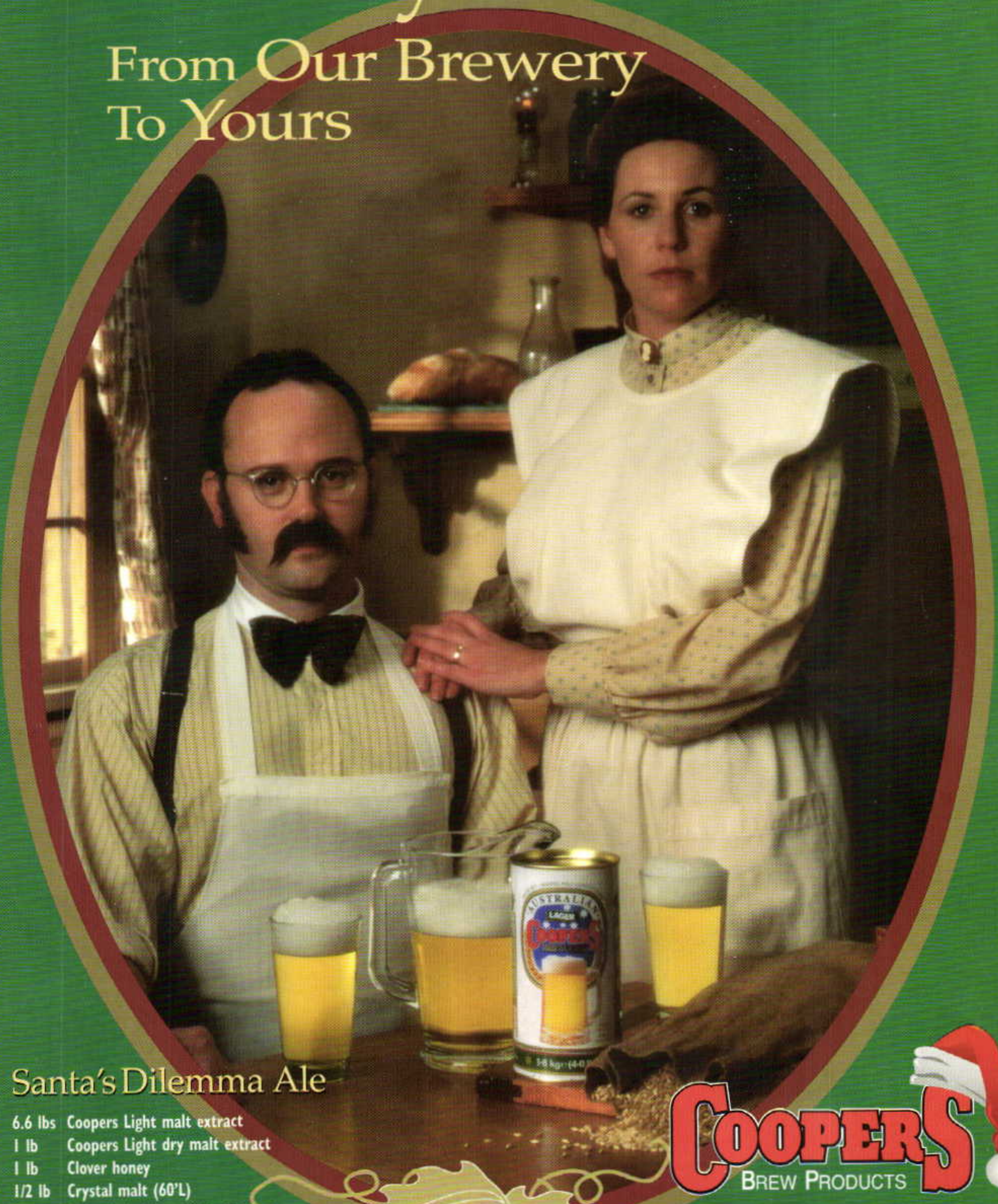
Starting at $895.00

Hats and T-Shirts
Many styles of hats and T's are available online at www.morebeer.com.

Hats $12 and up
T-Shirts $9 and up

Holiday CHEER

From Our Brewery To Yours



Santa's Dilemma Ale

6.6 lbs	Coopers Light malt extract
1 lb	Coopers Light dry malt extract
1 lb	Clover honey
1/2 lb	Crystal malt (60°L)
2 oz	Cascade leaf hops (45 min.)
1 oz	Mt. Hood leaf hops (2 min.)
4 inch	Cinnamon stick (10 min.)
1/2 oz	Ginger root, dried (10 min.)
1 oz	Curacao orange peel (10 min.)
	Coopers Ale Yeast (10 grams) or White Labs California Ale Yeast

Original Gravity — 1.064

COOPERS BREW PRODUCTS

CASCADIA IMPORTERS

www.cascadiabrew.com