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JANUARY-FEBRUARY 2003, VOL.9, NO.1

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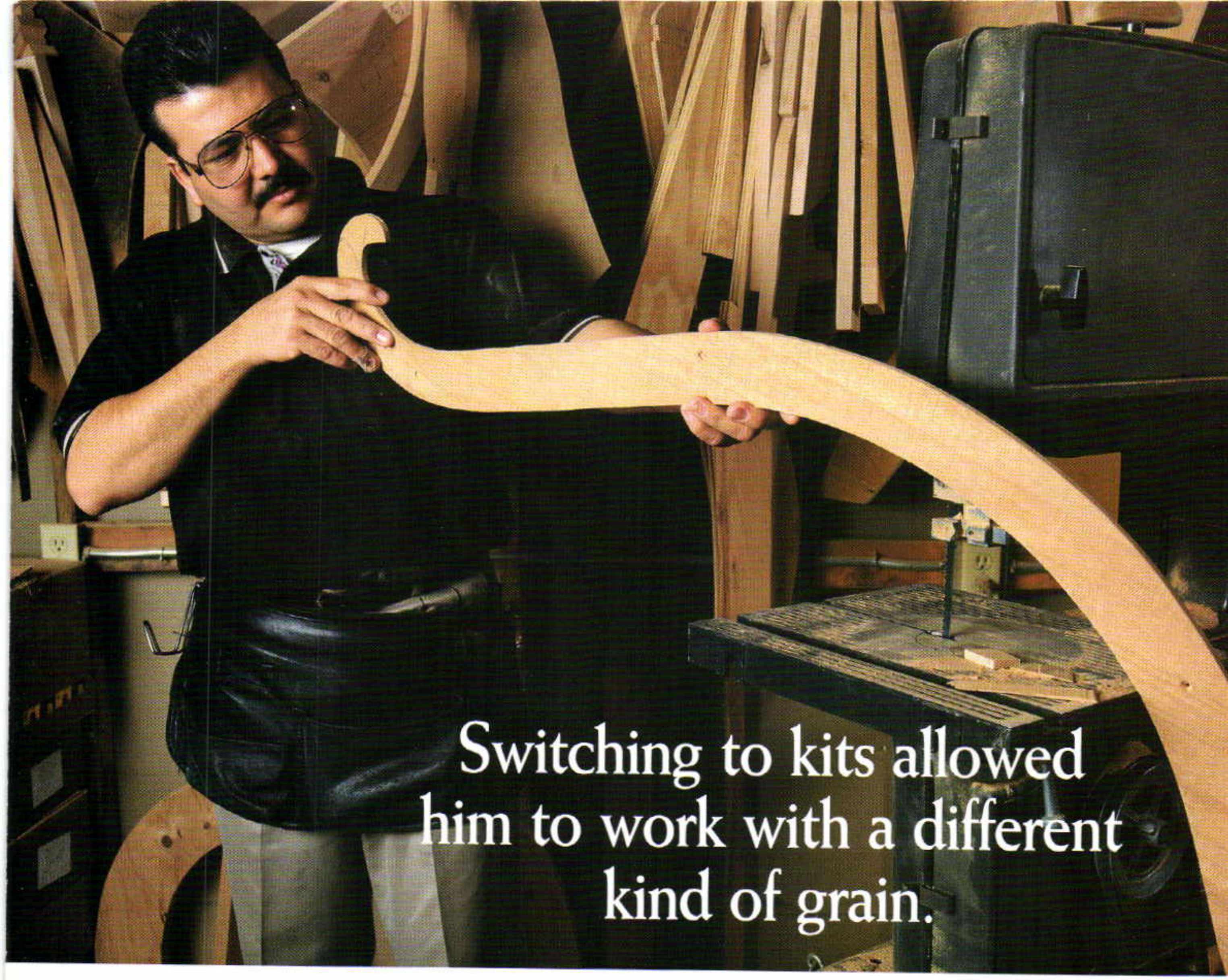

"I wouldn't have believed that a kit beer could be so good"

Roy Bailey - Beer Correspondent
CAMRA's 'What's Brewing' magazine (April 2000)

"It tasted just as good - if not better - than many a pint I've drunk in London pubs."

Richard Neill
'Weekend Telegraph' (April 99)

"It resulted in as good a home-made beer as I have ever tasted"

Maximum 5-point rating in kit review
'Bizarre' magazine (September 99)

This man loves beer and brewing. He's also discovered a talent for crafting fine furniture.

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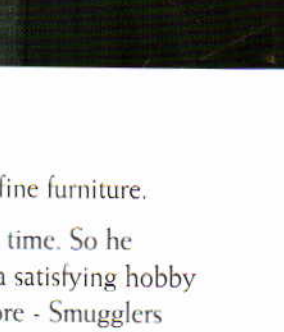

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JANUARY-FEBRUARY 2003
Volume 9 Number 1

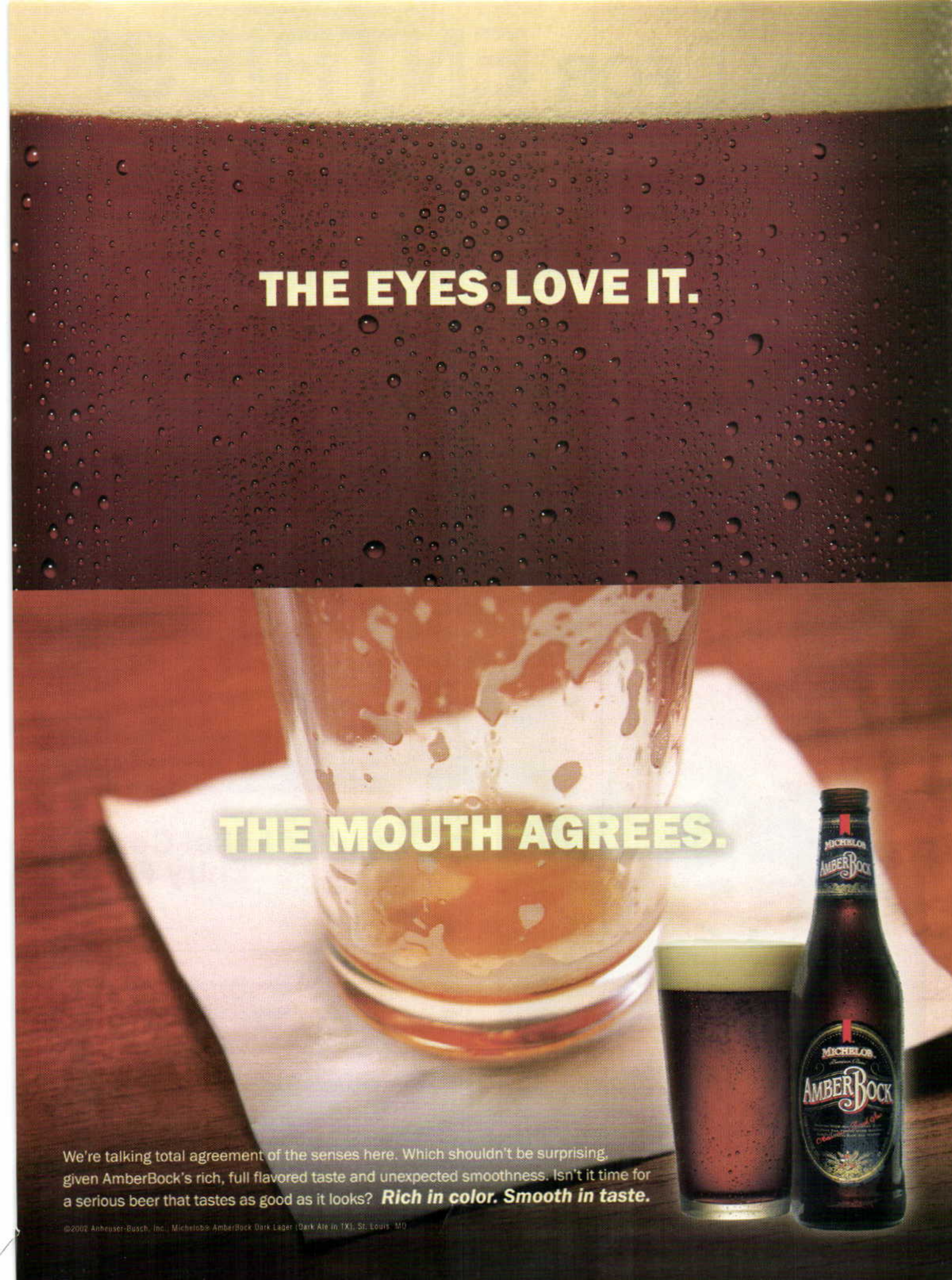
Departments

COVER photography: **Charles A. Parker**

Brew Your Own

Features

Where to find it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CALL FOR ENTRIES!

Brew Your Own's 8th Annual Homebrew Label Contest

Send us your best homebrew labels and you could win some great brewing prizes from BYO advertisers! Enter as often as you like, but you can only win one prize. Winners will see their artwork featured in the July-August issue of the magazine. Deadline to enter is April 15, 2003.

WIN GREAT HOMEBREW PRIZES!

Rules: Entrants can send labels or labels already stuck to bottles. The bottles can be full of beer. No digital or electronic files will be accepted. All other rules are made up by the editors of *BYO* as we go along. Labels are judged in one category, open to graphic artists and amateurs alike, so ultimate bragging rights are on the line. When submitting your labels, tell us a bit about the artwork and its inspiration. Is it hand-drawn? Created on a computer? Send us your best labels, tell us how you made them, and good luck!

Brew Your Own — THE HOW-TO HOMEBREW BEER MAGAZINE

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Manchester Center, VT 05255

DEADLINE: April 15, 2003

Brew Your Own
THE HOW-TO HOMEBREW BEER MAGAZINE

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Fax: (760) 738-4805

Special Subscription Offer
8 issues for $24.95

Web Site
www.byo.com

Brew Your Own (ISSN 1081-826X) is published monthly except February, April, June and August for $24.95 per year by Battenkill Communications, 5053 Main Street, Suite A, Manchester Center, VT 05255; tel: (802) 362-3981; fax: (802) 362-2377; e-mail: BYO@byo.com. Periodicals postage rate paid at Manchester Center, VT and additional mailing offices. Canada Post International Publications Mail Product Sales Agreement No. 1250469. Canadian Mail Distributor information: Express Messenger International, P.O. Box 25058, London BC, Ontario, Canada N6C6A8. POSTMASTER: Send address changes to *Brew Your Own*, P.O. Box 469121, Escondido, CA 92046-9121. Customer Service: For subscription orders call 1-800-900-7594. For subscription inquiries or address changes, write *Brew Your Own*, P.O. Box 469121, Escondido, CA 92046-9121. Tel: (800) 900-7594. Fax: (760) 738-4805. Foreign and Canadian orders must be payable in U.S. dollars plus postage. The subscription rate to Canada and Mexico is $30; for all other countries the subscription rate is $40.

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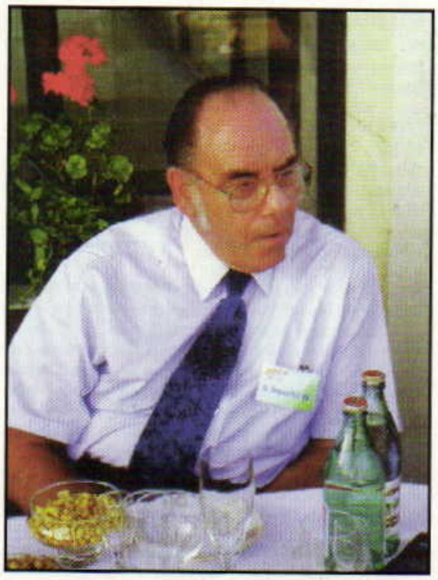
Contributors

tom miller

Tom Miller started homebrewing in 1989 after spending a year in Salzburg, Austria. Over the past decade, Tom has worked in the malting cellars at Augustiner Braeu in Munich and spent time as an assistant brewmaster for the Snake River Brewing Company in Jackson Hole, Wyoming. He lives near Buffalo and writes "Tips from the Pros" in every issue of BYO.

mark garetz

Mark Garetz lives in Danville, California and is the executive vice president of a marketing firm. In 1993, he founded HopTech as a supplier of high-grade hops, and a year later he expanded the company to include a full line of homebrewing equipment. In 1996, he founded the award-winning HopTown Brewing Company. He has since sold both businesses but they continue to thrive. Mark serves on the BYO editorial-review board.



terry foster

Terry Foster was born and educated in London. He holds a doctorate in chemistry and has been brewing for more than forty years. Terry wrote "Pale Ale" and "Porter" for the Classic Beer Style series of books, as well as "Dr. Foster's Book of Beer," which was published in 1978. He divides his time between Connecticut and the United Kingdom and keeps himself busy by homebrewing, helping at a New Haven brewpub and playing tennis. His authoritative article on porter, the classic British beer style, starts on page 30.

SIP with the CIP?

I have a question about the clean-in-place (CIP) device for fermenters and kegs that you recently featured *(Projects, October 2002)*. Besides washing my carboys and kegs, could I also use the CIP to sanitize them? I typically use an iodophor solution.

Alex Rengers
Long Grove, Illinois

Projects author Thom Cannell says: "Definitely! I just used my fermenter washer to clean a couple of kegs with PBW (a cleaner), then followed up with Star-San (a sanitizer). There's no reason you couldn't pump iodophor for its required contact time — about five minutes — in a no-rinse concentration. I also used the fermenter washer in place of the bottle washer ('Spritz It' in the May-June 2002 issue of BYO) to sanitize some special bottles meant to hold an Imperial stout (11% ABV). I just love this thing!

"We also used the washer to sanitize most of the fermenters in the 200-gallon batch brewed by four homebrew clubs that we documented in 'Fire-Brew' (November 2002). It worked just magnificently. By the way, we discovered that a cheap drill-powered pump puts out more solution than a fancy $120 magnetic pump."

Skim the Scum?

I have been homebrewing for about four years now. I started with extract and have since moved on to all-grain brewing. When my brewing partner and I started with all-grain, we were told that you need to scrape off the brown foam that forms just before the boil starts. However, we were never told why. I was wondering what this foam is made of and why it needs to be removed from the kettle.

Gary Tesdall
Costa Mesa, California

The brown scum that rises to the top of the kettle early in the boil is mostly proteins mixed with some tannins. It will eventually fall into the kettle if not skimmed. Most commericial breweries do not remove it, but some homebrewers prefer to skim it. You can make great beer either way.

There is another kind of brown scum, though. Braunhefe ("the other brown scum") is the stuff that rises to the top of a fermentation early on. This material is skimmed or blown off by many commercial breweries, especially when they are brewing beers with a delicate flavor.

Cleaning a Copper Coil

I was wondering if you could help me with a question I had about cleaning copper. My father-in-law is a bit of a pack-rat and has an old refrigeration unit from the 1960s. The compressor has failed and the refrigerant has leaked out. It has an amazing copper coil and fin "radiator" that I was thinking about using as a heat exchanger. I suspect that it may still contain oil or grease residue from the compressor and perhaps some refrigerant. Is this something that can be safely cleaned? I think I can hook up a pump to flush a cleaning solution through it. If that is an acceptable option, what cleaning solution would you recommend?

Jared Spice
Brampton, Ontario

Mail

Projects author Thom Cannell says: "I don't consider myself an expert — but I find experts and ask lots of questions. Here's the consensus:

"Your refrigerator coil may be salvageable, but I would be very suspect. The coil had both coolant and a special lubricating oil running in it for years and they have soaked into every pore of the metal. They will resist removal, as you predicted, and the aggressive cleaners that would remove these substances will very likely corrode the metal. Also, I would suspect assembly with lead-bearing solders. Finally, heaven only knows the purity of the copper tubing. Remember that, because of metal poisoning, moonshiners often went blind. As gadget-oriented and penny-pinching as I am, I'd try to find another use for this device."

Lobster Lament

My brew kettle smells like lobster water! Some friends of ours received live lobsters in the mail as a gift. They

did not want them — so my wife, who knows how much I love lobster, took the little buggers and cooked them as a surprise dinner. The bigger surprise was finding out that my 15-gallon aluminum brew kettle was used to boil the four lobsters. It was apparently the only pot big enough to hold them. I have soaked the kettle in oxygen cleaner and even boiled distilled vinegar (at a ratio of 1:3) in the kettle for over two hours to remove the smell. The stench is much less but I am worried that it may cause me to create a lobster beer next time I brew. What can be done to correct my kettle?

Michael Wolf
Huntley, Illinois

Unfortunately, you already have tried all of the best options. You could clean the kettle with caustic (a sodium hydroxide solution), but this would pit the metal. So get cracking on your first batch of Crustacean Ale ... and we hope the lobsters were very, very good.

Recipe Question

I was confused by the recipes (Pumpkin Patch Ale and Smoked Maple Porter) in the "Homebrew Nation" section *(November BYO)*. Is the pumpkin ale an all-grain recipe or an extract recipe? Why is maple syrup listed twice in the maple porter?

Brian Miller
Omaha, Nebraska

We misidentified the pumpkin ale as an all-grain recipe. It is really an extract recipe. Replace the "pale malt" with "pale malt extract" and follow the instructions. Maple syrup is listed twice in the porter recipe because the beer has two additions, one in the boil and one at bottling (along with DME). Sorry for the confusion. ■

homebrewer PROFILE

Rick Norton • Lee's Summit, Missouri

PHOTOS COURTESY OF RICK NORTON

Rick Norton, second from the left, with some fellow pub hoppers in Belgium.

In 1990 I started traveling in Europe on business. While abroad, I'd sample the classic European beer styles, only to become frustrated by the lack of good beer back home.

My world changed in 1992 when I read a newspaper article about a local group of homebrewers. I immediately ran out, bought a starter kit and brewed an English bitter. The end result was less than stellar, but I began to plan my next batch anyway. It then occurred to me that I should seek professional help ... from Uncle Bob.

Brewing has been a family tradition for three generations. My grandfather, Stephan Werkovich, immigrated to the U.S. from Austria in 1904, supposedly as a stowaway on a merchant ship. He settled in Kansas City and worked as Muehlebach's cellar master both before and after Prohibition. In 1938 his son Robert (my Uncle Bob) began working there, too. Bob went on to graduate from the U.S. Brewer's Academy in New York in 1947. After leaving Muehlebach in the early 1950s, he became head brewmaster at Hamm's. Bob retired in 1972, but in 1989 he offered his services as an advisor to Boulevard Brewing Co. in Kansas City during its first years of operation. Boulevard is now one of the fastest-growing breweries in the country and brews "Bob's 47" in honor of my uncle.

When I called on him for help, Bob lectured me on a number of topics and shared his experiences as a master brewer. He told me there once was a time when he could identify the age of a beer within a week of its creation. Unbelievable! Bob pulled no punches in his critiques. I think the best comment I ever got was, "Well, Rick, this beer don't suck too bad."

Bob passed away in 1996. That's about the same time I learned that a new homebrew club (ZZ Hops) was forming in my area. A few years ago I treated the club to beer from the smallest of the six remaining Trappist breweries: Westvleteren. I bought a case from the abbey in West Flanders and nearly got a hernia lugging it home.

My beers rotate between English bitters, American pales and browns, and an occasional Belgian tripel. Last year I designed my bar to include beer taps on the wall. Life is good!

Norton's grandfather is seated front right and his uncle is right behind him.

Uncle Bob talks beer with John McDonald of Boulevard Brewing.

reader RECIPE

RICK NORTON'S BELGIAN TRIPEL

5 gallons (19 L), all-grain
OG = 1.089 FG = 1.018 IBUs = 23

This beer won first place in the Strong Belgian Ale category at the 2000 homebrew competition sponsored by the Kansas City Bier Meisters.

Ingredients

11 lbs. (5 kg) Belgian Pilsner malt
1 lb. (0.45 kg) wheat malt
2 lbs. (0.9 kg) Belgian Munich
1 lb. (0.45 kg) Belgian CaraVienne
1 lb. (0.45 kg) flaked corn
1.5 lbs. (0.7 kg) Belgian candi sugar
1 oz. (28 g) Saaz (3.5% AA)
0.5 oz. (14 g) Tettnanger (4.5% AA)
1 oz. (28 g) Hallertauer Mittelfruh (3.4% AA)
0.5 oz. (14 g) Saaz (3.5% AAU)
0.5 oz. (14 g) Tettnanger (4.5% AAU)
1 tsp. Irish moss
1 quart (950 mL) starter Trappist Ale yeast (WLP500)

Step Mash:

121 °F (50 °C) for 30 minutes
135 °F (57 °C) for 20 minutes
155 °F (68 °C) for 80 minutes

Sparge with 4 gal. (15 L) of 168 °F (76 °C) water to get 6 gal. (23 L) of wort. Bring to a boil. Add 1 oz. (28 g) of Saaz hops after 15 minutes. Add 0.5 oz. (14 g) Tettnanger after 30 minutes. Add 1.5 lbs (0.68 kg) of candi sugar after 30 minutes. Add 1 oz. (28 g) of Hallertauer Mittelfruh after 60 minutes. Add 0.5 oz. (14 g) of Saaz and 0.5 oz. (14 g) of Tettnanger after 75 minutes along with Irish moss.

Cool wort to 70-75 °F (21-24 °C), aerate and add yeast. Ferment at 71 °F (22 °C). Transfer to secondary fermenter after one week and hold until fermentation is complete. Bottle and condition for at least two weeks.

homebrew IDEA

A box to warm your beer

Nils Hedglin • Sacramento, California

PHOTOS BY NILS HEDGLIN

The finished box holds a carboy and two cases of conditioning bottles.

Last winter, I found myself craving a stout, but my garage and basement were too cold and my house was too warm for ale fermentation, which is recommended at 60–75 °F (15–24 °C). So I built an insulated box with a heat source regulated by a thermostat. I wanted to be able to disassemble the box for storage, so I used door hinges to hold the sides and top together.

Start by cutting out the box sides. You need a front and back of 33.5 x 33 inches, two sides of 33.5 x 19 inches, and a top and bottom of 34.5 x 20.5 inches. (In metric, the front and back would measure roughly 85 x 84 cm, the sides would be 85 x 48 cm and the top and bottom would be 88 x 52 cm.) Most home-improvement stores will cut the pieces for you if you ask.

Next, attach the door hinges to the outside of the box. Mark the edge of the box side about one-third of the way in from top and bottom. This is where you will center the hinge. I found it easier to attach the hinges if I took them apart first. Make sure the part with the pin is facing the outside of the box when you screw it on. Attach two hinge halves on one end of a side using the drywall screws. Then overlap that side with the next side *(see the diagram at right)* and mark on the new side where the existing hinges are.

When marking the adjoining side, remember that the side edges will be overlapping and allow for this by marking the second halves of the hinges so they extend 1.5 inches (3.8 cm) from the edge. Continue around the box, attaching the hinges to the edges, then attach the last two hinges to the back and top of the box for the lid. On the bottom piece, place two angle brackets on each side near the corners. These will help align the box walls during assembly.

Now that the box is built, measure the actual interior dimensions and cut the insulation to fit. It will overlap just like the sides. A serrated bread knife worked well for cutting the insulation.

As for the wiring, a caution: If you're not an expert, hire an electrician! The thermostat is wired into a relay, which is required to take the low-voltage thermostat signal and switch it to high-voltage for the light bulb. A Wall-Pac transformer, which converts household wall-outlet power to low-voltage direct current, was used to supply power to the low-voltage thermostat and trigger the relay. When the temperature drops low enough the thermostat triggers the relay. I used a light bulb in a wall-mount outlet for the heat source. This was then mounted on a small board so I can place the light wherever I need it. Once the wiring is done, mount the thermostat on the box wall in an accessible spot. *(For wiring details, see diagram at right.)*

I was able to keep a carboy of ale bubbling and two cases of bottles conditioning at the proper temperature in this box. Next time I use the warming box I plan to add some small fans to circulate the air and better distribute the heat. Since each side may vary slightly, mark each wall of the box with its location so you can put it together the same way next time.

PARTS LIST

One particle board at 5/8"x4'x8' (4 cm x 1.2 m x 2.4 m); one sheet of polystyrene insulation at 5/8"x4'x8' (4 cm x 1.2 m x 2.4 m); box of drywall screws; thermostat; 10 hinges; 8 angle brackets; light-bulb socket; Radio Shack DPDT or SPST relay; Wall-Pac transformer.

homebrew calendar

January 9-February 27
Frederick, Maryland
Homebrewing Classes

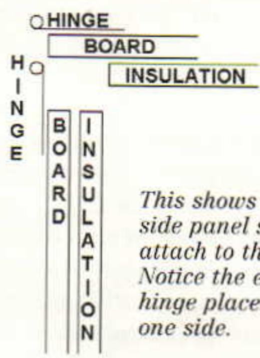
For eight consecutive Thursdays this class meets at the Flying Barrel. Cost: $165. Call (301) 696-2936.

January 24 & February 1
Coral Gables, Florida
The Coconut Cup

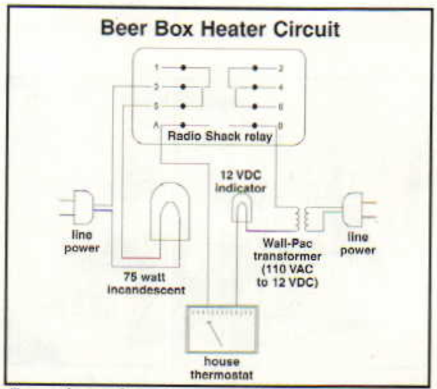
This contest has special awards for "best beer using coconut." Entries due on Jan. 24; awards on Feb. 1. Contact Jacob Miller at (305) 446-6692 or jakem1@is.netcom.com.

February 28 & March 21-22
Irving, Texas
Bluebonnet Brew-Off

Bluebonnet is sponsored by five Texas homebrew clubs and Dr. Chris White of White Labs is the keynote speaker. Deadline is Feb. 28th with the event in March. Contact Mark Wedge at (817) 938-8400 or markwedge@yahoo.com. See www.bluebonnetbrewoff.com.



This shows how each side panel should attach to the next. Notice the extended hinge placement on one side.



Complete the circuit with this detailed diagram of the wiring design.

replicator MILLENIUM ALE

Dear Replicator,

Is it possible to get the recipe for Millennium Ale from BJ's Pizza and Beer in Woodland Hills, California? They originally brewed this beer for the New Year's 2000 celebration and it was the reason I took up homebrewing.

Craig Shapland
Agoura Hills, California

Many brewpubs and micros made special high-gravity beers for Y2K. BJ's chose to make a tripel, a high-alcohol Belgian beer that is moderately fruity, with a spicy finish and high carbonation. Belgian candi sugar gives it a lighter body than the usual high-alcohol beer.

David Mathis, the head brewer at BJ's and the creator of this recipe, shared some tips and techniques with me. For fermentable sugars he suggests using just one malt, a European (preferably Belgian) two-row pale. Candi sugar and honey boosted the fermentables. For hops, Mathis picked European Hallertau Hersbrucker to get the low bitterness that's typical of a tripel. Three spices — bitter orange peel, coriander and ginger root — that are often used in Belgian beers for both aroma and flavor finished off the beer. When using spices, it is normal to not have any aroma hops.

This beer has a fairly high alcohol level (9% alcohol by volume), but the alcohol profile is relatively muted. BJ's conditioned it for a month to mature the flavors. I would suggest aerating heavily to give the yeast enough oxygen to ferment all of the sugars.

You can get more information about BJ's Pizza and Brewery at www.bjsbrewhouse.com or by calling them at (818) 340-1748.

BJ's Millennium Ale

5 gallon (19 L), extract with grains
OG: 1.090 FG: 1.02
IBU: 24-26 ABV: 9.1

Ingredients

7.75 lbs. (3.5 kg) Muntons light dry malt extract
2 lbs. (0.9 kg) honey (orange blossom)
1 lb. (0.45 kg) light Belgian candi sugar
8 AAU Hallertau Hersbrucker hops (bittering) (2 oz./56 g of 4% alpha acid)
1 oz. (28 g) bitter orange peel (Curacao)
1 oz. (28 g) ginger root
0.5 oz. (14 g) coriander seed (crushed)
1 tsp. Irish moss
White Labs WLP500 (Trappist Ale) or Wyeast 3787 (Trappist Ale) yeast
0.75 cup of corn sugar (for priming)

Step by step: Bring 3 gal. (11.4 L) of water to a boil. Remove from heat. Add extract, honey and candi sugar and return to boil. Add hops and Irish moss and boil 60 min. Add spices for the last 10 min. of the boil. Add wort to 2 gal. (7.6 L) of cool water in a fermenter and top off with cool water to 5.5 gal. (20.9 L). Cool the wort to 80 °F (26.7 °C), heavily aerate and pitch yeast. Allow the beer to cool to 68-70 °F (20-21 °C), and hold at this temperature until the yeast has completely fermented. Bottle and age for a month.

All-grain option: Replace the light powder with 11.75 lbs. (5.3 kg) Belgian pale malt. Mash grain at 154 °F (67.8 °C) for 60 min. Collect enough wort to boil for 90 min. and have a 5.5 gal. (20.9 L) yield, accounting for the 2 lbs. (0.9 kg) of honey in liquid form. Lower the amount of the boiling hops to 1.75 oz. (49 g) to account for higher extraction ratio of a full boil. The remainder of the recipe is the same as the extract.

homebrew basics

BEER COLOR

Beers vary in color from pale, straw-colored Pilsners to jet-black stouts, with a spectrum of yellows, reds and browns in between. In most beers, the color is derived primarily from malt. Malt color mostly comes from melanoidins produced when the malt is kilned (heated and dried during the malting process). Melanoidins are molecules formed from chemical reactions between sugars and amino acids. These molecules dissolve into the mash water and are run off with the wort.

Wort color is modified during several steps in the brewing process. For example, boiling can darken the wort by forming more melanoidins. This darkening can be pronounced in extract beers when the brewer boils less than the full wort volume. In contrast, fermentation lightens a beer. Fining or filtration can also remove color. And, of course, other ingredients — including fruits or spices — may alter beer color.

Malt color is measured in degrees Lovibond. The lightest malts, such as Pilsner malts, may have a color rating around 1.5 °L, while pale and pale ale malts are usually rated from 2–3 °L. Crystal malts, which are commonly used to add reddish color to beer, are rated from 20–120 °L. A few popular dark malts include chocolate malt (usually rated around 325 °L) and black patent malt (rated around 525 °L).

Beer color is usually measured in SRM units. SRM stands for Standard Reference Method and is the most commonly used measure in the United States. Very light beers, such as American lagers, weigh in at 2–5 SRM. Most pale ales fall in the range of 6–14 SRM. Brown ales, although they cover a huge range, are most commonly rated between 17 and 24 SRM. Stouts measure 35 SRM or higher.

homebrew SYSTEMS that make you DROOL

Deer Island Brewery • Alan Johnson • Deer Island, Oregon

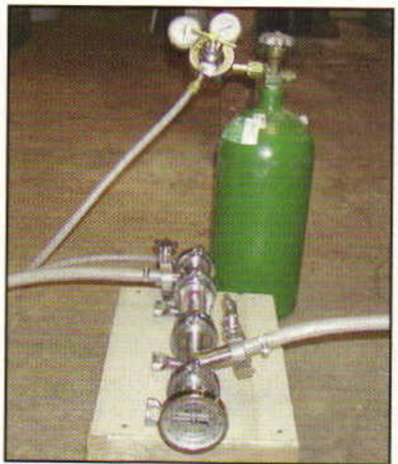
The Deer Island homebrewery has been a work-in-progress for about three years. With the help of his wife, Paula, Alan Johnson began cleaning out their old barn about nine months ago to make room for their growing collection of gear. The barn already had a water faucet and a small hot-water heater when they started. Alan then built a platform, installed a sink, plumbed water lines and put up cabinets for storage. The next phase of this project was the fermentation and storage room, which he keeps at 68 °F — perfect for ale fermenation.

Some of Alan's other projects include a table and motor for his grain mill, an impressive HERMS (Heat Exchange Recirculating Mash System), a hopback, and his most recent gizmo — a hop dryer for the hops they grow. The Johnsons, who are both "hardcore hopheads," have two dozen hops plants in their garden. They always add plenty of flavor and aroma hops to the pale ales and IPAs they like to brew.

Currently the Johnsons brew 10- and 15-gallon batches of beer using converted kegs on a two-tier system. They use a wort pump and the HERMS for reaching mash-off temperature. Their system is also nice for step mashes. Alan recently added a 27-gallon conical fermenter to his brewery. To learn more, check out his Website at http://www.ados.com/~bdk/DIBpic.html.

Alan's fermentation room holds beer and ingredients at a steady 68 °F.

A hopback uses leaf hops to filter the wort and adds a wonderful aroma.



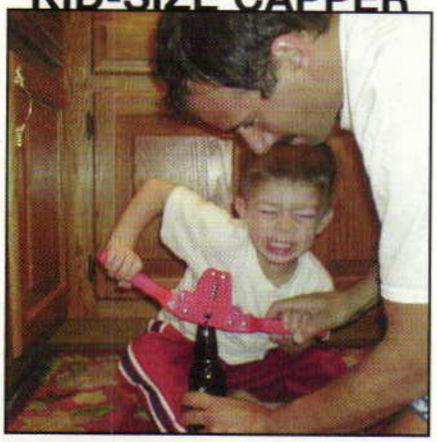
Alan's stainless-steel aerator injects oxygen into the wort at 3 psi.

Alan toasts his cool homebrewery with a pint of his own beer. It's made with the hops that he and his wife grow in their Oregon garden.

The Deer Island Brewery is a HERMS setup made from kegs.

Hey, if you're not busy later, wanna check out my fermentation room?

KID-SIZE CAPPER



Antonio Balducci, three years old in this photo, looks like he needs a little help from his father, David. The Balducci boys are capping a partial-mash batch of Bell's Best Brown Ale made from a *Brew Your Own* "Replicator" recipe (September 2002). David, who lives in Mechanicsville, Virginia, has been brewing "daddy juice" for five years using the partial-mash method. Antonio and his twin sister, Gianna, like to lend a hand.

SEND YOUR STUFF!

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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.

Secrets of Stout

Hints for mastering the smooth Irish brew

by Thomas J. Miller

Rich in flavor and black in color, stout is a far more delicate and demanding beer than the average homebrewer might think. The first key: Designing a well-balanced recipe, whether you use grains or extract. This month's pros share their thoughts and a favorite recipe.

Brewer: Sean Navish works at the Portsmouth Brewery in Portsmouth, New Hampshire. He has been brewing there for eight years. He also brewed at the Frank Jones Ale Brewery when they were in business during the early 1990s. Most of his brewing education has come as a homebrewer and during on-the-job training in commercial breweries.

My favorite beer style is oatmeal stout. Adding oatmeal to a stout lends a nice, velvety mouthfeel (mainly from the oatmeal's oils and proteins). This helps round out the aggressive roastiness and acidity of the dark grains.

Because stout is a darker beer, there is a risk of overusing the dark grains, such as roasted barley, chocolate malt and black patent malt (all the typical stout malts). When you calculate color into the recipe, it seems that you could use an infinite amount of these dark grains. But overuse of the darker grains can cause an astringent, acidic or burnt flavor in the stout. The darker grains should be less than 20 percent of the total grist.

I believe the defining character of stout comes through the use of roasted barley. If you want to add more complexity to the stout, you can use other dark grains. Caramel or crystal malt adds some sweetness. Black malt gives a "bite" to the stout. Chocolate malt adds color with a less-aggressive flavor. Caramalt or dextrin malt add sweetness and body because they are less fermentable than other malts.

The darker roasted grains are drier than pale malts, so they tend to shatter into smaller pieces in the milling process. You can get around this problem by milling the darker grains separately, with the gap on the mill set a bit looser. It also helps to evenly distribute the dark grains (and any flaked or rolled grains like oatmeal) in the mash. Mixing up the grist (or layering it) before wetting the grains is one way to achieve this.

Hops add a more floral or spicy type of bitterness, which makes the stout more complex. Any hop variety can be used to make stout, but the higher-alpha varieties seem to be detectable through the roasted grains more than the lower-alpha varieties, even when the same amount of IBUs are added. I like to use Chinook, Centennial or Galena hops (all rated around 9–15 percent alpha acids).

I prefer to use a traditional stout yeast like White Labs WLP004 (Irish Ale) or Wyeast 1084 (Irish Ale) yeast. They ferment cleanly, so the flavors of the malts don't get dulled. But, any English ale yeast is acceptable as long as it doesn't produce excessive amounts of diacetyl.

There are a few things to do to get a more full-bodied mouthfeel in your stout. The best way is to build the mouthfeel in the mashing process — mash at a higher temperature (155–160 °F) or use caramalt or dextrin malts at 8–10 percent of the grist.

For draft stout, definitely use a nitrogen and CO_2 mix (around 75 percent N_2 to 25 percent CO_2). A mixed-gas blend adds a lot to the finished stout — a creamy thick head, the cascading effect during pouring and the lower amount of carbonation allows the full flavors of the stout to be displayed. Also, mixed gas lets you drink more stout without feeling bloated!

Navish's Oatmeal Stout

(5 gallons/19 L, all-grain)

OG: 1.065 FG: 1.025
IBUs: about 50 SRM: 35

Ingredients

8 lbs. (4.1 kg) pale malt
1.0 lbs. (0.45 kg) caramel malt (60 °L)
0.2 lbs. (90 g) chocolate malt
0.2 lbs. (90 g) black malt
0.8 lbs. (0.36 kg) roasted barley
1.0 lbs. (0.45 kg) rolled quick oats
0.5 lbs. (0.23 kg) steel-cut oats
12 AAU Chinook hops (1 oz. of 12% alpha acids)
Wyeast 1084 (Irish Ale) or White Labs WLP004 (Irish Ale) yeast

Step-by-step

Mash the grains and rolled oats at 160 °F (71 °C) for one hour and then sparge and run off enough wort into the kettle for a 90-minute boil. Add one ounce (28 g) of Chinook hops at 15 minutes into the boil. Add 0.5 lbs. (0.23 kg) of steel-cut oats (Irish oatmeal) in a mesh bag to the boil during the last 45 minutes. Remove bag of Irish oatmeal and cool wort. Move cooled wort to fermenter and add Irish stout yeast. Ferment at 65–68 °F (18–20 °C) until reaching terminal gravity (about 7–12 days).

ROCKYARD BREWING COMPANY

Brewer: **Jim Stinson has been the head brewer at Rockyard Brewing Company in Castle Rock, Colorado since April 2002. He brewed for Alcatraz Brewing Company in Littleton, Colorado from May 1999 to September 2001. Before that he brewed at Irish Brewpub in Pueblo, Colorado from April 1998 to March 1999.**

Stinson began as a homebrewer in 1994, landing his first brewing job with Mickey Finn's in Libertyville, Illinois. He brewed at Mickey Finn's from September 1996 to October 1997.

There are many kinds of stout for a homebrewer to experiment with, including sweet and dry stout. I prefer oatmeal stout for its rich flavor and full body.

Stout is such a big beer that it seems as if you can almost throw anything into the recipe and it will turn out great. But, a little black malt and roasted malt go a long way. It's easy to overdo them in your grain bill.

Still, roasted barley and dark caramel malts are the key to a stout's unique flavor. Shoot for malt and caramel sweetness dominated by roasted and toasted flavors that finish with coffee-like dryness. You want a balance between the sweetness of the malt and the bitterness from the roasted barley. If you use dark caramel malts, these will contribute to toasted flavors and unfermentables, which will add to the beer's body.

A stuck mash is usually not a problem with all-malt beers, but stout brewers should be careful not to grind their dark malts into dust. If you do, the grains may end up gumming together, which could lead to lauter problems. Avoid the problem altogether by adding dark grains during the lauter (there is no need to mash them). Extract brewers can steep them while heating the boil water.

Hop flavor and aroma are not especially evident in stout. Hop bitterness ranges from balanced to high. Hops are necessary to balance the sweetness of the malt, particularly in fuller-bodied stouts that would be unbearably sweet without hops. I have used Nugget, Northern Brewer, Challenger and Amarillo with good success. I tend to avoid high-alpha hops because they sometimes leave a cloying resin taste.

I use Ringwood yeast (Wyeast 1187) for my stouts. Stouts tend to blow off a lot of foam. You can reduce this by pitching at a low temperature and then allowing the beer to warm to fermentation temperatures. ■

Bleach and iodine

"Help Me, Mr. Wizard"

Plus: hop oils, bottle shelf life and sparge water

To bleach or not to bleach

In the question about root-beer flavors in kegs ("The Root of the Problem," November 2002), the question-writer mentioned that bleach is a no-no. Of course, I read this not more than two hours after putting a bleach solution through a couple of Cornelius kegs. I have also read that you should periodically soak your transfer hoses overnight. So my question is, when is it appropriate to use bleach and when is it not?

Glen A. Hickox
Colorado Springs, Colorado

The author of the question about root-beer tainted beer did acknowledge in his question that bleach is a "no-no." I focused on the root-beer flavor taint and should have commented on that assertion because bleach can have its place in the brewery. Household bleach, or sodium hypochlorite, has a bad reputation primarily because of what it can do to beer flavor. When phenols — which are present in malt, wort and beer — react with bleach a potently aromatic compound called chlorophenol is formed. Chlorophenols are described as medicinal and remind me of the aroma of the throat spray Chloraseptic.

The strong medicinal aroma of chlorophenol is considered a defect in all beer. The easiest way to avoid this particular problem is to keep bleach out of your wort and beer; this means that you must thoroughly rinse equipment sanitized or cleaned in bleach, until the rinse water has no bleachy aroma or taste. Of course, if your local water is heavily chlorinated it already smells like bleach, and this water can cause chlorophenol problems without using a bleach sanitizer — but this is another issue. I prefer using sanitizers that do not require rinsing and so I use compounds other than bleach for sanitizing. My favorite is peroxyacetic acid (or PAA).

Bleach is a strong oxidizing chemical and it works extremely well as a sanitizer and as a cleaner. In fact, many industrial caustic cleaners (usually sodium hydroxide) are enhanced by the addition of bleach. These so-called chlorinated caustics are much more effective in the removal of protein films than regular caustic and are used by many brewers in the brew kettle where cleaning is most difficult.

The major downside to chlorinated cleaners is that chlorine can corrode stainless steel when the pH of the chlorinated solution is low (or acidic). Since caustic cleaners are alkaline and have a high pH, stainless steel can be safely cleaned with these chlorinated caustics.

Household bleach is also alkaline and has a pH around 12. This means that bleach can be used on stainless steel. However, when multiple cleaners are used for cleaning, it is possible for a chlorinated liquid residue to become acidic and thus corrosive. This can happen, for example, when a vessel is cleaned with a chlorinated cleaner followed by an acid-based cleaner or sanitizer.

This whole topic is pretty controversial among cleaning experts and stainless steel experts. Some argue that as long as the pH of chlorinated cleaners is kept alkaline then chlorinated cleaners are OK on stainless steel. Others argue that chlorinated cleaners should be avoided at all costs because of this multiple cleaner scenario. My advice is to avoid using chlorinated cleaners unless you clearly understand how and when they can cause corrosion.

If you want to use bleach as a cleaner, you can do it without problem. I recommend the cheap bleaches that only contain sodium hypochlorite. High-end bleaches, like lemon-scented Clorox, usually have scents to make them smell less like bleach and these should be avoided. Bleach works great for soaking hoses and for cleaning glass. You can also use it for special cleaning projects on stainless steel. For instance, I periodically — perhaps every one in ten cleanings — add plain bleach to caustic to remove a protein film that slowly builds over time in our whirlpool. This film accumulates despite the fact that we clean our whirlpool with caustic after every use. However, because of its potential corrosiveness, bleach should not be used as an everyday stainless cleaner. Finally, bleach is a great sanitizer if you don't mind running the risk of the dreaded chlorophenol nose!

The concentration required for good sanitizing action is really pretty low. The state of Kansas, for example, requires restaurants to use 100 ppm for dishwashers with a cool-water sanitize step (that's roughly two teaspoons of bleach per gallon or 3.8 liters). The University of Montana state-extension Website recommends 50 ppm for household sanitation of dishes and 100 ppm for sanitizing counter-tops and appliances. Cleaning is another issue — concentrations from 6–12 ounces per gallon (47–94 mL per liter) of water are more common. When I add bleach to caustic, I add about 12 ounces (355 mL) of bleach to two gallons (7.6 L) of a 2% caustic solution. That's one potent cleaner!

Iodophor rinsing

I use iodophor to sterilize and mix it according to the directions on the bottle. Do you have to rinse after you sterilize with it? I never have and I've never had any off-flavors, but I wonder if it is slowly eating away my insides.

David Reaser
Bethlehem, Pennsylvania

Iodophor is a very effective sanitizer and, unlike bleach, can safely be used as a no-rinse sanitizer without adversely affecting the flavor of your beer. The recommended concentration of iodophor is 25 parts per million. Most iodophors are diluted so that the typical use rate is somewhere around 1 ounce per gallon (7.8 mL per liter). They are always labeled with instructions giving suggested usage rates. If you use it at this concentration and allow your equipment to properly drain, you will be in good shape. Iodophor does have a flavor and, when used at higher-than-recommended strengths, it can impart an iodine flavor to beer — especially if it is not drained from the equipment surface.

Excessive iodine intake (extended consumption of about 0.75 milligrams per day) can cause iodine goiter, a condition characterized by enlargement of the thyroid gland. One ounce of a 25 ppm iodophor solution contains 0.75 milligrams of iodine. To leave that much sanitizer on your equipment would correspond to very careless technique. In addition, your beer would taste objectionable and the off-flavor would be a good warning sign to pay attention to your sanitation procedures. I suppose the flip side is that if you had 1/10th of an ounce (which is still a pretty fair volume) of residual on beer bottles and drank 10 beers per day you could have the same effect.

For more information on cleaning and sanitizing, see Steve Bader's article, "Beer Minus Bacteria," on page 36 of this issue.

Where do the hop oils go?

Why don't the hop oils rise to the top or, in the case of dry-hopping, stay on top of the wort during fermentation? Does the alcohol allow the oils to break down and go into solution? Also, with this in mind, would I get different hop character or utilization depending on when in the fermentation cycle I dry-hop my beer?

Christopher Karns
Olney, Maryland

Most of the aromatic compounds in hops that are referred to as oils belong to a large class of plant hydrocarbons (substances consisting of only carbon and hydrogen) known as terpenes. Examples include myrcene, humulene, caryophyllene and farnesene. Although terpenes are largely responsible for the characteristic aroma of hops, most are

lost to evaporation during boiling. The oils that do remain in the wort have a tendency to adhere to surfaces because they are not very soluble in aqueous solutions like wort.

I suppose if hops were added to a still liquid they might float to the top like vegetable oil on water, but boiling wort and fermenting beer have a lot of stirring action and the oils move about in the liquid. Furthermore, the concentration of aromatic oils represents about 0.5% of the weight of hops. If you added two ounces of hops to five gallons of wort, roughly 0.01 ounce (0.28 g) of oils would be present. At that small quantity, they would not be visible on the wort surface.

Like alpha acids, these oils oxidize during aging. Examples of oxygenated terpenes include humulenene epoxide, humulenol and caryophyllene epoxide. These compounds are more soluble in water than their non-oxygenated counterparts and have been credited with providing much of the hoppy aroma found in beers made using late kettle hop additions or dry-hopping. In fact, some hop producers — notably those in Germany — intentionally age hops prior to kilning, supposedly to increase the concentration of these oxygenated terpenes.

As far as dry-hopping goes, hop oils are definitely more soluble in beer than in wort because beer contains alcohol. In fact, many of the hop oils that can be purchased on the market are extracted with ethanol. A simple oil extract can be made at home by steeping hop pellets or cones in a neutral spirit, such as vodka, and straining the hops out of the alcohol solvent after several hours of steeping. One ounce (28 g) of hop pellets steeped in 6 ounces (178 mL) of vodka produces a pretty hoppy vodka martini! Let this cocktail steep in a closed container for one to two days and then either carefully decant the liquid off of the hops or strain through a fine mesh strainer lined with a clean, disposable coffee filter. I have never used this technique to make oil extracts for brewing purposes, but have used this method to help evaluate the aroma of different hop varieties. To test the hop aroma, I make the hop extract and sniff it.

The general consensus on dry-hopping is to add hops after primary fermentation. By adding hops after fermentation is complete, the loss of aroma due to carbon dioxide scrubbing is minimized. You can also expose the hops to the beer for at least one week prior to chilling the beer for cold conditioning. Warm beer will pick up more of the aromatics than cold beer will.

Counter-Pressure Conundrum

I'm about to purchase a counter-pressure bottler. How long does homebrew bottled in this way remain good? Longer than my kegged creations?

Buck Huenefeld
San Diego, California

This is the question that every brewer who bottles their beer wants answered, and the answer depends on your bottling techniques. When carbonated beer is bottled, the shelf-life clock starts ticking. (Bottle-conditioned beers follow a different progression of aging, so this answer will only address beers being counter-pressure filled). With very few exceptions, dissolved oxygen increases when beer is transferred to a bottle. Even commercial brewers with the most modern fillers equipped with bottle pre-evacuation features constantly worry about oxygen pick-up at the filler.

Oxygen is public enemy number one when it comes to beer stability, be it bottled or kegged beer. Most counter-pressure fillers are designed so that carbon dioxide can be purged through the fill tube and out of the top of the bottle prior to filling. This helps reduce the oxygen in the bottle and oxygen pick-up during filling. During filling it really helps to minimize splashing, because beer foams when splashed and also picks up more oxygen. Most counter-pressure fillers have long fill tubes that extend to the bottom of the bottle and this minimizes splashing.

Once the beer has been gently transferred to the bottle, the fill tube is removed and the bottle prepared for capping. This step is critical. The idea is to get the beer to controllably foam so that the air in the bottle headspace is displaced with foam and only then is the bottle capped. This is easier said than done. Sometimes the beer sits in the bottle and does not foam and other times it gushes out of the top like a geyser at Yellowstone. I like the former situation because it is easy to make beer foam, either by knocking the bottle on the counter or by rapping gently on the side with a plastic screwdriver handle. Geysers can be avoided by properly cooling your beer prior to bottling. The last protective measure to ward off oxygen pick-up is to use bottle caps with an oxygen-absorbing liner. These caps can make a good system better, but are not able to prevent oxidation without these other preventive measures in place.

Beer bottled using a counter-pressure filler under ideal conditions should remain fresh for at least two months and typically will stay fresh for four months. This is assuming the beer is kept cool or cold, is unfiltered and is not some high-alcohol behemoth — these giant beers will last much longer and some of the changes brought about by aging affect these beers in a positive way. In general, darker beers have a better shelf-life than light beers because compounds responsible for beer color are also play an anti-oxidant role. The most difficult beers to bottle are the really light styles like Pilsners and American-style lagers. If bottled improperly, these lighter beers can show signs of oxidation within days of bottling, especially if stored warm.

So how do bottles differ from kegs? If bottled properly, they really should have similar storage properties. The big difference with bottling a five-gallon batch versus kegging a five-gallon batch is roughly 48 bottle fills compared to one keg fill. A keg is easy to painstakingly fill. A keg can be filled to the brim with water and then completely filled with carbon dioxide by pushing the water out of the keg with the gas. Then you rack the beer into the CO_2-filled keg, eliminating any possible contact with 0_2. Oxygen pick-up is a non-issue using this method. The other thing about a keg is that you don't have to pull the fill tube out of it, thus exposing the beer to the environment, like you do with a bottle filler.

When you bottle, you may have some bottles that are about as low in oxygen as the keg and you probably will have others with higher levels. This results in variability within the batch — some will taste great after two months and some may taste oxidized. Of course, the real joy of bottling is convenience and the added flexibility of sharing your brews without having to bring your friends to your keg or hauling your keg around town!

Whether kegging or bottling, beer will not have any sort of shelf life if the key principles of sanitation, good yeast, healthy fermentations and careful racking practices are not used. Beer contaminated with bacteria or beaten up by sloppy racking practices is doomed. For those brewers who filter, this practice can do much more harm than good if proper filtration techniques are not followed. If everything is done correctly up to the point of filling, you will have maximum shelf-life, provided you use filling techniques that minimize oxygen pick-up and then store your bottled beer cold. For more information on counter-pressure bottling, see Chris Colby's article, "Under Pressure," in the November 2002 issue of *Brew Your Own*.

Sparge water and pH

How do you change the pH of your sparge water? My mash pH is just fine — I simply add the malt and it comes out perfect every time — but for sparging I'm clueless. The pH of my water is too high.

Michael Murphy
via email

The term pH is used to describe the concentration of hydrogen ions in a solution. As the concentration of hydrogen ions increase, a solution becomes more acidic — and since pH is a negative, logarithmic scale, the pH decreases as a solution becomes more acidic. The simple answer to this question is that you want to increase the concentration of hydrogen ions to reduce the pH of your sparge water. You can do this by adding an acid, such as phosphoric or lactic acid, to your sparge water.

Changing the pH of water is usually not so straightforward, because most water contains compounds that resist pH changes. These buffers include the very common carbonate ion. Water high in carbonate typically results in a mash pH higher than ideal (pH 5.2–5.4 is in the ideal range) and also results in a faster increase in the wort pH during sparging compared to waters with little or no carbonate. Compared to the mash, water has a relatively weak buffering capacity.

Water chemistry can be a very confusing topic, but in practice you really need to pay attention to a few key points. Check your mash pH. If it is between 5.2 and 5.4 you are doing well. If it is out of this range, mash pH can be adjusted after mash-in by adding calcium salts (from calcium sulfate or calcium chloride) or carbonate (from calcium carbonate or sodium bicarbonate). Calcium reacts with phosphates, proteins and amino acids from malt and reduces mash pH. Carbonates, on the other hand, increase mash pH. You can also add acids to the mash to decrease mash pH. Organic acids, like phosphoric and lactic, are usually used because they act as buffers and are easier to use than strong acids like hydrochloric. Strong acids result in more rapid pH changes and a little bit goes a long way.

When it comes to sparge water, I don't pay much attention to the pH of the water, because a high water pH does not always result in a rapid increase of mash or wort pH. This is due to the fact that water has a much lower buffering capacity than does a mash. Furthermore, most municipalities intentionally adjust water pH to around 8–9 to prevent corrosion in water lines. Strong bases, like sodium hydroxide, are usually used to adjust the pH — and strong bases, like strong acids, do not act as pH buffers. In other words, sparge water with a high pH and a low buffering capacity has little impact on mash or wort pH.

The thing to monitor during sparging is the pH of the wort. As a general rule, wort pH increases as the wort gravity decreases and the extraction of husky flavors increases. This is due to the fact that the buffering capacity of the wort decreases as the wort gravity decreases. Most brewers do not want to collect wort with a specific gravity less than 1.008 or 2 °Plato or a pH greater than 5.8–6.0. If you track your wort pH during sparging and find that it is too high, you can add a phosphoric or lactic acid to your sparge water so that the sparge water pH is in the low 5's. You may find that the wort pH of the last runnings is less than 6.0, and you really don't need to worry about adjusting your sparge water. ■

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!

Red Ale

The other style from Ireland

by Horst D. Dornbusch

Considering the popularity of Irish stouts, especially Guinness, we sometimes forget that stout was not the first Irish beer style. Nor has it always been the best-known one. In fact, the earliest references to stout date only to the late seventeenth and early eighteenth centuries.

Beer in Ireland is obviously much older than that, although nobody really knows how old. Irish missionaries went to Europe in the sixth century and started breweries on the continent, but I do not know if they learned brewing there or brought the skill over from Ireland. In addition, the Vikings probably brewed in Ireland during their occupation of the British Isles, from roughly the ninth to the twelfth century. Either way, history makes one fact fairly clear — the Celtic ales brewed in Ireland in the Middle Ages and earlier had a noticeable ruby-red tinge. Hence the name: Irish red ale.

Today, Irish red ale is an obscure style. Not a single contemporary commercial example can claim unqualified authenticity for itself. Much like the Vienna lager of central Europe, the Irish red has almost disappeared and there is some debate as to its true characteristics. As best we can tell, the emphasis of traditional Irish red ale brewers, not unlike that of Munich lager brewers, has been on strong, slightly nutty maltiness and certainly not on powerful hoppiness. The Celtic ales brewed in Ireland in the Middle Ages and before then were probably only lightly hopped. And, unlike the stout, they did not taste very roasted at all — even though they likely contained plenty of darkish (but not necessarily

IRISH RED ALE 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%

black) malts. The brew's maltiness and color come mostly from traditional brown malts, roasted barley and sugar syrups. These ingredients are what give the beer its familiar reddish tinge. To use a forced comparison, the Irish red is probably more like a marriage between a British brown or dark ale and a German altbier than it is a precursor to the Irish stout.

Irish red grains and extracts

The best grains and extracts for this very Celtic, traditional brew are of course authentic varieties from the British Isles. Malts from Hugh Baird, Crisp, Beestons and Simpsons would be appropriate for the style. If you really want to go all out, look for malts made from the famous Maris Otter barley variety. For extract brewers, the most authentic brew would come from a partial mash that combines roasted barley and crystal malt with a color rating no darker than 60 °L, steeped in a bag (as shown in the recipes).

If you don't want to mess with grain, you can try a mixture of plenty of amber and a smidgen of dark British-style extracts (see our extract-only recipe). Of course, if utter simplicity is your supreme goal, you can buy a prehopped, Irish red extract in a can. These beer kits come with yeast and are made by several companies. For quantities and procedures with this prehopped extract, just follow the instructions on the can. The product makes an acceptable brew if you are in a hurry, but using steeped specialty grains and boiling your own hops usually gives you much better results.

RECIPES

Smiling Eyes Irish Red Ale (5 gallons/19 L, all-grain)

OG: 1.044 FG: 1.011
SRM: 16 IBU: 25
ABV: approximately 4.3%

Ingredients

- 5.9 lbs. (2.7 kg) British-style pale two-row malt (~2.5 °L)
- 1.1 lbs. (0.50 kg) crystal malt (60 °L)
- 1.0 oz. (28 g) roasted barley
- 5.6 AAU Fuggles (bittering) (1.3 oz. of 4.3% alpha acid)
- 1.0 oz. (28 g) Bramling Cross hops (flavor)
- 1 tsp. Irish moss
- Wyeast 1084 (Irish Ale) or White Labs WLP004 (Irish Ale) yeast
- 3/4 cup DME or corn sugar

Step by Step

This is a true middle-of-the-road Irish red ale. If you prefer a slightly stronger version, simply bump up your pale malt quantity to about 7 lbs. while leaving all other quantities unchanged. This will bring your alcohol level in the finished beer to about 4.8 ABV.

The grain bill for this brew as well as the resulting SRM value have been calculated for a system with an extract efficiency of roughly 65%. If you know the efficiency of your system, make the proportionate adjustments, up or down, to your grain quantities. If you do not know the efficiency of your system and you use the amounts as specified above, you may get slightly more or less wort in your kettle, at the specified gravity, and the beer's color may be a shade lighter or darker than the proper red hue.

All hops amounts have been calculated for a net kettle volume (that is, the kettle volume after the boil) of 5 gallons. If your system produces more or less wort with the specified grain bill, do not forget to adjust all hops amounts up or down proportionally.

more IRISH RED ALE recipes

Irish red is a simple beer. Use a single-infusion process with a one-hour rest at roughly 152 °F (66 °C). Then sparge with about 180 °F (82 °C) water for about 75 minutes. Make sure that the mash temperature at the end of the sparge has reached 168-170 °F (76–77 °C). Boil your wort for 75 minutes. There are two hop additions, one about 30 minutes into the boil for bittering, the other about 15 minutes before shutdown for flavor. Add the Irish moss as you add the flavoring hops.

Heat-exchange the wort as close to the fermentation temperature of 65 °F (18 °C) as your setup allows. Aerate the cool beer, pitch the yeast, and place your fermentation vessel in an area that allows you to maintain the proper fermentation temperature. Let the brew ferment to the finish, which should not take more than 10 days. Rack the brew and let it condition for at least another two weeks. Then rack it again and prime it.

Smiling Eyes Irish Red Ale
(5 gallons/19 L, partial mash)

OG: 1.044 FG: 1.011
SRM: approx. 16 IBU: 25
ABV: approx. 4.3%

Ingredients

- 4.8 lbs. (2.2 kg) pale malt extract syrup (such as Muntons, Edme or John Bull)
- 1.1 lbs. (0.50 kg) crystal malt (60 °L)
- 1 oz. (28 g) roasted barley
- 5.6 AAU Fuggles hops (bittering) (1.3 oz./37 g of 4.3% alpha acid)
- 1 oz. (28 g) Bramling Cross (flavor)
- 1 tsp. Irish moss
- Wyeast 1084 (Irish Ale) or White Labs WLP004 (Irish Ale) yeast
- 3/4 cup DME or corn sugar

Step by Step

Coarsely mill the two specialty malts and pour them into a muslin bag. Place the bag in at least two gallons (7.6 L) of cold water and raise the temperature slowly, for at least half an hour, until it reaches 170–190 °F (77–88 °C). At this point, bubbles should start to pearl up in the liquid, but the pot must not boil! Lift the bag out of the steeping liquid and rinse it with several cups of cold water. Do not squeeze the bag. Discard the spent specialty grain and stir in the canned extract. For a higher alcohol content (approx. 4.8%), increase the amount of pale extract to about 5.8 pounds (2.6 kg). Fill your kettle to your usual volume, bring to a boil, and add the bittering hops. Boil for one hour. Add the aroma hops and Irish moss. Boil for another 15 minutes.

Heat-exchange the wort as close to the fermentation temperature of 65 °F (18° C) as your setup allows. Aerate the cool green beer, pitch the yeast, and maintain the proper fermentation temperature. Let the brew ferment to the finish, which should not take more than 10 days. Rack the brew and let it condition for at least another two weeks. Then rack it again and prime it.

Smiling Eyes Irish Red Ale
(5 gallons/19 L, extract only)

OG: 1.044 FG: 1.011
SRM: approx. 16 IBU: 25
ABV: approx. 4.3%

Ingredients

- 5.4 lbs. (2.5 kg) plain amber malt extract syrup (such as Muntons or John Bull)
- 0.5 lb. (0.2 kg) plain dark malt extract (such as Muntons)
- 5.6 AAU Fuggles hops (bittering) (1.3 oz./37 g of 4.3% alpha acid)
- 1 oz. (28 g) Bramling Cross (flavor)
- 1 tsp. Irish moss
- Wyeast 1084 (Irish Ale) or White Labs WLP004 (Irish Ale) yeast
- 3/4 cup DME or corn sugar

Step by Step

Mix the two malts with your hot brewing water in the kettle. For a stronger beer (approx. 4.8% ABV) increase the addition of amber extract to about 6.2 lbs. (2.8 kg). Bring the wort to a boil and add the bittering hops. Boil for one hour. Add the aroma hops and Irish moss. Boil for 15 minutes. Then follow the all-grain instructions for heat-exchanging, fermenting and finishing the brew.

Heat-exchange the wort as close to the fermentation temperature of 65 °F (18° C) as your setup allows. Aerate the cool green beer, pitch the yeast, and place your fermentation vessel in an area that allows you to maintain the proper fermentation temperature (such as a basement, attic or shed). Let the brew ferment to the finish, which should not take more than 10 days. Rack the brew and let it condition for at least another two weeks. Then rack again and prime it.

Style profile

The Irish red's color, like that of the copper-colored altbier from Germany, can vary widely. At the lighter end of the scale, with an SRM value of 11–14, Irish reds are a bit more red-amber than its name would lead you to expect. The style best acquires its coppery-red signature hue at an SRM range of 16–18. Brews beyond 18 SRM are no longer Irish reds but light browns. The color in the Irish red's grain bill (and thus in the beer) comes from some roasted barley as well as a fair amount of crystal malt. These grains also produce unfermentables that give the beer a rich and satisfying middle sensation of nuttiness intermingled with just a faint (but never dominant!) roastiness.

In spite of the color resemblance between the Irish red and the German altbier, and in spite of the unfermentables in the grain bill, the mouthfeel of a good Irish red should be very much like that of a very smooth British pale ale. This style requirement is probably the result of the indigenous barley from which it ought to be made. The protein levels of the malts grown in the mild, maritime climate of the British Isles tend to be significantly lower (roughly 9–10%) than those of the malts grown in the continental climates of central Europe or North America (roughly 10.5–11.5%). Lower-protein malts tend to produce beers with a medium body. Such medium-bodied beers are often perceived as having great smoothness, provided, of course, you do not oversparge your mash, which would add undesirable astringent compounds to the wort.

These malts make the red hue in your Irish red sparkle in the glass. And, because the portion of unmalted roasted barley in the grain bill may contribute a few impurities to the kettle, it is best to clarify the wort with some Irish moss shortly before the end of the boil (see recipe).

Irish red hops

Because an Irish red is a medium brew in just about any respect — including its hop bitterness, flavor and aroma — you should use only mild hops varieties. In fact, in such a smooth brew, a strong hop aroma would fight with the slight caramel-sweet finish. Hop aroma, therefore, is almost totally absent in an Irish red.

One of the reasons for the low hop content of Irish brews is probably historical. Hops arrived rather late on the Emerald Isle. It is a broad, but reasonably valid, generalization that hops as a beer flavoring had first taken hold in central Europe roughly between the tenth and sixteenth centuries. It came into wide use in Britain only in the seventeenth century, and in Ireland only in the eighteenth. Two hop additions in the kettle, therefore, are ample for an Irish red and this beer style is not a good candidate for dry-hopping!

Also, because hoppiness is subdued in an Irish red, powerful American Northwest varieties, such as Cascade or Galena, are really out of place (at least in my view). Some lovers of this style maintain that even such a British stalwart as East Kent Goldings can be too much. I picked Fuggles for bittering, because it is slightly less floral. An English Challenger or a Styrian Goldings (which, in spite of its name, is related to Fuggles, not a Goldings) would work well, too. If you are interested in a graceful brew, the mild German Hersbrucker — though not exactly Irish — is my tip.

For this style, I would definitely stay away from more assertive, high-alpha (10% and above) varieties, such as Chinook, Eroica or Nugget. Even mid-range (7–10%) bittering hops like Bullion, Centennial or Cluster might be a bit too much. But the mid-range Brewers Gold and Northern Brewer are okay. For the flavor hop addition I would use the relatively low-alpha Bramling Cross because of its mild, but fresh, black-currant and slight citrus notes. These notes give the brew a nice bit of background flavor — and even a touch of aroma — without being overpowering.

Fermenting the Irish red

Irish red ales are fermented slightly cooler than the typical British brown ale, but not quite as cold as its decidedly cool-fermented German coppery cousin, the lagered altbier. It is best to keep the fermentation temperature at or below 65 °F (18° C). This minimizes diacetyl production. The result is a fairly crisp beer with relatively low levels of fruity and butterscotch-like flavors — more than the altbier but less than the typical British ale.

The Irish red's finish, though crisp, is much less dry than you might expect from the low final gravity. Even if you use yeast strains that are known for producing beers with a dry finish, such as the ones listed in the recipes, the Irish red's smooth aftertaste is still characterized by a noticeable residual sweetness from unfermentables that is almost reminiscent of caramel. The smoothness of the Irish red (and that of many British or Irish pale and mild ales) is frequently — and unfortunately, in my subjective opinion — accentuated nowadays by the use of nitrogen instead of carbon dioxide for effervescence, especially in draught beers.

The fermentation temperature of the Irish red probably matches the basement temperature of many houses in North America during the cold season ... and that makes the Irish red ale a perfect beer to brew in the winter. Start your Irish red no later than mid- to early February so that it will be ready by St. Patrick's Day. Then you can serve it with a hearty meal after the parade and toast in Gaelic to everybody's health: Sláinte (roughly pronounced "slorntche").

Rich in history, but now rare

There are only few red beers available commercially in the United States, and a "red" appellation on the bottle is no indication at all that the brew inside is an Irish red ale. The St. Rogue Red from Rogue Ales in Newport, Oregon is an Irish red ale, but it is made with plenty of pungent Pacific Northwest hops. This gives the beer too much (at least for my subjective taste) "un-Irish" character for the style.

Nationally, by far the most common, Irish-sounding beer named "red" is made by Coors of Colorado. This company's Killians Red is neither spectacular nor awful. Although the beer is hardly noteworthy for what it is today, it is of interest for a bit of history that connects it with the original Irish red ale tradition. Even in Ireland, very few breweries nowadays make red ale. One of the last ones was the G.K. Lett Brewery of Enniscorthy in County Wexford, Ireland. This brewery had its roots in a friary brewery from the fifteenth century. In 1864, a certain George Killian Lett turned it into a secular brewing establishment for red ale. Unfortunately, this red ale brewery closed in 1956. A quarter century later, the fifth-generation George Killian Lett licensed the Killian name to Coors of Colorado and to Pelforth of France. Coors Killian's Irish Red, therefore, takes its name from George Killian Lett, the founder of the Enniscorthy enterprise and a classic Irish red brewer.

After the demise of the Lett Brewery, it seems there are only two Irish red ales of significance left. There is Smithwick's Ale from County Kilkenny, made in Ireland's oldest still-operating brewery, dating from 1710, and now part of the Guinness behemoth. The other is Murphy's Irish Red from County Cork, made in a brewery dating from the mid-1900s, and now part of the Heineken conglomerate. Neither of these commercial beers appears to be readily available in most parts of North America.

I have personally tasted the Smithwick's only once, at the Biermarkt Esplanade pub in downtown Toronto, Ontario, in October 2002. This place has an international beer list of well over a hundred brands and sells many true rarities. The Smithwick's I had there was malty in the middle and finished dry, with a slight sour note and some butterscotch flavor lingering in the aftertaste. I had the Murphy's only once, too, but unfortunately as an over-nitrogenated draught beer in a hotel bar in London, England, in the spring of 2001. As served, I found the Murphy's rich and malty, but overpowered in the finish by an excess of pearly, nitrous effervescence. ■

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COLONIAL ALE

story and photos by **Dan Mouer**

Using a recipe unearthed at a Virginia plantation, a brewer and archaeologist researched and recreated an authentic 18th-century beer.

The Curles Plantation in Virginia was owned by four generations of the Randolph family from 1699 to about 1840. It's now being excavated.

Have you ever dreamed about digging in the ground and having your shovel strike treasure? A chest of gold coins, perhaps? Or maybe, even better, a well-preserved bottle of beer? I may not have unearthed a bottle, but I found the next best thing while studying a colonial plantation in Virginia.

I am an archaeologist with a primary research interest in the 17th- and 18th-century plantation cultures of the New World colonies. As a homebrewer and home winemaker, I'm also fascinated by the role these beverages played in historical societies. I've found a wealth of relevant information at the 15-year archaelogical study of Curles Plantation on the James River in eastern Henrico County, Virginia.

From 1699 to about 1840, Curles was owned by four generations of the Randolph family. Three generations of Randolph women, all named Jane, left behind a type of cookbook called a "receipt" manuscript. Inside, I found a recipe for "Good Ale" from Mrs. Cary, a relative who lived across the river. Here is her original recipe.

Mrs. Cary's Good Ale

"Take 3 Bushels malt 1/2 high & 1/2 Pail dry'd let your water boil then & put into your Mashing tubb, When the Steem is gone off, so as you may see your face; then put your malt, & after mashing it well then cover it with a blanket, Let it stand 2 hours, then draw it off Slow, then boil it three or four hours, till the hops curdles. When boiled Enough, cool a little, & work that with your yest, & so put the rest of your wort in as it cools, which must be let in small Tubs, let it work till your yest begins to curdle then turn it up & stop your Barrel when it has done working; Note to Every Bushels malt a Quarter of pound of hops."

Since I'm a homebrewer, I wanted to brew this beer myself! To make it easier, I translated the recipe into contemporary English. I also included comments from my first attempt at recreating this ale, which I did with the help of Bob Henderson of The Weekend Brewer, a homebrew shop in Chester.

Take 3 bushels dried malt, 1/2 high and 1/2 pale, and put it into your mashing tub (or tun).

In the 1700s, almost all brewer's malt was imported from Britain. The grain was "floor" malted, then kilned with direct heat from wood or coal fires, which led to uneven modification and kilning levels.

Presumably the malt was then divided into relatively pale and high-colored fractions. To Mrs. Cary, the "high" was undoubtedly what London brewers meant by "brown." The high malt would not have been as dark as most modern brown malt, however, because this specialty grain is well roasted and, consequently, has little diastatic action. One exception is a brown malt made by Crisp that is intended to resemble the darker brown malt of the 18th century. (Most modern brown malt ranges from 70–100 °L, while Crisp brown is in the low 50s).

I chose Maris Otter for my pale malt; it seems to be the malt of choice among British brewers who produce traditional beers. Even though the Maris Otter is malted by methods that didn't exist in the 1700s, this and the Crisp brown seemed to be the most traditional malts I could select.

Mrs. Cary's recipe makes a barrel of beer. This likely meant wine barrels that had once held port or Madeira. These barrels held the equivalent of 36 U.S. gallons (136 L). A barrel of Good Ale required 3 bushels or 102 pounds

(46.3 kg) of "dry" malt. So if I wanted to make a 5-gallon batch (19 L), I needed 14 pounds (6.3 kg) of malt, divided equally between pale and brown. Wood-fired kilns lent a smokiness to the malt, so I also added 2 ounces (57 grams) of Bamberg rauchmalt.

Bring your water to a boil and put it into the mash tun. When it has cooled enough that the steam has cleared and you can see your reflection in the water, add your malt to the tun. Mix it up well and let it mash for two hours.

Jane Randolph and her cooks did not have thermometers. Instead, they waited until the water had stopped steaming and then added the malt. In re-creating this mash, I boiled three gallons (11.4 L) of water and then waited for the steam to die down. The water was 165° F (74° C) at this point. After mixing liquor and grains my thermometer told me we would begin the mash at 148° F (64.5° C). Not a bad temperature for maximizing extraction and attenuation, but I boosted it to about 152° F (67° C). Then I let the mash sit in my tun (an insulated cooler) for two hours.

At the end of the mash, draw your wort slowly from the tun into the boiler. Boil the wort three or four hours until your hops "curdle." Then take some of it aside and cool it to make your yeast starter. Add the rest of the "wort" (liquor) needed to make up your final quantity of ale.

Presumably, the coagulation of the hot break is what "curdling" meant. Setting aside wort for a starter is straightforward, but the original instruction — to "put the rest of your wort in as it cools" is ambiguous at best. Several historical brewing sources suggest that, after the first wort was drawn from the mash tun, more hot water was added to the grains and allowed to "mash" — actually, to steep — for a short while to extract more sugars. So I siphoned the sweet wort into my kettle, replenished the tun with 3 more gallons (11.4 L) of water at 152 °F (67 °C) and let it rest for 20 minutes. This extracts more tannins from the husks than does sparging, but, as far as I know, sparging was not practiced at this time.

I decided to ignore the recipe in one minor way by adding additional water at the beginning of the boil, rather than adding "the rest of the wort" at the end of the boil. Adding water "as it cools" may have helped precipitate trub, but I didn't want to introduce unwanted microbes. So I topped up my enameled kettle at the beginning of the boil to make 7 gallons (26.6 L) of sweet liquor.

Mrs. Cary prescribes a quarter pound of hops per bushel of malt. My recipe required 2 ounces (57 g) of hops, and I chose East Kent Goldings at 6% alpha acid. I added the hops at the beginning and boiled for almost four hours, replenishing the kettle as needed to wind up with 5 gallons (19 L) of slightly caramelized wort.

Place your wort into small tubs or other open fermentation vessels.

The 18th century kitchen was not equipped with pumps or siphons or hoses. The women of the day were no doubt physically strong, but they couldn't expect to empty 36 gallons (136 liters) of beer into a barrel. So they used small, open tubs.

I pitched two packets of Danstar Manchester yeast, a long-established dry ale strain, and fermented in a plastic bucket. I decided to cover it with a lid and airlock. By doing this, I missed the chance to introduce complex "colonial" flavors to the brew — but I also avoided contamination!

When the primary fermentation is over and the yeast falls back into the brew, pick up your tubs and turn them over to pour the beer into your barrel. When it's full, hammer in a tight bung.

As is still typical of some cask-conditioned ales, the carbonation comes from the last few days of fermentation in the barrel. Some historical documents suggest priming with molasses at this point (sugar was expensive), but I wanted my beer to be authentic. So I fermented at 70 °F (21 °C) and waited until the yeast cap fell back. Then I racked to a stainless Cornelius keg without any molasses or priming sugar and conditioned it at 60 °F (16 °C) for several weeks. The completion of fermentation provided the necessary spritz. I wouldn't attempt this method if I intended to bottle the beer! The OG of this beer was 1.066 and the FG measured 1.014.

Tasting Mrs. Cary's Ale

This beer is fairly clear and deep brown in color, with good head retention. The aroma and flavor are malt-accented, with strong coffee tones from the brown malt, and subtle smoky notes. Hops are present solely as a balance to the malt, but they contribute little flavor or aroma. If this were sweeter, it would resemble a strong Scottish ale. Instead, it has the dry finish and mouthfeel of an English ale. It is probably best classified as "old ale," though wee heavies come close. ■

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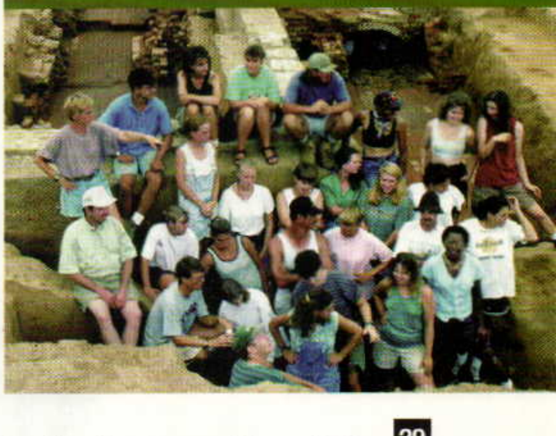
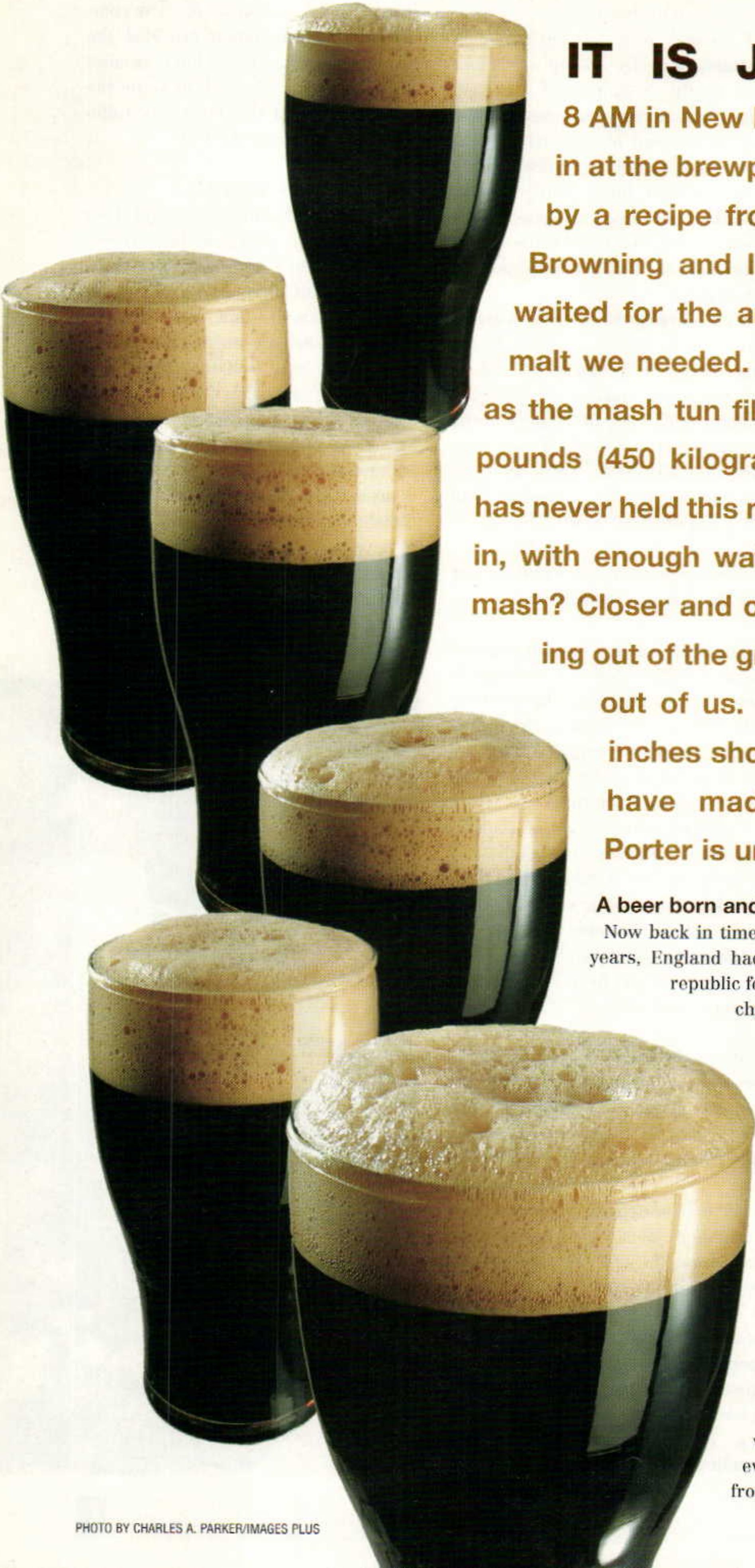
Archaeology students work along the foundation of Curles. In the photo below, brewer and author Mouer is the man in the white hat.





IT IS JANUARY 2002, 8 AM in New Haven, and we are mashing in at the brewpub, brewing a beer inspired by a recipe from 1744. Head brewer Jeff Browning and I sweated last night as we waited for the arrival of the special brown malt we needed. Now we're sweating again as the mash tun fills. We have to get in 1,000 pounds (450 kilograms) of grain, and the tun has never held this much before. Can we fit it all in, with enough water to obtain a good, even mash? Closer and closer it comes, grain pouring out of the grist case and sweat pouring out of us. Finally it stops, just a few inches short of the top of the tun. We have made it, and Presumptuous Porter is underway!

A beer born and raised in London

Now back in time to 1722 and London. In the previous eighty years, England had had a civil war, executed a king, been a republic for twenty years and then restored the monarchy. In between, of course, there were several wars with countries like France and Holland, not to mention The Great Fire of London and a few devastating epidemics.

By 1722, however, the country was on the verge of a long period of political stability and sustained growth. The Industrial Revolution was soon to begin. And what was invented? Why, porter, the first true English beer style in the modern sense — a nationally-known beer brewed to specific characteristics.

How did it start? The most common story holds that there were several sorts of beer available in each pub, variously known as pale, brown and twopenny. It was common practice for the publican to serve individual pots containing a mixture of three or even four beers, all of which had to be drawn from its own separate cask. In 1722, Ralph

PHOTO BY CHARLES A. PARKER/IMAGES PLUS

perfect PORTER

The beer that went from boom to bust and back again: **how to brew the British workingman's pint at home.**

By **TERRY FOSTER**

Harwood, a brewer at the Blue Last in Shoreditch, East London, came up with a single beer that was supposed to match the flavor of these mixtures. He called it "Entire Butt," but it soon became known as porter, due to its popularity with the manual laborers of London's many markets.

We don't know what Harwood's secret was, and certainly no recipe of his remains. It was common practice in those days to take three or more runnings from the mash, giving a strong, a middling and a weak beer. What Harwood may have done is to combine these runnings into a single beer, which could explain the name "Entire."

But the key to porter's success may also have been the malt he used. His new porter was made entirely from brown malt, produced in Ware in Hertfordshire and shipped down the river Lea into London. Brown malt as such was nothing new, but malting procedures in those days were not well controlled. Kilning was an especially tricky process; burning and charring often occurred on the kiln, so that malts were variable in quality. Perhaps the Ware maltster had developed a procedure that yielded a brown malt of improved flavor and quality.

We do not know just how this first porter tasted. A 1760 letter from a certain "Obadiah Poundage" tells us that it was highly hopped, that it was clear (and so translucent brown, rather than black), and that it required long storage before being drunk (more than four or five months). We know that the brown malt was kilned over a wood fire, and some writers have suggested that this would have resulted in a beer with a smoky flavor. However, I am not so sure. Brown malt was kilned over a very hot fire, so that the grain actually burst and swelled like popcorn; this was why it was sometimes also called "blown malt." Such a heating method may not have resulted in much smoked flavor in the malt. Aging was carried out in wooden tuns, so that the beer may well have developed some acidic notes in its flavor. However, one of the most successful porter brewers, Whitbread, used ceramic tiled cisterns for storage, rather than wood.

> Harwood's new beer was soon nicknamed "porter" for its popularity with the manual laborers in London.

A publication called the *Town and Country Brewer* gives a recipe for brewing porter in a 1744 edition. It doesn't say how it tasted, but this did give me the opportunity to try to recreate it, in the form of the Presumptuous Porter I mentioned earlier. Of course, we could not use the original brown malt, since this is no longer made. Instead we used modern, drum-dried brown malt (more about this later), which had to be mashed along with pale malt. The result was outstanding — a beautifully balanced brown beer, with a full-bodied, biscuity flavor, and dangerously drinkable considering its 8% alcohol level.

We do know that porter was cheaper than other beers. (Obadiah Poundage quotes "twopenny at fourpence per quart, and porter at threepence per quart.") We also know that it rapidly became popular in London, and was soon being produced by brewers other than Harwood, notably Samuel Whitbread and Ralph Thrale. As the population of London grew and the Industrial Revolution got underway, these city brewers grew in size: By the end of the 18th century, for example, Whitbread was producing close to 200,000 barrels a year.

So popular had this beer become that brewers in other towns, notably Bristol and Edinburgh, started to brew porter. Indeed, some of the Scottish brewers deliberately poached brewmasters from their London counterparts, so that they could discover the "secret" of porter brewing. Robert Hare, of Philadelphia, is credited with brewing the first porter in the United

Greg Noonan's award-winning smoked porter, brewed at his Vermont Pub and Brewery in Burlington (above), helped spark the style's modern-day revival.

States, somewhere around 1776. A little earlier than that, Irish brewers also began producing porter, notable among them being Arthur Guinness. At the same time, there developed a tendency to call stronger porters "stout porter," as opposed to the regular weaker porter.

As the London porter brewers became bigger, so they became more technical. Towards the end of the 18th century the thermometer and the hydrometer (or saccharometer as it was called) found use in the industry. At about the same time, grain prices were rising rapidly and brewers were looking to improve efficiency. Malts were now sold by the "quarter" measure, and brown was cheaper per quarter than pale malt. But the quarter was a volume measure, and brown malt had a lower density (about 244 pounds or 110 kilograms per quarter) than pale malt (about 336 pounds or 150 kilograms per quarter). So it was not actually cheaper in terms of cost per pound of malt. Bear in mind, too, that pale malt had become less expensive in relation to brown as the maltsters improved their techniques, especially as coke for kilning was now widely available. Add the fact that the hydrometer showed brown malt gave a lower yield of fermentable extract than pale malt on an equivalent weight basis, and brewers realized that brown malt was actually quite expensive!

Through most of the 18th century, brewers had no real idea of the strength of their beers. All they could say was that more malt gave a stronger beer. The hydrometer allowed them to measure the original gravity of porters and see how they related to other beers. In 1784 the first publication on this subject, Richardson's *Statical Estimates*, gave average original gravities of five porters as 1.071, while seven samples of Common Ale averaged 1.075. The 1744 recipe I referred to earlier was calculated as having an original gravity of 1.075.

The brewers tried to cut down on the use of brown malt, but could not give it up entirely, because that was what gave porter its characteristic flavor. Some of the smaller and more unscrupulous London brewers resorted to additives to give cheaper beer the "true" porter flavor. Some of these were quite nasty, including things like sulfuric acid and opium, while others, such as licorice, were more acceptable. What finally turned things around was the development of roasted malt by Daniel Wheeler in 1817. His "patent black malt" enabled brewers to use pale malt as the main source of fermentable extract, with a small proportion of roasted black malt to give the desired color and flavor.

Until later in the 19th century, when chocolate malt was invented, black malt was the only alternative to brown. Black malt gives beer a bitter flavor, so porters produced from pale and black malt had a somewhat harsher taste than those produced from brown malt. In effect, beers brewed in this way were a different type of porter, and are now sometimes referred to as "Victorian" or "robust" porter.

Porter's popularity starts to sag

Porter started losing sales in the 19th century. First, pale ales had grown popular as glass mugs had become common in pubs, and as the Burton brewers developed India pale ale. Second, in their quest for better economics, brewers started to move away from long storage of beers. They began to produce so-called "running" beers, which were shipped out of the brewery only a month after brewing. To begin with, they might add a proportion of well-aged beer to a new one to improve its flavor. In some cases they even provided publicans with casks of new and "stale" porter, which would then be mixed in the pub — a return to the situation when the first porter was brewed!

Of course, porter didn't disappear quickly; even in 1863 it still represented some 75% of the London beer market. But many of the porter brewers now produced ales as well — and as pale ales became more popular, some of the big London brewers opened breweries in Burton-on-Trent so they could compete with the likes of Bass and Worthington. As porter declined in volume so it declined in strength, and stout more clearly became defined as a separate style, rather than being just a strong porter.

By 1913, porter was quoted as having an original gravity of only 1.040, as compared to mild ale at 1.050! Mild at this stage had become the most popular beer in Britain, displacing porter almost completely. During the First World War there was an acute shortage of roasted malt and gravities declined still further, and porter ceased to be brewed in London around the 1930s. It did continue to be available in Ireland, where Guinness' "plain" lingered until 1973.

Porter bounces back

Porter began to re-emerge in the 1970s, when Timothy Taylor brought out its version. As the microbrewing revolution took hold there was a revival of interest in the style, and several other regional breweries got into the act. These days a number of breweries offer porter, notably Samuel Smith, with its Taddy Porter, widely available over here, and Fuller's with a beer titled "London Porter." One of interest is Nethergate's Old Growler, brewed according to a 19th-century recipe with coriander.

Oddly, porter was slower to disappear from the United States. The style was quite widely brewed over here in the 19th century, with Philadelphia porter being the most famous. Yuengling's of Pennsylvania, the oldest brewer in the States, still offers a porter (though it is now bottom-fermented in the lager style). The common wisdom is that pale lagers pushed out ales in general, and porter in particular, especially after Prohibition. That was certainly not true in New England, where a good many brewers continued to offer both porter and ale well after Prohibition had ceased. In the late 1970s, Narragansett Brewery was still producing its porter, and it has the (dubious) distinction of being the first commercial porter I ever drank!

Many new porters were born during the American microbrewing revolution. Two of the most successful micros, Sierra Nevada and Anchor, have both had porter in their portfolios, as do Full Sail from Portland and Wild Goose from Maryland, along with many others. Lots of brewpubs have their own versions, such as the Presumptuous Porter we brewed at Brü-Rm at BAR in New Haven. Quite a few micros have gone for the idea that the original might have had a smoked flavor, and, notably, Alaskan Smoked Porter has achieved a deservedly good reputation. Very early in the craft-brewing explosion, Greg Noonan also came up with an excellent smoked porter at the Vermont Pub and Brewery in Burlington. Porter may not be as popular now as it was in the 18th century, but there is something about the beer that intrigues home and craft-brewers, and they almost all have a go at the style, sooner or later!

Base malt and extract

You can use brown malt if you like, and I'll discuss that later, but most modern porters use pale malt as a base, and crystal and chocolate or black malts for color and flavor. British pale malts may be most authentic, but U.S. two-row malt will give a result that's just as good. Although not authentic, some Munich malt (15-20% of the grist) makes a good addition to the soft complexity of this beer. Crystal malt is vital, since it gives a nutty, caramel flavor and color. Porter should have a nice, warming reddish hue, and crystal will help with that. This means you should go with the higher-roasted crystal malts (80–120 °L), at a rate of around 0.5–1 pound (0.23 to 0.45 kilogram) per 5-gallon (19-liter) brew.

For a "brown" porter, add a little chocolate malt, up to 0.5 pounds (0.23 kilograms) in 5 gallons (19 liters). You do not want to overdo it, as you do not want to make the beer too dark, or to have too much of a roasted flavor. For a "robust porter" black malt is the answer, up to a maximum of 6 ounces (168 grams) in 5 gallons (19 liters). Again, don't overdo it. You want to taste the bitter, roasted flavor of the black malt, but you don't want it to dominate the beer. And, of course, you can mix black and chocolate if you like, but keep the total roasted malt to a maximum of 0.5 pounds (0.23 kilograms) per 5 gallons (19 liters).

Clearly, this is a fairly simple approach, and it lends itself well to malt extract brewing. Simply use a pale extract as foundation and add the specialty grains (crystal, chocolate or

MAKING BROWN MALT at home

The following is based on directions given in "Old British Beers and How to Make Them" (Dr. John Harrison, 1991).

Take a large cookie sheet, line it with aluminum foil and cover with two-row pale malt to a depth of about 1/2 inch (a bit over 1 cm). Place the malt in a pre-heated oven at 200–220 °F (93–104 °C) for 40–45 minutes, to ensure it is evenly heated. Raise the oven temperature to 300 °F (148 °C) and hold for 60-70 minutes to reach the amber malt stage. Remove a few grains for later testing, then raise the oven temperature to 350 °F (177 °C) for 30-40 minutes to obtain brown malt. Remove the cookie sheet from the oven, and allow the malt to cool before use.

You may need to adjust these times according to your own oven's characteristics; do not go to higher temperatures, as above 400 °F (204 °C) the malt may char badly.

To test the malts, take some of the starting pale malt, some of the amber malt, and some of the brown malt, and slice them in two across the center. Look at the center of each grain: the pale malt should appear white, the amber slightly more brown than the pale, and the brown should be a definite light brown, or khaki color. Remember that brown malt produced in this way cannot be mashed alone; it has no starch-converting enzymes of its own, and must be mixed with pale malt before mashing.

PERFECT PORTER recipes

PORTER by the numbers

OG	1.045–1.060 (11–14.7 °P)
FG	1.010–1.015 (2.5–3.8 °P)
SRM	35–70
IBU	25–45
ABV	4.5–6.0%

All-grain recipes

Standard Brown Porter

(5 gal/19 L, all-grain)

OG = 1.058 FG = 1.012
SRM = 55 IBU = 32

Ingredients

7.5 lbs. (3.4 kg) two-row pale ale malt (3-4 °L)
1 lb. (0.45 kg) crystal malt (80 °L)
0.5 lb. (0.23 kg) chocolate malt
8.5 AAU East Kent Goldings hops (bittering)
(1.7 oz./48 g of 5% alpha acid)
0.5 oz. (14 g) East Kent Goldings hops (flavor)
Wyeast 1098 (British Ale) yeast or White Labs WLP002 (English Ale)
0.75–1 cup DME or corn sugar

Standard Robust Porter

(5 gal/19 L, all-grain)

OG = 1058 FG = 1014
SRM = 50 IBU = 35

Ingredients

6.0 lbs. (2.7 kg) two-row pale ale malt (3-4 °L)
2.0 lbs. (0.9 kg) Munich malt (8 °L)
1 lb. (0.45 kg) crystal malt (80 °L)
4 oz. (112 g) black malt
9.3 AAU English Fuggles hops (bittering) (1.9 oz./53 g of 5% alpha acid)
0.5 oz. (14 g) Fuggles hops (flavor)
Wyeast 1098 (British Ale) yeast or White Labs WLP002 (English Ale)
0.75-1 cup DME or corn sugar

Step by Step

Use a single-step infusion mash at 153–155 °F (67–68 °C) for 1–1.5 hours (lower temperatures will result in a drier, lighter beer). Sparge one hour, with water no hotter than 175 °F (80 °C), until run-off reaches SG 1.010–1.012. Boil 90 minutes, with bittering hops added after the first foamy head subsides. Add flavor hops 15 minutes before the end of the boil. Adjust wort volume with cold water, and cool to about 70 °F (21 °C). Pitch with yeast starter, and allow to ferment. By 5–7 days, final gravity should have been reached; rack into a glass fermenter. One to two weeks later, rack again, prime with DME or corn sugar, and rack into keg or bottles. The beer should be ready to drink after conditioning for a week or so.

Presumptuous Porter

(5 gal/19 L, all-grain)

OG = 1.075 FG = 1.018
SRM = 127 IBU = 60

This beer is from a 1744 recipe, first translated by Dr. John Harrison of the Durden Park Beer Circle in England. I adapted this to my own 5-gallon (19-liter) brewery, and we then produced it on a 10-barrel scale at Brü-Rm at BAR in New Haven. It violates some of my "rules" discussed above, but it was received extremely well at a public tasting.

Ingredients

9 lbs. (4.1 kg) Briess 2-row pale malt
1.5 lbs. (0.7 kg) crystal malt (80 °L)
0.8 lb. (0.4 kg) black malt
1.5 lb. (0.7 kg) Crisp brown malt (38 °L)
16 AAU Magnum hops (bittering) (1.3 oz./36.4 g of 12.4% alpha-acid)
1 oz. (28 g) East Kent Goldings (flavoring, add at 75 minutes boiling)
1 oz. (28 g) East Kent Goldings (flavoring, add at end of boil)
Wyeast 1098 (British Ale) yeast
0.75–1 cup DME or corn sugar

Step by Step

Proceed exactly as with other all-grain beers; sparging may need to last up to a half-hour longer, because of the large amount of grain. The cooled wort must be well aerated (oxygenated if possible) to ensure a good fermentation.

1822 Porter

(5 gal/19 L, all-grain)

OG = 1.055 FG = 1.015
SRM = 64 IBU = 38

Ingredients

3.0 lbs. (1.4 kg) 2-row Maris Otter pale malt (2.5 °L)
3.0 lbs. (1.4 kg) Muntons amber malt (40 °L)
3.0 lbs. (1.4 kg) Crisp brown malt (38 °L)
8.5 AAU East Kent Goldings hops (bittering) (1.4 oz./39 g of 6% AA)
1 oz. (28 g) East Kent Goldings hops (flavor, after 75 minutes boiling)
1 oz. (28 g) East Kent Goldings hops (flavor, at end of boil)
Wyeast 1028 (London Ale) yeast
0.5 cup cane sugar for priming

Step by Step

Proceed exactly as with the other all-grain beers. This is an excellent beer, with a lovely, long, biscuity finish that merges into the hop bitterness. The finished beer has little hint of roastiness, lots of full body, and a slight licorice note. This beer is well worth the effort of finding the unusual grains.

Partial mash recipe

Brown Malt Porter

(5 gal/19 L, partial mash)

OG = 1.055 FG = 1.019
SRM = 60 IBU = 30

Ingredients

5.5 lbs. (2.5 kg) plain amber liquid malt extract (such as John Bull or Muntons)
1.5 lbs. (0.7 kg) 2-row pale ale malt (3-4 °L)
0.5 lb. (0.23 kg) Crisp brown malt (38 °L)
0.5 lb. (0.23 kg) crystal malt (80 °L)
8.0 AAU US Fuggles hops (bittering) (1.6 oz./45 g of 5% alpha-acid)
1 oz. (28 g) US Fuggles hops (flavor)
Wyeast 1098 (British Ale) yeast or White Labs WLP002 (English Ale)
0.75–1 cup DME or corn sugar

Step by Step

Place all the milled grains in a muslin bag, add to 2 gallons (7.6 liters) of water at 165 °F (74 °C), and keep at 150–155 °F (66–68 °C) for 30 minutes to 1 hour. Remove the bag, rinse with hot water, and combine this water with that from the partial mash. Add the malt extract, stirring well to ensure it is properly dissolved, then bring to a boil. Follow instructions as under the other malt extract recipes for hopping, fermenting and conditioning.

Extract recipes

Standard Brown Porter

(5 gal/19 L, extract and grains)

OG = 1.056 FG = 1.012

SRM = 55 IBU = 32

Ingredients

6.6 lbs. (3 kg) plain pale malt extract syrup (Coopers, John Bull or Muntons)
0.5 lb. (0.23 kg) pale DME
1.0 lb. (0.45 kg) crystal malt (80 °L)
0.5 lb. (0.23 kg) chocolate malt
8.5 AAU East Kent Goldings hops (bittering) (1.7 oz./48 g of 5% alpha acid)
0.5 oz. (14 g) East Kent Goldings hops (flavor)
Wyeast 1098 (British Ale) yeast or White Labs WLP002 (English Ale)
0.75–1 cup DME or corn sugar for priming

Standard Robust Porter

(5 gal/19 L, extract and grains)

OG = 1056 FG = 1014

SRM = 50 IBU = 35

Ingredients

6.6 lbs. (3 kg) plain pale malt extract syrup (Coopers, John Bull or Muntons)
0.5 lb. (0.23 kg) pale DME
1.0 lb. (0.45 kg) crystal malt (80 °L)
4 oz. (112 g) black malt
9.3 AAU English Fuggles hops (bittering) (1.9 oz./53 g of 5% alpha acid)
0.5 oz. (14 g) Fuggles hops (flavor)
Wyeast 1098 (British Ale) yeast or White Labs WLP002 (English Ale)
0.75–1 cup DME or corn sugar

Step by Step

Add specialty malts to 1 gallon (3.8 liters) water, bring to 170 °F (77 °C), and strain off malts. Add water to 3 gallons (11.4 liters), and bring to a boil. Turn off heat and add extracts, stirring well to ensure the extracts are properly dissolved. Return to heat.

Bring to a boil, add the bittering hops, and boil one hour, with flavor hops added for last 15 minutes of the boil. Strain, or siphon off from the hops, and add cold water sufficient to obtain the starting gravity of 1.058. Cool to around 70 °F (21 °C), and follow instructions for all-grain beers for fermentation.

black) discussed above, by the usual steeping method. You can use darker extracts if you prefer, but would then want to adjust the crystal and roasted malts downwards. A number of companies also sell pre-hopped porter kits.

For all-grain recipes, there are further options in brown and amber malts that are available over here. Your supplier may not have them as a stock item, but he should be able to get the brown reasonably easily, although amber is a little scarcer. You also can make your own brown malts by toasting them in an oven *(see page 33)*.

Brown malt will give the beer a beautiful red hue and a biscuity flavor, as well as a feeling of authenticity. As I said, brown malt is drum-roasted pale malt, not wood-kilned green malt as was the original. Remember: This brown malt cannot be mashed on its own, as it still contains unconverted starch, but no enzymes. Therefore it needs to be mixed with pale malt, in a proportion of up to one-third of the total. Amber malt, which is also lightly roasted, gives some interesting toasted notes to the beer. I have made an excellent version of an 1822 porter recipe, with a 1:1:1 ratio of pale, amber and brown malts. (Note that you cannot use brown malt with an extract recipe, because it needs to be mashed; just steeping it in hot water will give you a mess! If you would like to experiment, you would need to do a partial mash along with some pale malt.)

Picking hops for your porter

For hops, the obvious approach is to use the classic English varieties, Goldings and Fuggles. These hops are not traditional as far as the first porters are concerned, since neither variety was developed until later. (Goldings is the oldest, and only goes back to 1785.) So you can use whatever you like.

Porter should be a balanced beer — complex, but with no single outstanding flavor. With that goal in mind, be sure you pick hops with good aromatic character for both bittering and aroma. Typically, you can use Goldings and Fuggles, Hallertauer, Saaz and American varieties such as Willamette, Mount Hood and Fuggles (the U.S. variety are milder in flavor than the English). Be careful with high alpha-acid hops; you want a definite bitterness, but do not overdo it. (One notable exception is Larkins, a small brewery in Kent that uses Goldings to produce a porter with unusually high bitterness. I made my own version of this with 58 IBUs, and it was excellent!)

Hop aromatic character is a little more debatable — it would not have been present in the original, as hop chemistry was not then understood, but lightly done can add to the complexity of this wonderful beer.

The right yeast for the job

Porter has to be brewed with top-fermenting yeast. You want a clean fermentation, without fruity-tasting esters. Wyeast 1098 (British Ale) is excellent, as is 1028 (London Ale) or White Labs WLP002 (English Ale). A high ester producer, such as the Ringwood strain, is probably not suitable. For the same reason, you do not want fermentation temperatures to stray too high above 70 °F (21 °C).

Proper porter water

One reason porter was suited to brewing in London is that the city's water is high in temporary hardness (calcium carbonate). The acidic brown malt could handle this but pale malt could not, since mash pH would be too high for the malt enzymes to do their job efficiently. You could try to match London water, but most homebrewers would rather not mess with water treatments. *(If you want to give it a whirl, see "Clear Water" in the January-February 2002 issue of BYO.)* So long as mash acidity is in the range pH 5.2–5.5, you have nothing to worry about. If it's not, add gypsum (1–2 teaspoons in a mash for 5 gallons or 19 liters of beer). ■

Dr. Terry Foster is the author of "Pale Ale" and "Porter," two books in the Classic Beer Styles series (Brewer's Publications). This is his first article for Brew Your Own.

ILLUSTRATIONS BY SHAWN C TURNER

What is the most important skill in homebrewing? Knowing how to clean and sanitize your equipment. Here's a straightforward guide to doing it right and picking the proper products.

HOMEBREWING is all about having fun. Having fun making our beer, having fun drinking our beer, having fun talking about our beer. Yet the one subject we rarely talk about is the most important one: cleaning and sanitizing our equipment.

Why do we avoid the topic? That question is easy to answer. Cleaning and sanitizing is the boring, dull part of our hobby. Never mind that this is the most critical part of homebrewing. Cleaning and sanitizing is a lot like work, and this hobby is all about having fun, right? Right ... but there's nothing less fun than realizing that sloppy sanitation has laid waste to your latest batch.

In this article I will explain how to clean and sanitize your brewing equipment. I'll also offer an overview of the most common chemicals available to homebrewers today: how well they work, how much to use, advantages and disadvantages, and which ones I like best. I also have listed the leading manufacturers' Web sites at the end of the article, so you can research the chemicals and make your own decisions, if you wish.

As homebrewers today, we can choose among sanitizing chemicals that are easier to use and more effective than most products sold in the past. We also have more choices: Only six or seven years ago, the only cleaning and sanitizing chemicals available to homebrewers were those you could find at the grocery or hardware store. Many commercial brewers use chemicals other than the ones I discuss in

beer minus BACTERIA!

There's nothing less fun than realizing that sloppy sanitation has ruined your latest batch of homebrew.

this article. These chemicals are not typically suggested for home hobbyists, either because they potentially are more dangerous for a novice to use, or are not easily available in small quantities.

A few definitions

First let's define cleaning, sanitizing and sterilizing, since they are entirely different processes and should not be confused.

Cleaning your equipment means that you have removed all of the visible dirt and residue on your equipment, but not living organisms. Cleaning chemicals work by releasing the bonds of the dirt from the surface of your equipment.

Sanitizing means you've treated your equipment with a chemical solution (or heat) that will eliminate all spoilage organisms. You must clean your equipment before sanitizing it, since it is difficult to properly sanitize equipment that still has residue. Sanitizing chemicals kill or neutralize the wild molds, bacteria and yeast that are naturally present in our environment (and on your equipment!).

Sterilizing means the complete elimination of spoilage organisms. This is not realistic in the homebrewing environment.

Time to clean up

So, it's been a few months (or longer) since you made your last batch of beer. Your carboy, airlock and hoses all have stains, and some dirt and residue from your last porter are visible upon close inspection. Where do you start?

Well, first you need to clean your fermenter, airlock, hoses, siphon and any other piece of equipment that is going to contact your beer. This can also include things like spoons and funnels, items that are easy to overlook. It would be easy (and tempting) to just hose them out, but that will expose your beer to contamination and could ruin your next batch.

In teaching brewing classes over the past 12 years, I often refer to the false sense of over-confidence new brewers get from their first few good batches of beer. This early success tricks brewers into thinking that they can back off on their cleaning and sanitation schedule. Of course, the problem is that these new brewers have started with new equipment, and have followed cleaning and sanitizing instructions to the letter. Then, just as their equipment has been used for several batches of beer — and has gradually gotten dirtier and less sanitary with each batch — the brewer starts thinking that a lower level of cleaning and sanitation will still do the trick. That is when they brew their first "bad" batch of beer! This event normally teaches the homebrewer that sanitation must be paramount in order to make good beer.

Soaking and scrubbing

There are two methods of cleaning your equipment: You can either use a cleaning solution and scrub your equipment, which takes less time but more elbow grease, or you can use a chemical and water and give this solution enough time to soak your equipment clean.

I normally use a combination of the two methods, since I often am too impatient to wait for the chemical to work by itself, and am too lazy to scrub everything for hours. I soak my equipment for about 20 minutes with a cleaning solution, then scrub lightly to make sure I have gotten rid of all the residue and dirt. For hoses, airlocks and siphons that you can't scrub, a good cleaning chemical and patience is the best bet, and since these pieces of equipment are inexpensive, you should simply replace them periodically.

When scrubbing any plastic equipment, I would suggest using a sponge or soft cloth towels to avoid scratching. For glass and stainless steel, more abrasive scrubbers like carboy brushes are acceptable, but even with stainless steel it is possible to scratch the surface, so the softer your scrubber, the better.

Most household cleaners should be avoided, since either they are unsafe for human consumption (bathroom and oven cleaners) or they are too mild (dishwashing detergents) to effectively clean your brewery.

Many kinds of cleaners

Percarbonates are a relatively new group of cleaning chemicals that have become available to homebrewers. Percarbonates are a combination of sodium carbonate and hydrogen

By Steve Bader

peroxide (and other secret ingredients, which is basically what separates the various brands from each other), and they effectively remove dirt and deposits from all types of brewing equipment. Percarbonates work with active oxygen and a mild alkali to help lift the grime. The hydrogen peroxide does provide some degree of sanitization, but it is better to rely on them only as cleaners. One of the best properties of the percarbonate family is that they are environmentally friendly.

PBW (Powder Brewery Wash):

PBW is the strongest of the percabonates listed here. This is my favorite cleaner, because it is very effective in dissolving stubborn stains in hard-to-reach places. It works well to clean hoses, airlocks, fermenters, all plastic and all metals with a 30-minute soak. PBW also works well to clean the interior of your Cornie kegs.

PBW works well in hot, warm and cool water. For stubborn stains, an overnight soak is necessary. The solution can be used to soak more than one piece of equipment. A normal dosage is 1 tablespoon per gallon (3.8 liters). Heavy-duty cleaning requires 2 tablespoons per gallon (3.8 liters). Rinse all equipment twice with warm water after using PBW.

PBW is commonly used as a clean-in-place (CIP) chemical in commercial breweries, where it is difficult to reach the surface the brewer is cleaning.

Straight-A, One-Step & B-Brite:

These percarbonates are similar to PBW, but they are not as strong, at about one-third the cost. While they work as well as PBW for most cleaning jobs, they come up short on the really tough jobs. These percarbonates also do not dissolve easily in cold water. Straight-A and B-Brite are both stronger than One-Step.

I do not recommend using One-Step as both a cleaner and a sanitizer, even though the directions suggest it can be used for both. Based on my experience, I just don't think One-Step is as effective as other sanitizers.

These cleaners also work well to remove labels from commercial beer bottles. Use at a rate of 1 tablespoon per gallon (3.8 liters) of warm to hot water, and rinse after cleaning.

Sparkle-Brite (sold in Canada, called Diversol):

Sparkle-Brite is a cleaner that contains TSP (tri-sodium-phosphate) and potassium bromide. This is a corrosive chemical that requires great care when using. While it works well, other chemicals are easier to use, less dangerous to use, and more environmentally friendly. Use at a rate of 1 teaspoon per liter of water (1 tablespoon per gallon) for cleaning.

Pro-Zyme (sold in Canada):

This is an enzyme-enhanced detergent that is effective in removing protein buildup from beer- and winemaking equipment. Use at a rate of 7 grams per liter of hot water (roughly one-quarter ounce per quarter-gallon).

Pro-Zyme is a mild irritant, much like laundry detergent. Leftover residue of this chemical may cause your beer to lose foam retention.

Chlorine bleach:

Chlorine bleach is a good cleaner for glass. It's of limited use for plastic, since it can be absorbed by the plastic, leading to off-flavors in your beer. Chlorine should never be used for stainless steel, since it can actually eat holes through the stainless steel if given a long-enough contact time.

For cleaning glass, use at a rate of about 2.5 tablespoons per 5 gallons (19 liters) of water. Let the solution soak for about 30 minutes, then scrub to remove stubborn deposits. You must rinse heavily to remove the excess chlorine smell. Chlorine is not very effective on beer stone and some other brewing residues, so I would suggest avoiding its use.

Dishwashing detergents:

Standard household dishwashing detergents can be used for light-duty cleaning on boiling pots, spoons, funnels and strainers. I would recommend one without any perfumes that could eventually transfer to your beer. A mild, unscented dishwashing detergent like Ivory should work for your routine cleaning needs. I would not use dishwashing detergents for fermenters, airlocks, beer bottles and caps.

Sanitizing your beer gear

Now that your equipment is clean, the hard part is over. It's time to sanitize your equipment, so you can get to the fun part of brewing. All of the sanitizers listed below are added to water, and then you use the solution to soak your equipment for 2 to 30 minutes.

Bleach and Sparkle-Brite must be rinsed with water; with the others, you can just turn the stuff upside-down and let it drip-dry for 5 minutes.

Star-San:

Star-San is a flavorless, odorless, no-rinse food-grade sanitizer from the makers of PBW. Star-San is an acidic sanitizer developed for the brewing industry. When used according to directions, Star-San will completely eliminate all microorganisms with which it comes into contact. Star-San acts quickly (under 5 minutes) and it foams up, allowing it to sanitize cracks, crevices and other "impossible" places in your equipment.

Star-San will leave a microscopic

Step one: put on that wacky clean-up spacesuit! Step two: dunk your bottles in a no-rinse sanitizer.

common CLEANING and SANITIZING PRODUCTS for HOMEBREWING

Cleaners	comments	recommended dosage	contact time	advantages	disadvantages
PBW (Powder Brewery Wash)	Sodium percarbonate. This product uses active oxygen and mild alkali to clean deposits on equipment. It effectively cleans wine and beer-making equipment.	Dosage varies depending on the dirtiness of the equipment. Approximately 1 tablespoon per gallon (3.8 L) is normal strength. Stronger cleaner than Straight-A, One-Step and B-Brite.	30 minutes to overnight for stubborn stains.	Environmentally friendly, effective equipment cleaner. Can be used to clean multiple pieces of equipment before disposing of solution. Safe for plastics and metals.	More expensive, avoid contact with eyes.
One-Step and B-Brite	Sodium percarbonate. This product uses active oxygen and mild alkali to clean deposits on equipment. It effectively cleans beer-making equipment. I recommend these products only as cleaners.	1 tablespoon per gallon (3.8 L) of warm water, rinse after cleaning.	30 minutes to overnight for stubborn stains.	Environmentally friendly, effective equipment cleaner. Can be used to clean multiple pieces of equipment before disposing of solution. Safe for plastics and metals.	Slightly more expensive, avoid contact with eyes.
Straight-A	Sodium percarbonate. This product uses active oxygen and mild alkali to clean deposits on equipment. It effectively cleans beer-making equipment. Heavier-duty product than One-Step.	1 tablespoon per gallon (3.8 L) of warm water, rinse after cleaning.	30 minutes to overnight for stubborn stains.	Environmentally friendly, effective equipment cleaner. Can be used to clean multiple pieces of equipment before disposing of solution. Safe for plastics and metals.	Slightly more expensive, avoid contact with eyes.
Sparkle-Brite (Diversol in Canada)	Sanitizing detergent. Primarily used in beer-making. Contains clorinated tri-sodium-phosphate and potassium bromide.	1 teaspoon (3.5 grams) per 0.25 gal (1 L) of cold water for cleaning.	Soak or scrub surface, soak overnight for stubborn stains.	Effective cleaner for stubborn stains if left to soak for up to 48 hours.	Corrosive, avoid breathing and skin contact. Avoid contact with acids. Somewhat dangerous to use.
Pro-Zyme (Canada)	Enzyme-enhanced detergent.	7 grams/liter of hot water.	Soak or scrub surface, soak overnight for stubborn stains.	Effective for removing protein buildup in equipment.	A cleaner only, requires elbow grease or long soak.
Dishwashing detergent	Mild detergent. Requires scrubbing to clean surfaces.	1 teaspoon per gallon (3.8 L) of hot water.	Requires scrubbing to be effective.	Inexpensive, readily available.	Low-strength cleaner, good for only the most routine cleaning chores. Be careful not to scratch surfaces.

Sanitizers	comments	recommended dosage	contact time	advantages	disadvantages
Star-San	Excellent food-grade sanitizer. No rinsing required. Foaming action penetrates hard-to-reach areas in your brewery. Can sanitize for a few days!	1 fluid ounce (30 mL) per 5 gal (19 L) of water. Effective in a pump applicator. Do not rinse.	Under 2 minutes!	Easy to use, effective sanitizer, no-rinse sanitizer.	Seems expensive on cost-per-ounce basis, but is actually inexpensive on cost-per-use basis.
Iodophor	Excellent equipment sanitizer. Iodine-based detergent.	1 tablespoon per 5 gallons (19 L) of liquid. Spray or soak equipment. Drip dry, do not rinse.	10 minutes for equipment.	Easy to use, effective sanitizer, no-rinse sanitizer.	Concentrated solution will stain skin and fabric, not a good cleaner.
Heat	Wet heat in boilpot is effective sanitizer for wort chillers above 200 °F (93 °C). Dry heat must be above 350 °F (177 °C).	Temperatures above 200 °F for wet heat, contact time 10 minutes or more. Dry heat above 350 °F for 30 minutes.	10 minutes for wet heat, 30 minutes for dry heat.	No chemicals required.	Dry heat requires long contact time, can weaken glass equipment.
Sparkle-Brite (Diversol in Canada)	Sanitizing detergent. Primarily used in beer-making. Contains clorinated tri-sodium-phosphate and potassium bromide.	1 teaspoon (3.5 grams) per 0.25 gal (1 L) liter of cold water.	Must have a minumum 20-minute contact time to sanitize.	Works as both a cleaner and a sanitizer, but avoid using same solution for cleaning and sanitizing.	Corrosive, avoid breathing of dust and skin contact. Avoid contact with acids. Somewhat dangerous to use.
Chlorine (bleach)	Not recommended for use in beer-making. Extremely effective in killing virtually any living organism, including yeast.	2.5 tablespoons per 5 gal (19 L) of liquid.	5 minutes for equipment.	Inexpensive, easily obtained.	Kills everything in sight (including beer yeast), but must be heavily rinsed, possibly re-contaminating equipment.

film on sanitized items that will continue to protect your bottles and equipment even after they have dried. This residue will not affect the quality, flavor, clarity or color of your beer.

Star-San can be mixed at a rate of one fluid ounce per 5 gallons (30 mL per 19 liters). This solution can be put into a spray bottle and used as a spritz-on sanitizer, reducing the quantity you need. Star-San is effective as long as the pH is less than 3.5, at which point it will turn cloudy to signify its lack of ability to sanitize. Star-San is environmentally friendly, biodegradable, and will not harm the "helpful" bacteria in a septic system.

While Star-San is the most expensive sanitizer per ounce, it also is the most effective chemical sanitizer readily available to homebrewers, requires the least amount of time to sanitize, and is cost-effective when used in the spray-bottle form.

Iodophor:

Iodophor has been the most common homebrew sanitizer the past 7 years or so. Iodophor is used by the food-service and medical industries to sanitize equipment. Iodophor is an iodine detergent, germicide and sanitizer. The most common brand names are BTF and BEST.

I have used iodophor for a number of years in my brewing. I love it because it's a no-rinse sanitizer and very easy to use. A solution of 12.5 ppm (part per million) takes approximately 10 minutes to sanitize your equipment. I like to make up a solution at a rate of 1 tablespoon per 5 gallons (19 liters). I soak or spray my equipment, then allow it to drip-dry for at least 10 minutes. No rinsing is necessary at this concentration.

You can re-use the solution as long as the original orange-amber color is still apparent. The solution will hold its color for up to a week in a sealed container. The concentrated iodophor solution will stain fabric, so you need to be a bit careful when pouring to make your solution.

Sparkle-Brite:

Sparkle-Brite (or Diversol) is a sanitizing detergent, used primarily for beer-making in Canada. This is an effective sanitizer, but it must have a minimum 20-minute contact time to sanitize. This is a corrosive chemical that requires great care when using. While it works well, there are other chemicals that are easier to use, less dangerous to use, and more environmentally friendly.

Dry or wet heat:

The only effective method of using heat in a homebrewery is boiling your wort, which we all do, or using the oven and its dry heat to sanitize bottles and other heat-resistant equipment.

You can sanitize an immersion wort chiller by submerging it in your boiling wort for the last 15 minutes of the boil. If you make yeast starters, you can sanitize the starter wort in glass canning jars with metal lids. You place the jars in hot water at 180 °F (82 °C) for 20 minutes, then gradually cool them to room temperature to avoid breaking the jars.

Using your oven to sanitize heat-resistant bottles and such is effective, but does take extra time, since the bottles must be both heated and cooled slowly, and normally the stress of heating and cooling will weaken the bottles. While dishwashers have also been used and suggested for this task, the risk of bacterial contamination is fairly high due to food residue in the dishwashers, and is not recommended.

Chlorine bleach:

Chlorine bleach is a good sanitizer for glass equipment, but it's of limited usage for plastic, since the chlorine can be absorbed by the plastic, leading to off flavors in your beer. And it can corrode stainless steel.

For sanitizing, use at a rate of about 2.5 tablespoons per 5 gallons (19 liters) of water, and let the solution soak for about 5 minutes. You must rinse heavily to remove the excess chlorine smell, and if you are rinsing with well water, you could re-contaminate your equipment.

If your tap water is heavily chlorinated, it is impossible to totally remove the chlorine, unless you have filtered the water with a carbon filter. Chlorine's biggest disadvantage is that it can kill yeast cells in even the lowest concentrations, so any breakdown in rinsing can lead to fermentation problems. I see no reason to use chlorine in your home brewery unless you do not have access to Star San or iodophor.

My recommendations

If I had easy access to all of these cleaning and sanitizing chemicals, what would I do? My cleaner of choice is easily the percarbonate PBW. It is strong, works effectively, requires a minimum of effort, and is environmentally friendly. The cost is about $10 to $12 a pound, which should get you through about 12 to 15 five-gallon batches of beer. While this cost is slightly higher than the other cleaners, it is worth the few extra dollars in time saved and peace of mind. As a compromise, you could use a combination of Straight-A for routine cleanings and PBW for your aggressive cleanings. Standard dishwashing detergent could be used for equipment that comes in contact with your beer prior to boiling.

After I have cleaned my equipment, I would suggest using Star-San and the spray-bottle method of coating the surfaces. For the inside of glass carboys, remove the spray nozzle and pour in a few tablespoons of the solution. Then turn the carboy to coat the entire interior surface.

Using PBW and Star-San will make cleaning and sanitizing a simple task, so you can get on to the most important job — opening your latest bottle of homebrew to share with friends! ■

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Fermentation

Homebrewing options for fermenting your wort

by Chris Colby

PHOTO COURTESY OF BLICHMANN ENGINEERING

On brewday, you make your wort. Then you unleash an army of yeast cells to turn the wort into beer. The biochemical details of fermentation are the same for all brewers, whether professional or homebrewer. However, homebrewers approach their fermentations with a different set of equipment and operate at a much smaller scale than professional brewers do. In this article, I will discuss the homebrew-specific aspects of fermentation, including fermentation options, equipment and what to do if you experience a stuck fermentation.

Open vs. Closed Fermentation

Homebrewers have the choice of performing an open or closed fermentation. As the name implies, open fermentations take place in a container that is open to the environment. Traditionally, most English ale breweries used open fermenters and some still do. One advantage to an open fermentation is that the yeast have access to environmental oxygen during fermentation. Breweries that use open fermentation typically have wide, shallow fermenters that expose much of the surface area of the wort to air. The fermenter shape itself may also influence the development of beer flavor. Most homebrew fermenters, in contrast, are relatively tall and deep. The absolute depth of most homebrew fermenters, however, is not that great.

The obvious problem with open fermentation is that the wort can easily become contaminated by airborne microorganisms, leading to sour or other off-flavors or aromas. Some breweries with open fermenters use positive pressure in the fermentation room to reduce the chance of contamination. Filtered air is pumped into the room, resulting in a net flow of air — and things floating in the air — out of the room.

Closed fermentations take place in sealed containers. The carbon dioxide gas (CO_2) produced is vented through some sort of pressure release mechanism — homebrewers use a fermentation lock or blow-off tube. Most commercial breweries use closed fermentations. Likewise, the vast majority of homebrewers use closed fermentations to lower the risk of contamination.

If you do want to try an open fermentation, select a top-fermenting strain of ale yeast and the widest fermenter you can find. You can use a stainless-steel kettle, if you'd like. Place the fermenter in the cleanest room (or closet) in your house and make sure it won't be disturbed by kids or pets. Make and pitch a yeast starter so you get the fermentation started as soon as possible. Consider putting a lid on the fermenter until there are visible signs of fermentation. Then, remove the lid and let the beer undergo primary fermentation. Rack the beer to a closed secondary fermenter or package it when primary fermentation stops.

Secondary Fermentation

Many homebrewers perform a "secondary fermentation" of their beers. Secondary fermentation simply

1. A glass carboy is the fermenter of choice for most homebrewers. Although breakable, the glass won't absorb odors and is impermeable to oxygen.
2. Cylindro-conical fermenters allow you to perform primary and secondary fermentations in the same tank.
3. Fermentation buckets are the old homebrewing standby. Buckets are cheap, easy to clean and block light from your beer.

means the beer is racked to another vessel (a secondary fermenter) and allowed to age prior to bottling or kegging. Despite the name, the beer does not begin a second phase of fermentation. For this reason, some people call this phase conditioning or maturation instead of secondary fermentation.

The main advantage to secondary fermentation is that the beer is racked off the trub and yeast from the primary fermentation. If the beer remains in contact with these materials for too long, the beer can pick up "meaty" or "brothy" off-flavors. How long a beer can remain in primary is a debated point among homebrewers. Some rack their beer as soon as primary fermentation has stopped, or slowed substantially. Others report batches that have sat in primary for months and still tasted fine.

Two disadvantages of racking a beer to a secondary fermenter are the potential to expose the beer to microorganisms or oxygen during the transfer. If you practice good cleaning and sanitation procedures, the first disadvantage is negligible. However, this still leaves the problem of oxygen pickup. To minimize this, rack your beer as quietly as possible. Keep the outflow end of the racking tube under the beer in your secondary fermenter. Some homebrewers use secondary fermenters that are smaller than their primary fermenters to minimize the headspace in the secondary fermenter. In addition, they may top up their secondary fermenters with water that has been boiled, then cooled.

If possible, you should lower the temperature of your beer during secondary fermentation. Both ales and lagers benefit from a period of cold bulk conditioning. One or two weeks of cold conditioning, below 40 °F (4.4 °C), is sufficient for most ales. Lagers are typically aged longer (up to three months) around freezing.

To perform a secondary fermentation, clean and sanitize a fermenter and racking cane. Rack the beer from primary to the secondary fermenter once primary fermentation has ceased. Wait until the beer clears, then move the beer to bottles or a keg.

If you do have a **stuck fermentation**, you need to **correct** the **situation** as **quickly** as possible. The best **remedy** is to **immediately pitch** an **adequate** amount of **yeast.**

Temperature

Once the wort has been cooled, aerated and the yeast has been pitched, the primary task for the homebrewer is to maintain the temperature at a suitable level. Homebrewers employ many diverse methods for temperature control and these have been discussed in detail elsewhere. See my article "Make Me Sweat" *(Summer 2001)* and Glenn BurnSilver's "Chill Out" *(January-February 2001)* for suggestions on cooling and heating your wort, respectively.

Fermentation Equipment

The two most popular fermenters for homebrewers are buckets and carboys. For homebrewers with some spare change, cylindro-conical fermenters also are gaining in popularity.

Buckets: Like most homebrewers, I fermented my first batches of beer in a bucket. A bucket fermenter should be made of a food-grade plastic that is not affected by alcohol. Most homebrew bucket fermenters are made from HDPE (High-Density Polyethylene) plastic, which can easily withstand any of the substances found in a normal batch of homebrew. Five to seven-gallon (19–26.5 L) buckets are the most common sizes.

As a fermenter, buckets have several advantages. Buckets are cheap and, for all practical purposes, nonbreakable. Unless you place them in direct sunlight, most will shield your wort from harmful levels of light. Light can cause skunking and perhaps cause mutations in the yeast. They are easy to clean because, unlike carboys, you can reach all the surfaces without a brush. A bucket can also withstand the temperature extremes of homebrewing, from boiling to cool liquids. In addition, buckets have handles and are stackable, which saves storage space — so what's not to love?

Well, over time plastic buckets will absorb flavors and odors from the materials in contact with them and some sanitizers — iodine, for example — can discolor the plastic. Bleach will also leach into the plastic. Many homebrewers believe that plastic buckets become progressively more susceptible to harboring contaminants the longer they are used. They argue that small scratches in the plastic provide hiding places for bacteria. Finally, plastic is oxygen permeable. Over time, oxygen can diffuse into your beer.

The point about sanitizing is debatable, but the fact that buckets gradually become discolored and take on an aroma isn't. I still have my very first homebrew bucket. I can detect a vaguely beer-like smell coming from it from a couple feet away. I'd brew a batch of beer in it if I had to . . . as long as the beer was a ginger-raspberry Imperial stout lambic.

Of course, buckets are cheap enough that you can simply replace them when they become unusable. Like tubing, they are something that should be replaced periodically. A brand-new bucket fermenter will last for many batches and have no adverse impact on your beer. As long as it cleans up and doesn't harbor any aromas, you can keep using it. As for oxygen permeability, this shouldn't be a problem during active fermentation. There will be plenty of yeast cells to scavenge any oxygen while the batch is still fermenting. However, to be safe, you should never let a batch sit for too long in a plastic bucket once fermentation has subsided. For this reason, many homebrewers use a bucket for primary and a carboy for secondary.

Carboys: Glass carboys are available in a variety of volumes, with 2, 3, 5 and 7 gallon (7.6, 11, 19 and 26.5 L) volumes being common. Carboys are cheap, but have many disadvantages compared to buckets. They are slippery when wet and breakable if dropped, making handling them potentially messy and dangerous. Carboys do nothing to block light and you need a brush to clean them. You can crack a carboy if the temperature changes too quickly in it, for example if you pour hot wort into room temperature glass. Carboys also take up a lot of storage space, as they aren't stackable.

Despite these shortcomings, most homebrewers prefer carboys to buckets. The primary reason for this is that glass will never absorb any flavors or odors and can be completely cleaned after use. Handled properly, the carboy will remain flavor-neutral forever. In addition, oxygen cannot permeate glass. So, you can let a batch of beer age indefinitely without worrying about oxygen getting to the beer through the glass. For many homebrewers, these two advantages outweigh all of the disadvantages.

In addition, the shortcomings of carboys — except for the extra effort of cleaning them — are easily overcome. If you make sure to siphon cool wort to your fermenter, wipe off any liquid on the outside before moving it and cover it with a dark T-shirt, you will be fine. If you are overly worried about flying glass from a breaking carboy, you can wrap the carboy in a criss-cross pattern with duct tape. This won't keep a carboy from breaking, but it will ensure that most of the glass shards will be contained if it does break.

Glass can develop beer stone, however. Beer stone is a deposit of minerals that often builds up on beer equipment, especially when hard water is used. If your carboy develops beer stone, you can remove it with vinegar or a commercial scale-removing solutions such as CLR.

Cylindro-conical fermenters: If you can afford one, stainless-steel fermenters are a great choice. Cylindro-conical fermenters are available in 7-gallon (26.5 L) and larger sizes. Cylindro-conical fermenters allow open or closed fermentation, are accessible for cleaning and light proof. Stainless steel won't absorb flavors or aromas. It can handle homebrew-relevant amounts of temperature stress and is not fragile, like glass.

Cylindro-conical fermenters also have features that buckets and carboys lack. A valve at the bottom of the fermenter allows you to draw off yeast and trub that has sedimented. So, you can perform both primary fermentation and conditioning (secondary fermentation) in it. Many include a racking arm for transferring beer to Corny kegs. In addition, some have glycol jackets for controlling the temperature during fermentation.

Stainless steel fermenters start at around $400 and proceed upwards. Plastic models, starting around $100, are also widely available and offer a good, affordable alternative.

Fermentation locks: Homebrewers performing closed fermentations seal their fermenters with either a fermentation lock or a blow-off tube. Fermentation locks sit on top of your fermenter and seal the wort from the outside with a layer of water. As carbon dioxide is produced, it must bubble through the water to escape. Your fermentation lock should be thoroughly cleaned and sanitized before placing it on your fermenter.

The two most popular fermentation locks are the "S" type tube and the "jiggle hat" locks. Either works fine under most circumstances. If your fermenter will be cooled after the lock is placed, the "S" type of lock can prevent "suckback" — the condition where lock liquid is drawn into the fermenter by the lowering pressure in the fermenter brought about by cooling. If you fill the "S" lock with the minimal amount of water it will bubble backwards and not be sucked into the fermenter. If you add too much water to an "S" type lock, the whole column of water in the lock can be deposited into your beer. The water itself wouldn't be a problem, but without the water the barrier to contaminants would be gone. Plus, if your water wasn't sterile, it could contaminate your wort. Another way to avoid suckback is not to affix the fermentation lock until the carboy is at a stable temperature and fermentation has begun. You can fill the fermentation lock with water or some form of sanitizing solution. Adding water to the lock allows you to monitor your fermentation by smelling the gas escaping from the carboy without having its aroma tainted by the sanitizing solution. And, if suckback seems likely, you will avoid getting sanitizing solution in your wort.

Some homebrewers, however, add sanitizing solution to their locks as an added protection against contamination. For this, you can add dilute solutions as you would use for sanitizing your equipment. Alternately, you can use alcohol, such as cheap vodka. Be aware that some types of plastics can be clouded or cracked by some chemicals, so watch that your solution isn't destroying your lock.

Blow-off tubes: During early fermentation, a blow-off tube is an alternative to a fermentation lock. A blow-off tube is a tube that extends from the fermenter to a small bucket of water. During early fermentation, kraeusen is pushed through the tube and out of the fermenter. Kraeusen, and the gunk that floats in it, does not taste good and using a blow-off tube is a way of separating this material from your wort.

Most homebrewers using blow-off tubes ferment in carboys. They fit a large-diameter Tygon tube over the neck of the carboy and place the other end in a large glass or small bucket. The carboy must be sufficiently full to allow the kraeusen to reach the tube. However, if the carboy is too full, you will lose some beer. The reservoir should be filled with a sanitizing solution. Otherwise, the kraeusen floating in the water and coating the inside of the blow-off tube can be a pathway for contaminating organisms to enter your wort. After early vigorous fermentation, the blow-off tube can be replaced with a fermentation lock.

Stuck Fermentation

One problem that homebrewers face is stuck fermentations — fermentations that don't start or stop before attaining a reasonable final gravity.

The most common cause of a stuck fermentation is an inadequate amount of healthy yeast in the wort. If you pitch a vial of White Labs liquid yeast without making a starter, you have no idea how many of the yeast cells in the package are alive or healthy. The package may have been frozen or overheated in transit or at the store. Making a yeast starter will ensure that you have healthy yeast when it is time to pitch.

You can tell if the yeast inside Wyeast "smack-packs" are not healthy — the package won't swell. If a package does swell quickly, you'll know that you have some healthy yeast cells in the package. However, you can't see inside Wyeast packs and I have found that it is relatively easy to pour the liquid out of a package and leave the bulk of the yeast behind. If you do use smack packs, be sure to shake well before pouring off the yeast.

White Labs tubes and Wyeast XL smack-packs are billed as "ready to pitch." This is no doubt accurate, but I still recommend making a starter. Starting with plenty of healthy yeast, it's still possible to end up with an underpitched wort if some of the yeast are stunned or killed when pitched. If your wort is too hot — over 100 °F (38 °C) or so — or, if the temperature difference between your wort and yeast is too great, you can end up with too few healthy cells in the wort.

When faced with a potentially stuck fermentation, you should first check to see if the fermentation is really stuck. One possibility is that the fermentation has simply run its course. Under optimal brewing conditions, a normal-strength ale will complete most of its fermentation in three to five days. At higher temperatures, however, the fermentation can go faster. Check and see if there is a ring of kraeusen, which looks like brown crud, around the inside of the fermenter. This is a sign that fermentation has occurred. Second, measure the specific gravity of the beer with a hydrometer.

If you do have a stuck fermentation, you need to correct the situation as quickly as possible. The best remedy is to immediately pitch an adequate amount of yeast. Keeping a couple packages of dried yeast in your refrigerator is a handy way to always have some backup yeast on hand. Pitching two packages of dry yeast should quickly kick-start a stuck fermentation.

Along with the added yeast, you may want to aerate the wort again. Late aerations can cause problems in a beer, however. If the fermentation has progressed less than one-third of the way to the final gravity, aerate the wort as you normally would on brew day. If the wort has fermented more than this before quitting, you are probably better off adding the yeast only.

Some homebrewers attempt to restart fermentation by adding yeast nutrients. However, lack of yeast nutrition is rarely the problem. My advice is to always make a yeast starter and pitch more yeast if necessary. ■

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Flavor Maturation

The journey from green beer to great beer

Homebrew Science

by Steve Parkes

What's the secret to a long life? Drink good beer and age it properly.

Fermentation is a long process that we appreciate as we impatiently watch our carboys bubble away. We rarely think of it as two distinct processes, however. Microbrewers and brewpub brewers tend to use cylindro-conical or unitank fermenters in which fermentation and maturation are almost a continuous process. But in larger breweries and at home, differentiation between the two important parts of beer fermentation is marked by a transfer of vessel and perhaps a change in temperature.

Primary fermentation is the process by which most of the sugar is converted into alcohol and carbon dioxide gas, and a vast array of flavor compounds — some of which are undesirable — are formed. In the past several issues of *Brew Your Own*, I've discussed many issues related to primary fermentation, including yeast *(September 2002)*, fermentation *(October 2002)*, diacetyl formation *(November 2002)* and the formation of other flavor-active molecules *(December 2002)*. In this article, I will discuss the continuing development of beer flavor that occurs in secondary fermentation.

For secondary fermentation — which is also known as lagering, cellaring, ruh storage or maturation — green beer is transferred to a second vessel for the maturation to continue. The vessel may be another tank or fermenter, or even a closed can or a bottle. What happens during the maturation process can have a profound effect on beer quality, yet it is often the area in which brewers tend to make sacrifices. As homebrewers, we all know the feeling of impatience as we wait for our creations to age sufficiently.

There are three main goals of maturation — flavor development, clarification and carbonation. Flavor development is the process in which mature beer flavors develop and green beer flavors — such as diacetyl, acetaldehyde and hydrogen sulfide (H_2S) — are reduced. Clarification is the removal of yeast and haze-causing molecules. Carbonation is the process of dissolving carbon dioxide gas (CO_2) in beer.

Commercial practices

Lager is a German word meaning "to store" and traditionally all the goals of maturation were accomplished by storing beer at around 32 °F (0 °C) for up to three months. Modern commercial brewers cannot afford this luxury and extensive research over recent years has been aimed at reducing that period. Now it is unusual for a lager beer to be aged for over 28 days, since — with modern processes and techniques — all the goals of maturation can be largely accomplished within that period.

Yeast can be removed by filtration, and so long periods of settling time waiting for the beer to clear are unnecessary. Beer can be stabilized to resist the onset of hazes by a variety of techniques, including cold filtration and absorbing chemical compounds.

Carbonation can be adjusted artificially. All these techniques still involve a period of cold maturation to produce a beer that is visually pleasing and long lasting.

Flavor maturation

Maturation can be defined as the removal of green beer flavors and the production of mature beer flavors. Green beer flavors include diacetyl, H_2S and some aldehydes. Mature beer flavors include higher alcohols and esters, which — once formed — cannot be removed from beer.

Vicinal diketones

Vicinal diketones (VDKs) are by-products of the synthesis of the amino acids valine, leucine and isoleucine. Diacetyl (2,3 butanedione) and 2,3 pentanedione are the two most common vicinal diketones found in beer. Diacetyl imparts a butterscotch or buttery flavor to beer.

Using diacetyl as the example, during primary fermentation the yeast will produce alpha acetolactate from pyruvate and excrete alpha acetolactate. Alpha acetolactate is a precursor to valine or leucine production and a product in the pyruvate metabolism pathway. As with many precursors, the yeast cell produces extra alpha acetolactate, ensuring that there are no delays in the amino acid biosynthesis

PATHWAYS OF FLAVOR MATURATION

FERMENTATION ⟶	MATURATION	COMMENTS
diacetyl (or 2,3 butanedione)	acetoin, then 2,3 butanediol	requires yeast, aided by higher temperatures (a diacetyl rest)
acetaldehyde	ethanol	requires trace amounts of zinc
H_2S (in beer)	H_2S (in atmosphere)	requires uncapped fermenter or maturation tank
DMS	DMS	cannot be removed by yeast, must be minimized by employing sound boiling and cooling procedures
yeast (live)	yeast (dead)	can occur if beer is not removed from yeast after primary fermentation

pathway. Some alpha acetolactate is excreted by the yeast and, once outside of the cell, it is spontaneously oxidized and decarboxylated (non-enzymatically) to produce diacetyl.

It is important to note that oxygen is not required for the oxidation of alpha acetolactate, and the presence of metals such as copper (Cu^{2+}), aluminium (Al^{3+}) or iron (Fe^{3+}) will readily cause this reaction. This reaction is also favored in lower-pH and higher-temperature conditions. Diacetyl is responsible for the buttery taste in green beer; it may be perceived as sweet (as in butterscotch) or intense (as in rancid butter).

Once the diacetyl has been formed, it will remain outside of the cell until late in the fermentation. Given the chance, the yeast will absorb the diacetyl and reduce it to acetoin (that has a slight musty character) and then finally to 2,3 butanediol (a higher alcohol with very little aromatic character). So, the buttery taste will vanish. The yeast cell carries out this reduction to use up the NADH ("reducing power") produced earlier in the fermentation, but can only do this if it is still healthy and active.

Vicinal diketone content is seen by many professional brewers as the criterion for judging the state of maturation of a beer. Many large commercial breweries measure the diacetyl content of maturing beer regularly and begin finishing processes once the level has dropped sufficiently.

To facilitate the removal of diacetyl, the brewer must first ensure that it is formed rapidly and consistently during the primary fermentation. A rapid fermentation (i.e. higher temperature), low pH and sufficient Cu^{2+} or Fe^{3+} will aid in the formation of diacetyl. Subsequent removal of diacetyl is facilitated by contact with live active yeast during maturation. Removal of yeast before the end of maturation (due to settling, fining, filtration or cooling) will leave residual diacetyl in the finished beer. If the yeast are unhealthy (due to poor aeration at the beginning of fermentation or high alcohol contents in green beer), they may have rigid membranes, resulting in poor uptake of diacetyl or insufficient reducing power to reduce diacetyl to 2,3 butanediol.

Petite mutant yeasts, also known as respiratory deficient yeast, also tend to leave vicinal diketones in the beer because they lack reducing power at the end of the fermentation (even though they tend to stay in suspension due to poor flocculation qualities).

The traditional way to reduce diacetyl is simply to age the beer until the level has dropped below the flavor threshold. Rapid removal depends upon contact with healthy yeast, and the rate of removal is increased with higher temperatures. Many brewers use a "diacetyl rest," which is a short period — around one to three days — of aging at around (64 °F) 18 °C between primary and secondary fermentation. Some brewers who use flocculant yeast will use a method that keeps more yeast in direct contact with the beer (i.e. beechwood chips). Other brewers will ferment with a less flocculant yeast.

Acetaldehyde

Acetaldehyde is produced early in the fermentation and excreted from the cell. It is responsible for grassy, green apple or rough flavors in green beer. Acetaldehyde formation is generally favored by conditions of high metabolism coupled with low growth. Overproduction is favored by warmer fermentation temperatures, high pitching rates, poor wort aeration, and pressure early on. Once again, sufficient viable healthy yeast available for maturation will reabsorb the acetaldehyde and produce ethanol.

Zinc appears to be a cofactor in the conversion of acetaldehyde to ethanol, so trace amounts of this metal are required for conversion. Zinc is a trace element found in malt and water; it also leaches out of metals used in the manufacture of traditional brewing equipment, such as copper and brass.

In fact, when brewers switched over to stainless steel brewing systems, zinc deficiency became an issue in their fermentations. Some brewers simply added zinc by hanging a piece of copper or brass inside the kettle or the fermentation tank. For homebrewers, this should not be a problem unless you are reclaiming your yeast and using it repeatedly over many generations. Every fresh pitch should have sufficient zinc available inside the yeast cells.

Hydrogen sulfide

Hydrogen sulfide (H_2S) is a volatile molecule that is largely a problem with lager style beers. Hydrogen sulfide is responsible for the rotten egg smell in green beer. Yeast will take sulfate ions from the brewing water and convert them to sulfite and excrete them from the cell. It does this while producing certain amino acids inside the cell. H_2S is highly volatile and is also removed along with excess CO_2 purged from the beer during maturation. If you visit a large lager brewery and tour the cellars, this is what you will most likely be smelling (along with the perpetual ammonia leaks). Ale yeasts produce little H_2S so this is rarely a problem.

Temperature and maturation

In general — when considering diacetyl, acetaldehyde and H_2S — the cooler the primary fermentation temperature, the less of these three compounds is produced. However, at lower temperatures, the longer these compounds will take to drop below their respective flavor thresholds.

Ale and lager yeast ferment at different temperatures and both behave similarly within their respective ranges. For instance, a lager fermented at 57 °F (14 °C) produces three times the diacetyl as the same lager fermented at 46 °F (8 °C). When left to age at the same temperature at which the beer fermented, the beer took only five days for the diacetyl to drop below the flavor threshold.

Warm maturation will reduce diacetyl quickly, but will also strain the yeast. This increases the chance of off-flavors from yeast autolysis. Ale brewers should leave their beer at fermentation temperature for 24–48 hours after the terminal gravity is reached before transferring or cooling the beer for maturation.

Yeast autolysis

Beer flavor can also be influenced by yeast autolysis. Prolonged exposure of the beer to large amounts of inactive or dying yeast cells can result in off-flavors associated with dead yeast. These flavors can be bitter, soy-like, brothy, beefy or drainy and are generally considered unpleasant.

Yeast autolysis is a particular problem for lager brewers who attempt accelerated maturation at elevated temperatures, over 57 °F (14 °C). It is also a problem for ale brewers.

Leaving your beer in the carboy for long periods (over a week) after the primary fermentation is completed, without either refrigeration or decanting your beer off of the settled yeast into a secondary maturation container, will almost certainly cause this flavor to develop in your beer. Sending the beer to a bottle with too much yeast in it will also cause this problem. Before bottling you should be able to see through the beer in a glass. If there is too much yeast in the beer, the bottled beer will be opaque.

Flavor development is just one of the three main goals of maturation. I will discuss the other two goals — carbonation and clarification — in the next edition of this column. ■

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Quite a Sight

Installing a sight glass on your kettle

story and photos by Thom Cannell

Using simple tubing for illustration, here's how our sight glass will look. The tube is held with Oeticker clamps.

Don't you hate it when you empty your boiling kettle and come up short? Do you envy your pals who have nifty sight glasses attached to their kettles? Wouldn't you like one of your own? Those are all questions I've answered for myself with a resounding yes!

What's a SIGHT GLASS?

Sight glasses are columns that attach to your kettle and are open at the top and bottom — open to the interior of the kettle, that is. Liquid flows in from the bottom opening and equalizes at the same level as the liquid in the kettle. Before describing no-weld and welded options, we should mention the cheapest measurement tool, a story pole. This is simply a long spoon or thick dowel calibrated for each of your pots. Markings at every half-gallon level will yield a good approximation of how much liquid your kettle or sparge-water pot contains. Elegant? Sure, but with a coolness factor of zero.

Selecting the SAFEST TUBING

Professional-grade sight glasses are just that — glass. However, the way I bumble around in the brewhouse, even tough borosilicate glass won't work. In typical homebrew fashion, most homebrewers have turned to the ubiquitous Tygon tubing. In theory, this is a very bad idea, even though thousands of brewers get away with it. Regular clear 3/8-inch Tygon is rated at 26 psi at 73 °F (22.8 °C). Go on, read that again: 26 psi won't blow up a balloon and 73 °F (22.8 °C) — that's pitching temperature!

Tygon formulation B-44-4X IB — that's Internal Braid and the specification number, it's printed on the tubing — is rated to handle four times the pressure of non-reinforced Tygon tubing. This kind of Tygon is a 3/8-inch tube with a 5/8-inch outside diameter (OD) and is rated to handle 100 psi at 160 °F (71 °C). That's about 88 psi more than our application requires, so it can safely handle the job.

While the temperature rating will be exceeded by boiling wort at 212–216 °F (100-102 °C), the reduction in maximum pressure to atmospheric makes this a very reasonable option when the tubing is properly installed and tightly clamped.

Just remember that there is hot liquid in the sight glass. Like your kettle spigot, which gushes when you twist it open, you need to be careful with the sight glass and keep it protected.

SUPPLIES (WELDED)

Parts:

Stainless steel tubing	$5.00/foot (1')
Tubing bender	$11.00
Brazing rod (used 1/10)	$15/oz.
Brazing flux (used 1/1,000)	$12.00
Braided tubing	$0.60/ft.$0.90

Tools:
Tubing bender, oxy-acetylene (or TIG or MIG) welding equipment.

SUPPLIES (WELDLESS)

Parts (bushing-based)

Male pipe-to-FIP bushing 1/2 x 3/8"	$1.00
3/8" FIP-to-MIP street elbow	$2.75
1/2" female pipe coupling	$1.75
3/8" barbed fitting	$1.50
1/2" clamps	$1.00
Braided tubing	$0.60/foot
Heatproof O-ring	$1.00

Parts (compression-based)

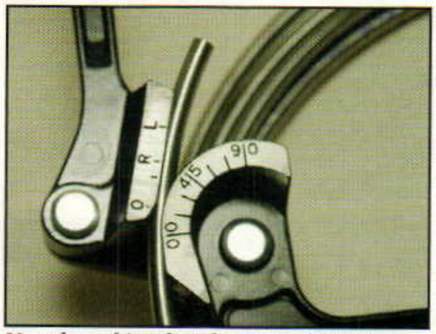
1/2" cast FIP-to-FIP elbow	$2.50
1/2" x 1/2" MIP compression connector	$1.70
1/2" barbed fitting	$1.70
1/2" clamps	$1.00
Braided tubing	$0.60/foot
Heatproof O-ring	$1.00

Tools and miscellaneous:
wrenches, screwdriver, drill bits and motor, Teflon tape or Teflon pipe dope.

If you don't want to weld, you can make a no-weld sight glass from compression fittings like these.

Here's an exploded view of a weldless assembly showing the fitting, O-ring, elbow, barbed fitting, hose and clamp.

Here's a tubing bender and a coil of thin stainless-steel tubing the author purchased at an Internet auction.



Use the tubing bender to make 90° bends in the stainless-steel tubing. You'll need a top and bottom bent tube.

Step-by-Step NO-WELD FIT

There are several ways to make a weldless bulkhead fitting; all are very similar. First you have to punch or drill a hole in the kettle, insert a threaded fitting, install a rubber O-ring to prevent leakage, and attach two "nuts" to secure the whole thing. In all cases, stainless-steel materials are preferred over brass. You could use a close nipple (pipe threaded at either end), an interior O-ring (available from many retailers for under a buck), and a female coupling inside with a brass elbow and barb fitting outside. However, experts say compression fittings are less likely to leak than this arrangement.

The first photo on page 49 shows a compression fitting pulled from just such a weldless fitting; the compression nut goes on the inside of the kettle and you'd attach a brass or stainless steel elbow to the external male fitting. The second photo shows an exploded view of a similar compression-fitting system. Another version is using (from left to right) a brass barb fitting, a FIP-to-MIP street elbow, a bushing (a fitting that is threaded internally and externally), an O-ring and a female coupling. Of course in either case you need a pair of these parts, one at the bottom and one at the top!

Drilling your kettle will require the correct-sized drill bit, which will add another $10-$15 to the cost. Still, at $6 per assembly, your total is less than $30 for a solid sight glass system.

Step-by-step CONSTRUCTION

Each weldless connection begins by marking points perpendicular to the pot's bottom, 1–2" from the bottom and top, and then marking the points for a 1/8" pilot hole. With a punch, dimple the pilot hole mark; drill bits skate on stainless steel. Drill a hole sized for your connectors (3/8–1/2"), then insert the close nipple or small end of the compression fitting. From the inside, fit a heat-resistant O-ring and tighten the nut (for compression fittings, it may be better to fit the O-ring from the outside.) Using two wraps of Teflon tape or pipe dope, seal external threads and attach an elbow. Using the same technique, attach a barbed fitting. Then install braided tubing and clamp.

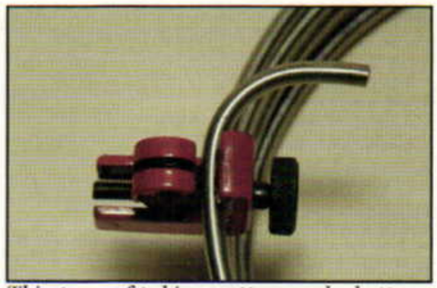
Step-by-step WELDED FIT

Another way of making a sight glass is with stainless-steel tubing. Gather two right-angle tubes, two Oetiker tubing clamps, 12–18 inches (30–46 cm) of heat-resistant tubing and you're almost done. Finding stainless tubing, bending it and joining the metal is the skilled part.

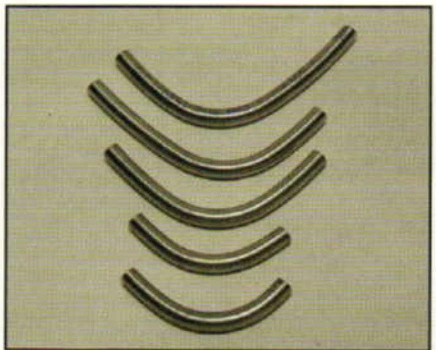
Stainless-steel tubing is available in many grades and wall thicknesses. Wall thickness is not an issue for us, nor is internal diameter, as long as the tube is large enough that it won't clog up with debris from the kettle; 1/8–3/8" should be sufficient. Grade is important; you must use 304 or 316 grade tube. The 300 family of stainless steel is used for brewery equipment: 304 is the most commonly used; 316 offers improved corrosion resistance. Most high-quality brew kettles are 304 and 316 is the best steel for fittings and tubing. Plus, they are easy to weld.

I've reached the conclusion that brazing skills are more common than shielded gas (Metal Inert Gas or Tungsten Inert Gas) welding knowledge. After playing with an inexpensive TIG rig from HTP America *("TLC for Stainless," November 2001)*, I returned to brazing. Not because I wasn't a good welder; I just didn't have the time to devote to learning this tool. Pity.

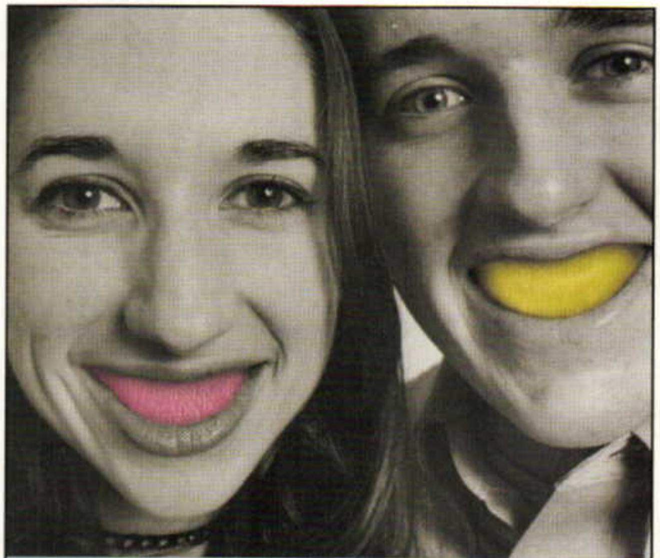
So I'm back to brazing, which produces a bond that is almost as strong as welding. The difference? In welding, two metals are made liquid; they commingle and become one. Brazing heats surfaces to red heat and joins them with a filler metal that melts at a lower temperature. Brazing requires skill, the correct brazing rod, and the proper flux. Our research says that

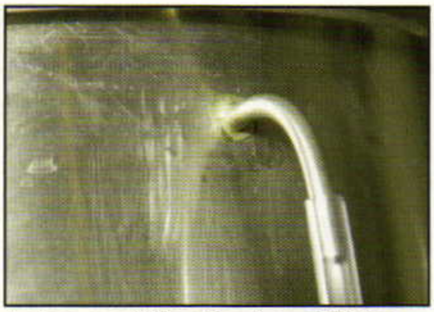


This type of tubing cutter works better than a hacksaw because it leaves a smoothly beveled edge.



You can make a selection of bent tubes to choose among, then trim the selected tubes to their final size.





A close-up of the silver brazed fitting. Brazing uses a filler metal to join two metal surfaces together.

Once the tubes are welded to the kettle, insert the tubing. The final step is to secure the tubing with Oeticker clamps.

brazing requires a high silver-content rod and specific flux. Flux cleans and protects metals as they are joined.

Welding equipment supplier Harris Welco recommends a brazing rod containing 56% pure silver plus copper and nickel, SafetySilv 56, with a low 1205 °F (651.6 °C) melting point. As you'll see, it produces a connection (fillet) that's comparable to TIG welding. Compared to more common SafetySilv 45, SafetySilv 56 matches stainless steel coloration better. It's not as expensive as the silver content makes it sound, but it may require a special order. For brazing stainless steel use Stay-Silv Black Flux.

For experienced welders, regular white flux is for lower-temperature applications; stainless steel takes more heat to braze than copper or steel, and the flux has a tendency to burn up because its active range is lower. Black Flux has a greater range and the alloy will "wet out" easily. This particular flux cleans up with soap and hot water.

Step-by-step WELDING OPTION

Using a tubing bender, bend two 4" (10 cm) lengths of stainless-steel tubing at 90° and cut the tube after bending. Then cut or trim to length with a tubing cutter.

Drill two holes in your kettle, each approximately 1.5" (3.8 cm) from the top and bottom. Hole diameter should equal the internal diameter of your stainless-steel tubing plus approximately 1/32" (0.79 mm). Fit the prebent tubing and hold at 90° to kettle surface at both axis: up-down and side-to-side. I jammed a wire into the tube from beneath and used sand bags to locate the wire. Brush on flux and braze using a very small tip on your torch. Then wash the cooled weld with soap and water and green 3M scrubbing pad. Attach your internal-braided Tygon tubing and clamp it tight *(see photos at left and on page 49).* ■

Thom Cannell writes "Projects" in every issue of Brew Your Own.

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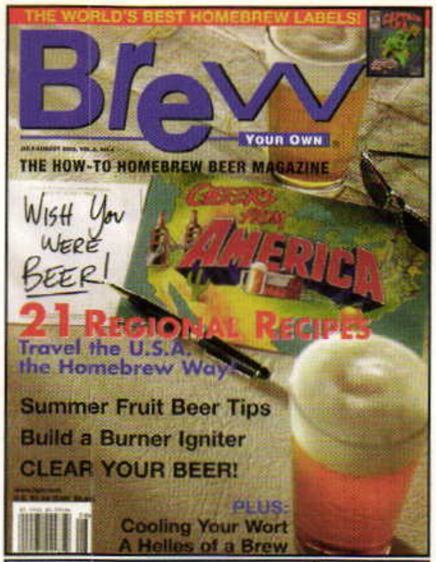

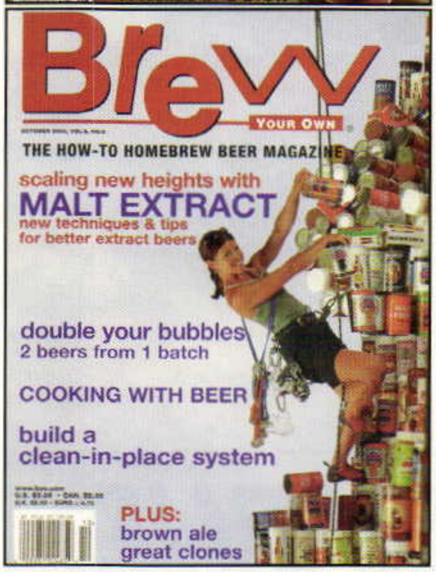

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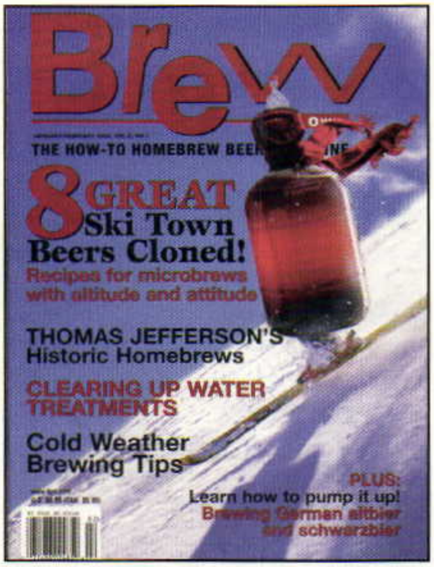

Brown Ale

(Mild, Northern English Brown, Southern English Brown, American Brown)

Bell's Best Brown Ale Clone	Sep 02
Modern British Brown Ale	Oct 02
Nut Brown Ale	May 02
Traditional British Brown Ale	Oct 02

English and Scottish Strong Ale

(Old Ale, Wee Heavy)

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Ubu Ale	Jan 02

European Dark Lager

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Chocolate Schwarzbier	Sep 02
Five-Grain Dunkel	Mar 02
Lakefront Eastside Dark	Oct 02
Medieval Cloister Schwarzbier	Nov 02
Schwarzbier	Jan 02

European Pale Lager

(Bohemian Pilsner, Northern German Pilsner, Dortmunder Export, Munich Helles)

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Chesapeake Pilsner	July 02
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Kohl's Kellerbier	Sep 02
Munich Beerhall Helles	July 02

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German Amber Lager

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Strike Tonic Fest Beer	Oct 02
FireBrew! Oktoberfest	Nov 02
Sprecher Special Amber Lager	July 02

India Pale Ale

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India Pale Ale	Mar 02
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India Pale Ale	May 02
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Kölsch and Altbier

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Kölsch	Oct 02
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Sly Fox Altbier	Jan 02
Sticke Alt	Jan 02
Taylor Kölsch	May 02

Light Ale

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Sunsplash Golden Ale	Jan 02
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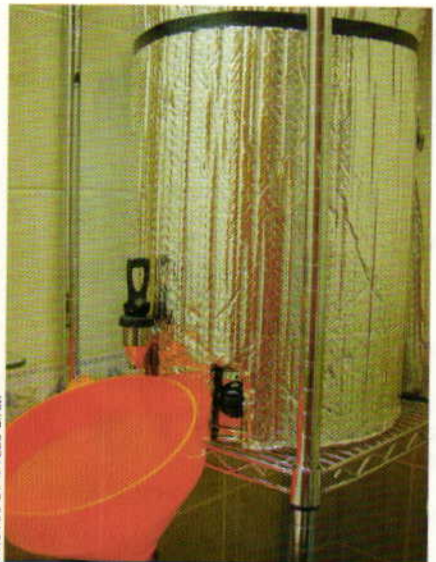
Banned Beer

Underground brewing in Kuwait

by Myles Liam

PHOTOS BY MYLES LIAM



The electric water pot Liam uses as a mash tun and brew kettle works well, but temperature control is tough.

It's not easy chilling wort when it's 120 °F outside, but our underground brewer gets the job done.

Cocky Rooster Ale, Liam's second and more successful brew, is ready for secret sipping among close friends.

Stories of bathtub gin and speak-easies spun through my head as I entered a world I'd thought existed only in Prohibition-era America. Like most Americans, I arrived in Kuwait on a plane, flying into the past with a job and no clue. I had accepted an assignment to work in a part of the world where oil flows like water and women hide their faces. I had been briefed on the facts ... no pig and no booze. No booze? Welcome to the underground.

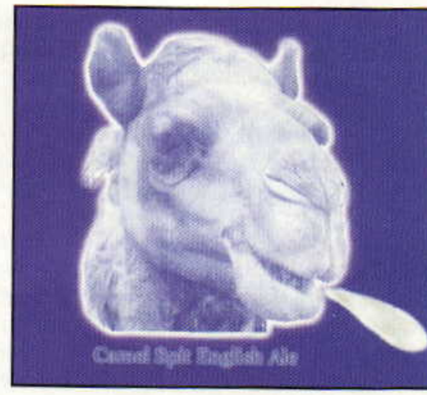
Upon arriving, I immediately e-mailed a few friends back in the States and asked for homebrewing advice. They sent me to the *BYO* Website. This was a lucky thing, because I was like a virgin on prom night: "Where the hell is the zipper on this dress?"

After a few days of research, I began my search for the essentials. My first stop was the sook markets, where spice merchants, rug makers and peddlers sell their wares. As I rounded the corner past a gold trader, there it was ... grain. Every grain you could imagine, except none of the bags were identified. "Is this barley?" I asked a toothless guy in a dirty dis-das. He smiled. It looked like the right stuff, so I took a few kilos home.

Next I started looking for brewer's yeast and hops. After an exhaustive search, I reached the only logical conclusion: I couldn't buy either. So I called my wife and talked her into becoming a smuggling mule. On her next trip, she tucked some hops and yeast into her ... well, never mind.

The last ingredient was water. Most Kuwaiti water is either deep-well water, which tastes a little brackish, or desalinized water, which has an antiseptic taste. For my brewing I used bottled well water, which comes in five-gallon (19-liter) plastic bottles and is called "spring" water (yeah, right!).

Now I needed to set up the brewery. I cobbled together some makeshift equipment: a 40-liter electric water pot served as mash tun and brew kettle; the dryer and two pillowcases for my grain kiln; plastic water bottles for a fermenter; 20 feet of copper tubing for a chiller; and glass apple-juice bottles with swing-tops for bottling.



After a bit of experimentation, I figured out that I had bought unmalted barley (cow feed) and wheat (chicken feed). I malted both in the dryer and set up my "grain mill." I'd originally tried to use my pasta maker, which has two adjustable stainless-steel rollers, but I couldn't get enough grain to pass through the rollers. Eventually I gave up and used my coffee grinder. I ended up with flour, but I proceeded anyway.

My first brew was a hefeweizen, Chicken Feed Wheat Beer. The electric urn worked great, though I had a tough time controlling the temperature. I also made a mess of the kitchen. My biggest problem was cooling the wort with an outdoor temperature of 120 °F (49 °C). After a day of waiting, I ran it through the chiller again and pitched the yeast at 60 °F (16 °C). I didn't have a hydrometer, so after the kraeusen fell I transferred it to secondary and waited two weeks to bottle.

After two weeks I opened it for tasting. It tasted like beer! Since then I've successfully brewed Cocky Rooster (complete with exploding bottles) and Camel Spit Ale. My beer may not win any competitions — at least not in Kuwait — but I'm having fun here in the homebrew underground. ■

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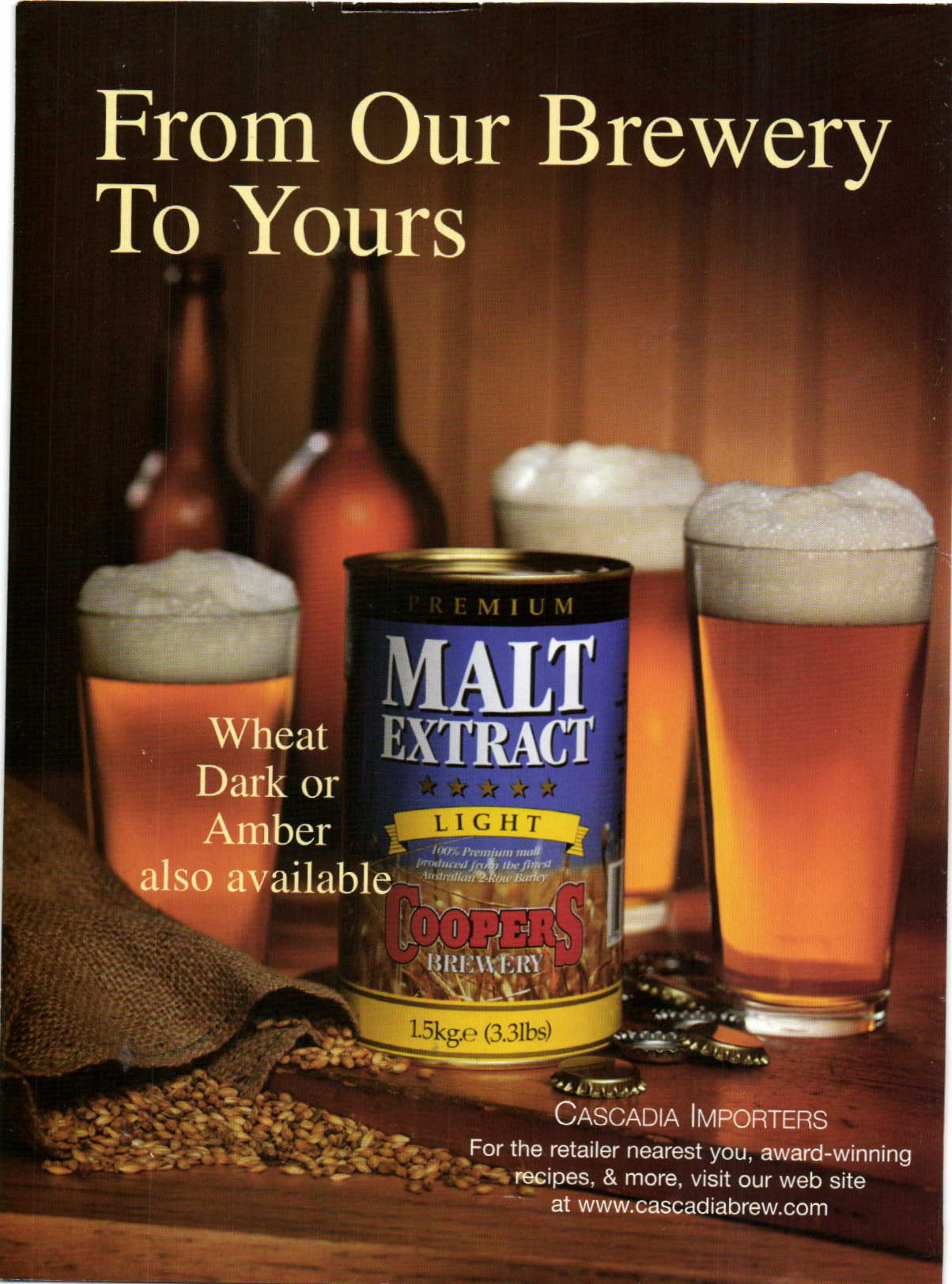
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