HISTORIC HOMEBREWS: Make Captain Cook's Own Recipe

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OCTOBER 2004, VOL.10, NO.6

THE HOW-TO HOMEBREW BEER MAGAZINE

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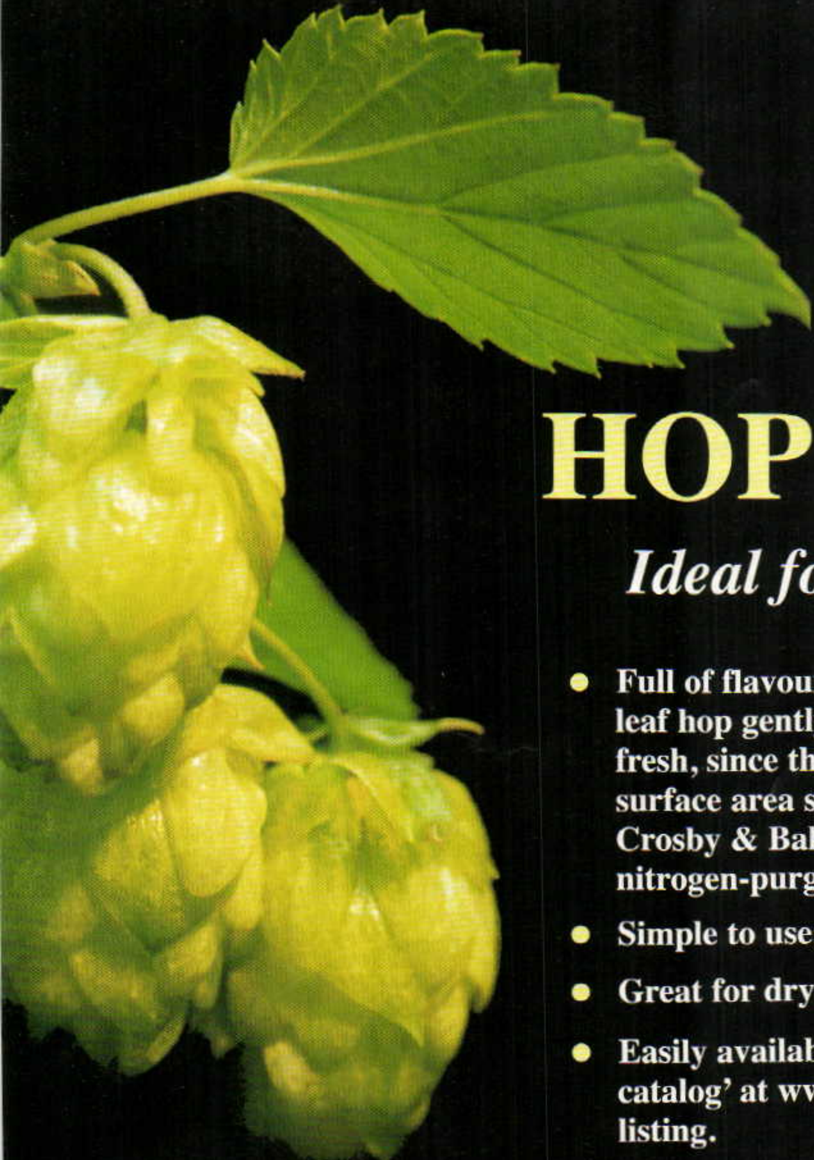

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Brew Your Own

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Where to find it


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THE HOW-TO HOMEBREW BEER MAGAZINE

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RECIPE INDEX

BYO RECIPE STANDARDIZATION

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

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

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

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

ContribUTors

Bev Blackwood has been homebrewing since New Year's Day of 1998 and is rapidly approaching his 100th batch of beer. A beer lover since the early 80's, he travels extensively to explore the world of beer and is a frequent contributor to a number of publications. A member of Houston's Foam Rangers homebrew club, Bev brews competitively and is fortunate enough to win every now and then. His favorite styles to brew are India pale ales, Belgian strong goldens and English barleywines. He also spends considerable time at the Saint Arnold Brewery in Houston, Texas and has occasionally assumed the guise of the noble Saint himself — although he never claims any "saintly" attributes when asked! As the Houston area liaison for the American Homebrewers Association, Bev has run the Southern regional for the National Homebrew Competition twice.

Outside the beer world, Bev oversees the implementation and training of San Jacinto College's administrative software package. He ran his first marathon in January of 2004 and is currently in training for two more marathons this winter. He follows the Houston Astros and Rice Owls baseball teams and regularly attends Houston Grand Opera. With over 120 bottles, his single malt scotch collection is among Texas' best and Bev has also begun to make meads, wines and tinctures of various fruits, herbs and vegetables. Once upon a time, he also had a local cable TV production, The Malt Show, which he hopes to continue someday. His wife, Crystal Davis, is legendary in Houston brewing circles for her patience and understanding of Bev's hobbies.

On page 24 of this issue, Bev turns up the heat with his story on the techniques and recipe considerations of brewing beer with hot peppers.

Steve Piatz is an Electrical Engineer by training and holds a Professional Engineer license. By day he is a technical leader for the development of operating system software for Cray supercomputers.

Steve started homebrewing in the very early 1990's along with several of his friends. In the summer of 1992 they discovered the Minnesota Home Brewers Association (MHBA). Working with the MHBA he became involved with the first homebrew competition at the legendary Sherlock's Home brewpub (now closed) in the fall of 1992 and became hooked on judging beer. He was the competition organizer for its last few years and served as president of the MHBA. He became a BJCP judge in the spring of 1993 when the BJCP exam was offered for the first time in Minnesota. He has been a BJCP exam grader for a number of years and in June of 2004 became one of the two BJCP Exam Directors. Along the way he has advanced to become a BJCP Grand Master I judge.

When brewing, Steve makes a lot of the mainstream beverages — such as pale ales, Pilsners, bocks, porters and stouts along with meads, ciders and the occasional wine — but every year he manages to make a few unusual brews. He has made things like a historic molasses-based beer or beer with no hops.

Since he tasted his first lambic in a BJCP exam preparation class, he and his wife were hooked and he made his first attempt at lambic in 1996. Now days, he doesn't consider lambic to be unusual or eccentric and brews enough lambic to keep his nine dedicated lambic fermenters full. As a lambic lover, his best day was a tour of lambic breweries — from 9:00 AM until 1:00 AM, nothing but lambic for liquid all day other than one bottle of the Trappist Westvleteren 12. On page 44, Steve gives homebrewers advice and a recipe for making lambic-style beers at home.

Where to Go for Simcoe

In your most recent issue (September 2004), some of your clone recipes from the story "Attack of the Hop Clones" specify the use of Simcoe hops. Where can they be obtained? I have never seen them available to homebrewers.

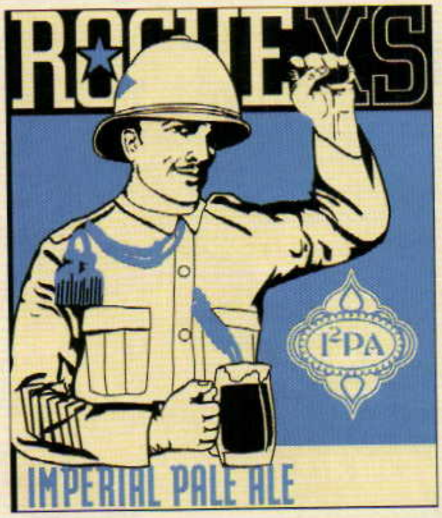
Blake Warren
Maitland, Florida

Simcoe is a new variety that is rapidly gaining favor with many commercial brewers. On the homebrew scene, however, it has only shown up in a few shops. If your local shop doesn't carry Simcoe, two online stores that do are Austin Homebrew (www.austinhomebrew.com) and Beer Beer and More Beer (www.morebeer.com). Hopefully more shops will be adding this hop to their lineup soon.

Rogue Ruminations

In your clone recipe for Rogue's Imperial IPA ("Attack of the Hops Clones," September 2004), you thank Beer Beer and More Beer for their help. However, I've brewed their clone kit of this and it's different than your clone. They use White Labs WLP001 (California Ale) while you use WLP051 (California Ale V). Also, they use a different amount of pale malt. Why the difference between two clones of the same beer?

Marvin Peterson
Fresno, California



Rogue uses a proprietary strain of yeast — their Pacman yeast — to ferment their Imperial IPA. Beer Beer and More Beer chose White Labs WLP001 (California Ale) yeast as their substitute for this yeast; we chose the very similar WLP051 (California Ale V) yeast as ours. They will both yield a similar profile.

As for the differences in the grain bill, all recipes in BYO now conform to our set of standard assumptions, the basics of which are given on page 6. So, our grain amounts reflect this. If you know the extract efficiency of your system (and your hop utilization rate), you can use it to tweak our recipes to match your system. If you don't know these numbers for your system, we feel our numbers will apply to the "average" homebrew setup.

Elissa Dry Hops

In your story "Attack of the Hop Clones" (September 2004), many of the recipes refer to dry hopping. Some recipes require hops added to the secondary, some into the wort prior to cooling and some just say "dry hop." The recipe I question is the Elissa IPA clone. Do I dry hop in the secondary or in the wort prior to cooling? Or is it too much to do about nothing?

Frank Tylla
Racine, Wisconsin

Dry hops are hops that are added to beer in the fermenter or keg. Most homebrewers add their dry hops to their secondary fermenter or to their kegs, although it is not unheard of to add dry hops in the primary fermenter. For the St. Arnold Elissa IPA clone, add the dry hops either in secondary or to your keg. Hops added late in the boil are not called dry hops. These are sometimes labeled aroma hops or late addition hops.

Dogfish Huh?

Your Dogfish Head 90-minute IPA clone gives the boil time to be 105 minutes. Hello? It's 90-minute IPA! Shouldn't it be boiled for 90 minutes? Or am I missing something?

Frank Mallone
Piscataway, New Jersey

Dogfish Head boils their 90-minute IPA for 90 minutes. In our clone, we thought that extending the boil a bit (by 15 minutes) made sense for two reasons. First of all, you will need to collect quite a bit of wort and boil it down to 5 gallons (19 L) to hit the target gravity of 1.088. Some extra boil time will help with that. Also, you will need to develop some color in the boil to get the right SRM for this beer — a longer boil will help here, too. All of the clones in the "Attack of the Clones" story were designed to produce beers that could be made on homebrew systems. Wherever possible, we retained the procedures the commercial brewery used, but our primary focus was constructing a clone that would work for a homebrewer.

Dogfish Head Craft Brewed Ales

Awesome, but Confusing

The September 2004 edition of *Brew Your Own* magazine is just awesome! You guys have done a great job! I especially appreciate the effort in contacting the brewers of some of the best IPAs around and finding out clone recipe hints from these folks. I have a question about the AleSmith IPA clone recipe, however, which is found on page 39 of this issue. It says "FWH" after the first two additions of bittering hops? Can you tell me what the acronym "FWH" stands for? I assume that this means 90 minutes, but I would like your confirmation before I actually try to make this beer.

Chris Wignall
Bellevue, Washington

Editor Chris Colby responds: "Thanks for the kind words, Chris. I had a lot of fun phoning and emailing the brewers who participated in the 'Attack of the Clones' and 'Brewer's Roundtable' stories. The guys I contacted — many of whom began their brewing careers as homebrewers — were very interested in helping out homebrewers and were very generous with their time.

As to your question, 'FWH' means 'first wort hops' — hops added to the wort as it is being run off from the mash, before boiling. Often time, homebrewers will run off their wort and add the first wort hops once the bottom of the kettle is covered. Good luck brewing the AleSmith IPA clone."

Citrus in Beer

I just finished reading Mr. Wizard's column in the September issue, in which Robert Papsis asks about how to get a citrus fruit flavor into his beer. One of our brew club members (YAHOO/Youngstown Area Homebrewers of Ohio) has hit upon a great method for doing this. He gets some Crystal Light lemonade drink mix and adds it to the finished beer as he kegs it. A couple of the little plastic tubs (each makes 1/2 gallon of lemonade) added to the keg adds a perfect lemon flavor to a lightly-hopped beer. I have had it and it is a very refreshing summer drink! One could probably use other flavors, too. Crystal Light uses artificial sweeteners, which will not restart any fermentation.

Dave Szakacs
Niles, Ohio

Thanks for the info. There is always more than one way to skin a cat, as the saying goes.

Barleywine Question

In Horst Dornbusch's article "Big Bad Barleywines" (March–April 2004 *BYO*) he said he pitches four packages of different liquid yeasts for a heavy duty big ale. My question is, if you use more than one package of yeast, would you pitch all yeasts at once or wait and pitch the higher alcohol tolerant yeast later on?

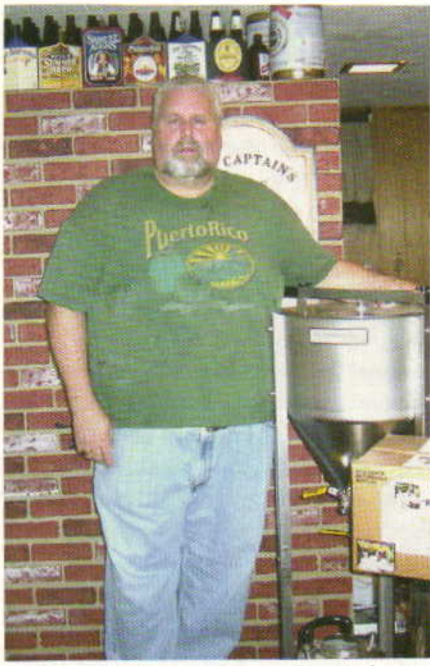
Mike Tentis
Poynette, Wisconsin

You will likely get the best results if you pitch all four yeasts at once. That way they can all absorb oxygen from the wort and build healthy cell walls for the long fermentation ahead.

Another option, of course, is to make a large yeast starter. For 5 gallons (19 L) of barleywine, a 2–4 qt. (~2–4 L) starter at a specific gravity of 1.030–1.040 would work well. Some brewers transfer yeast grown for big beers to a higher gravity starter before pitching the yeast. ■

brewer PROFILE

Brian "Big B" Stack • East Longmeadow, Massachusetts



photos courtesy of Brian Stack

Big B and his big stainless steel conical fermenter make a nice Pig Tale Ale.

Over the years as my interest and knowledge in home brewing grew, so did my list of escapades. One good story is about the batch I was brewing that had some sort of green fungus growing in the neck of the carboy. Not knowing what to do, I consulted my local home brew store and was told to dump it. Being a frugal New Englander and not wanting to waste my money, I skimmed off the scum with my wine thief and carbonated it any way. It turned out, by all who tasted it, to be fantastic! Too bad I will never be able to replicate that exact beer, as I have no idea how to grow scum on purpose.

Then there was the time when my wife and daughters went shopping and my son Jonathan and I decided to bottle a batch. Things started out fine. I was filling and Jon was capping. All of a sudden we had a pressure problem with the counter-pressure bottle filler. For anyone who's been in this situation, it's needless to say that we had a mess on our hands. We did manage to get it all cleaned and things were "looking up" by the time my wife came home. Then she "looked up" and discovered some mysterious spots on the ceiling. I guess we missed those in our clean-up efforts. After some explaining we all had a good laugh and decided to leave them as conversational items. Having the nickname of "Big B" it was only natural to call my brew house Big B's Brewing Co. Boy was I excited the day I found bottle caps from Brewer's Best at my local home brew shop.

Portable keg coolers keep the Pig Tale Ale refreshing on road trips.

Why shouldn't I tell my friend's that I have them specially made for me with the BB logo? My good friend Carl decided to raise a pig. The picture on my label is one that his wife took of me holding the piglet with Carl in the background the day we picked it up from the farm.

For about six months we compiled many funny stories. One time the pig got loose while Carl was at work and his wife had the duty of chasing it around the neighborhood. This picture was the beginning of Pig Tale Ale. All my labels now include this infamous picture, as do the cartons I keep the bottles in.

Big Winning RECIPE: Spring Thaw IPA: Roger Halperin • Broomfield, Colorado

This homebrew won Best Of Show at the 8 seconds of Froth Competition in Bedford, Texas in May.

Ingredients (12 gallons/5.4 L)

18 lbs. (8.1 kg) Maris Otter pale malt
8 lbs. (3.6 kg) Munich malt
3 lbs. (1.4 kg) crystal malt (15 °L)
1 lb. (0.45 kg) Victory malt
1 lb. (0.45 kg) wheat malt
19 AAU Centennial whole hops (first wort hops) (2 oz./57 g of 9.5% alpha acids)
19 AAU Centennial whole hops (30 min) (2 oz./57 g of 9.5% alpha acids)
9.5 AAU Centennial whole hops (5 mins) (1 oz./28 g of 9.5% alpha acids)
2 oz. Amarillo Gold whole hops (dry hop at 1 week)
1 oz. Centennial whole hop (dry hop at 1 week)
2 tsp. Irish moss (15 min)
White Labs WLP051 (California Ale V) yeast

Step-by-step

Prep: Make a 4-cup starter 4 days before brew day with 3 cups of water, 1 cup light dry malt extract.

Mash in your grains at 145 °F (63 °C) and hold for 15 minutes. Raise temperature to 150 °F (66 °C) and hold for 45 minutes. Raise temperature to 168 °F (71 °C) and hold for 15 minutes.

Sparge with 170 °F (77 °C) water and collect 14 gallons of wort. Add first hop addition once the wort has covered the bottom of the kettle.

Proceed with hop additions as detailed in ingredients above.

Chill wort to 65 °F (18 °C) transfer to carboys and pitch yeast. Starting gravity should be 1.072.

Temperature at primary fermentation should be at 65–68 °F (about 20 °C) and continue for two weeks.

Temperature at secondary fermentation should be at 65 °F (18 °C), with dry hops for one week.

Final gravity should be 1.016.

homebrew CLUB

Great Northern Brewers

Anchorage, Alaska

The Great Northern Brewers took it to the man and changed brewing laws in Alaska.

The Great Northern Brewers were fighting for a cause from the group's earliest days. Our first members — Dave Yanoshek, John Craig, Gary Busse, and John Dean — came together in a legal battle against the state of Alaska in 1987. Though it was OK in the state to grow your own marijuana at home for personal use in 1987, it was illegal to make your own homebrew without a state permit!

The state was not going to let our club set up a display at an annual event called the Fur Rendezvous. We were peeved to say the least. The club wrote and spoke with legislators to have the law abolished, and won! At about the same time, we came up with the current name, Great Northern Brewers. Today, the club has 180 members, and continues to grow. The members all have one thing in common, a love of beer. Many club members have become professional brewers. Mark Staples of Midnight Sun Brewing Company and Mike Hartman, former brewer at the Sleeping Lady Brewery, were long-time club members before going pro. We support good beer and have a positive symbiotic relationship with many local breweries, brewpubs and alehouses.

One highlight event for our club is January's Great Alaska Winter Beer and Barleywine Festival, where we volunteer as servers and judges. This is the world's largest Barleywine Festival. We have had Michael Jackson, Charlie Papazian, Steve Beaumont, Greg Noonan, Ray Daniels and George Fix all speak at the event.

In February, we participate in the Fur Rondy Festival, a Mardi Gras-like costume party and dance. In addition to a homebrew competition, the Fur Rondy Festival sponsors a costume party. We won the costume party two years ago as the Alaskan's Very Natural Gas Pipeline driven by personal methane gas.

For National Homebrew Day (on the first Saturday of May), we host our yearly brewathon. The brewathon features six brew stations that stay open from 9 am to 9 pm. Last year, teams of old and new brewers produced 365 gallons using 10-gallon brew systems!

After a club campout at Trail Lakes Campground around summer solstice, a Club Golf Tourney with dual corny-keg-equipped beer carts, and an Oktoberfest club crawl, we come to our annual holiday party in December. The holiday party provides a live band, plenty of food, and lots of homebrew. We also present the Homebrewer of the Year Award. This goes to the brewer with the most points from the four competitions we host, and the struggle for this prize is epic.

We have some truly skilled and innovative brewers in the club. Our past president, Steve Schmitt, was AHA mead maker of the year. Club members have a diversity of brewing interests, although most of us like Pacific Northwest hoppy beers. We have some avid smoke beer brewers led by "Suds" John Craig, a longtime member. We have many Belgian beer lovers and the club hopes to someday organize a group trip to Belgium. We are also highly involved in the Beer Judge Certification Program. All in all, the Great Northern Brewers are a diverse group with a passion for beer.

we want you

Do you have a system or some unique brewing gadgets that will make our readers drool? Email a description and some photos to **edit@byo.com** and you too may have a claim to fame in your brewing circle!

Send us your story!

BYO

If we publish your article, recipe, photos, club news or tip in Homebrew Nation, you'll get a *BYO* Euro sticker.

replicator

by **Steve Bader**

Dear Replicator,

My wife and I tried a beer at the Nevada Palace in Las Vegas called Sin City Amber. The beer is produced and sold only in Las Vegas. It's a shame since it's the best amber I've ever had. Any chance you could come up with a recipe to replicate it?

Rick Conley
Alexandria, Louisiana

Sin City Amber has been the dream of head brewer Rich Johnson for almost his entire professional brewing career. He uses generous amounts of German Munich malt to get both the amber color and the rich, malty flavor. For more information you can visit the Sin City Beer Company web site at: www.sincitybeer.com or by calling (702) 809-4939.

Sin City Brewery – Sin City Amber

(5 gallons/19 L, extract with grains)

OG = 1.053 FG = 1.012
IBU = 18 SRM = 11 ABV = 5.3%

Ingredients

3.3 lbs. (1.5 kg) Coopers light malt extract syrup
2.25 lbs. (1.0 kg) Coopers light dry malt extract
1.5 lb. (0.7 kg) German Munich malt (15 °L)
1.0 lb. (0.45 kg) German Munich malt (10 °L)
1 tsp. Irish moss
4.75 AAU Hallertau Hersbrücker hops (bittering hop, 60 min.)
(1.0 oz./28 g of 4.75% alpha acids)
2.4 AAU Hallertau Hersbrücker hops (boil 10 min.)
(0.5 oz./14 g of 4.75% alpha acid)
White Labs WLP820 (Oktoberfest/Märzen Lager) or Wyeast 2308 (Munich Lager) yeast
0.75 cup corn sugar (for priming)

Step by Step

Steep the 2 crushed Munich malts in 3 gallons (11.4 L) of water at 150 °F (66 °C) for 30 minutes. Remove grains from wort, add the malt syrup and dry malt extract and bring to a boil. Add the first addition of Hallertau Hersbrücker hops, Irish moss, and boil for 60 minutes. Add the last addition of Hallertau Hersbrücker hops for the last 10 minutes of the boil. Now add wort to 2 gallons (7.6 L) cool water in a sanitary fermenter, and top off with cool water to 5.5 gallons (20.9 L). Cool the wort to 75 °F (24 °C), aerate the beer and pitch your yeast. Allow the beer to cool over the next few hours to 68 °F (20 °C) and hold at this temperature until the yeast has started fermenting. Then cool to 50 °F (10 °C) until finished fermentation. Sin City then does a diacetyl rest by warming the beer to 70 °F (21 °C) for 4 days. Then rack the beer to a secondary and cool the beer again to 50 °F (10 °C) for another four days. Finally, Sin City lagers the beer at near freezing for another two weeks.

All-grain option:

This is a multiple step infusion mash. Your grain bill will be 8.5 lbs. (3.8 kg) German Pilsner malt, 1.5 lbs. (0.7 kg) German Munich (15 °L), and 1.0 lbs. (0.5 kg) German Munich (10 °L). Mash grains together at 100 °F (38 °C) for 20 minutes, then increase to 125 °F (52 °C) for 10 minutes, then 150 °F (66 °C) for 25 minutes, then 162 °F (72 °C) for 30 minutes, then 172 °F (78 °C) for 5 minutes, then begin runoff. Collect enough wort to boil for 90 minutes and have a 5.5-gallon (20.9-L) yield (~7 gallons or 26.6 L). Lower the amount of bittering Hallertau Hers-brücker hops in the boil to 0.75 ounce (21 grams) to account for higher extraction ratio of a full boil. The remainder of the recipe is the same as the extract.

homebrew calendar

October 1–2
Northern California Homebrewers Festival
Dobbins, California

The Northern California Homebrewers Festival will take place at the Lake Francis Resort in Dobbins, California on October 1–2. This is the seventh annual festival where homebrewers meet to share homebrews and brewing ideas. The theme for the event this year is "Extreme Brewing," and several "extreme brews" will be on tap. For more information, contact Jim Fortes at (650) 365-2977 or email jbrewco@sbcglobal.net.

October 9
Maltose Falcons Homebrewing Society 30th Anniversary Party
Woodland Hills, California

The Maltose Falcons Home Brewing Society is hosting a gala celebration in honor of its 30th anniversary. The event will be held at the Warner Center Marriott in Woodland Hills and costs $45 in advance, $50 at the door. The party will feature a dinner banquet with beer-themed courses and two club-operated bars will serve homemade beers. A special room rate has been arranged with the hotel for guests who attend the party. For more information, contact Jim Kopitzke via email at anniversary@maltosefalcons.com or call (818) 884-8586.

October 14–16
The 21st Annual Dixie Cup Homebrew Competition
Houston, Texas

The 21st annual Dixie Cup Homebrew Competition will be celebrated Vegas-style this year at the Comfort Inn in Houston, Texas. Homebrewers will compete in Black Jack as well as brewing. Each year the competition features one special beer category. Past styles have included "Beer that gets you Lei'd," "Big and Stupid," "Malt Liquor" and "Breakfast Cereal Beer." This year's special beer category is "Two-Style Texas Hold 'em," where brewers are challenged to take any two of the past special styles and make them one. For more information, contact Ed Moore by email at dixiecup@foamrangers.com or call (713) 668-9440.

BREWER'S DICTIONARY

O is for...

off-flavor: a term used to describe any taste in a brew that is inconsistent with the style or is just offensive. These flavors are often caused by poor sanitation, excessive aging and oxidation.

original gravity (OG): this is the specific gravity of a wort before it goes through any fermentation. The measurement tells you the amount of solids that are in a wort in reference to that of pure water at a certain temperature (which is given the value of 1.000 SG).

Oktoberfest: Both a German festival and a German brew. The festival started nearly two hundred years ago in Munich and is now a 16-day event. The brew is typically lagered and cold-cellared for at least eight weeks and German beer laws demand a starting gravity of at least 1.052.

old ale: a dark English style ale that is meant to age at least one year. This ale has an acidic flavor that was originally caused by lactic acid. This acid was formed by the *Lactobacilli* contained in the wooden storage vessels where they were aged in the late nineteenth century.

over-priming: this is a flaw in bottling where too much sugar is added to the brew before bottling or kegging. The result is an over carbonated brew, or worse case scenario "bottle explosion."

oxidized: a brewing fault where a brew is exposed to excessive oxygen, causing flavor problems and spoilage. This can be caused by poor bottling procedure, or excessive headspace.

homebrew SYSTEMS that make you DROOL

Scott DeWalt • Houston, Texas

(Above): Scott DeWalt (left) and buddy Sean Lewis in front of the TexanBrew brewery.
(Left top): The complete TexanBrew system.
(Left middle): The mini-exchanger contains 25-feet of copper tubing coils.
(Left bottom): The mash tun during sparging.

Our "TexanBrew brewery" is a home brewery that, like almost all, has grown over time — from a five-gallon turkey pot to three converted kegs on a custom stand. The TexanBrew brewery is a Recirculating Heat Exchange Mash System (RHEMS). A typical RHEMS consists of a mash tun, hot liquor tank and boil kettle. Our brewery adds to those a separate, electrically heated vessel containing the heat-exchanging coils. Dubbed the mini-exchanger, this is the heart of the TexanBrew brewery.

The mini-exchanger minimizes the amount of water we need to heat in order to raise and maintain mash temperatures. For the base of this piece, we removed the top of a Cornelius keg then drilled a ⅞-inch hole through the bottom of the keg to allow us to install a 2000-watt 110-volt heating element. Twenty-five feet of copper tubing, bent around a 6-inch cylinder and mounted into the keg, serve as the heat-exchanging coils. The entire vessel is electrically grounded and insulated using closed-cell foam. At the start of each brew session the mini-exchanger is filled with water and heated to about six degrees above the desired mash temperature. After dough-in, wort is pumped from the bottom of the mash tun, through the mini-exchanger and up to the return manifold. Recirculation continues for the entire brew session. Raising the temperature of the mini-exchanger's water heats the mash about two degrees per minute.

To simplify the fly sparging process, I installed a float switch in the mash tun. Water from the hot liquor tank is pumped into the mash tun through a check-valve (which prevents a siphon from moving the sparge water back into the hot liquor tank). As wort drains from the mash tun during the sparge, the float switch activates the pump, which moves water from the hot liquor tank into the mash tun until the desired level is achieved. Setting the sparge only requires us to monitor the outflow from the mash tun.

Color Tips for Extracts

Achieving proper hue in your extract brew

by Thomas J. Miller

Extract brewing might sound simple, but it still provides plenty of room to customize your beer. Color, for example, is one target that extract brewers can work to fine tune. Here, two professional brewers who use extract offer their thoughts on getting the color you want from your extract homebrews.

Brewer: Chris McKim is the brewer at The Brew Kettle Taproom and Smokehouse, a brewpub and brew-on-premise in Strongsville, Ohio. He has been brewing for twenty years, including thousands of extract-based beers.

THE BREW KETTLE TAPROOM & SMOKEHOUSE

When I first started brewing there were not that many extracts available and the quality was sometimes questionable. There is a lot more to choose from these days, with many extracts capable of producing high quality brews. It is important for extract brewers to know, however, that they are essentially brewing another brewer's recipe. In other words, let's say some brewer in Australia, as an example, picked the base malt and some specialty malts to make up the wort, which eventually became the extract. An extract brewer's job is to simply rehydrate the original wort, ferment it, and call it his or her own.

Some homebrewers do not want someone else determining the final composition of their beer. I think it is possible to get around this conundrum by using the lightest malt extract you can find. In this way, you will be able to determine what specialty malts comprise the color and flavor of your favorite brew.

In our brew-on-premise site we use as little amber or dark malt as possible for all of our beers. As an example we might use 5 drums of light malt per week compared to barely one drum of dark malt. An imperial stout recipe that we produce contains four pounds of dark malt but 15 pounds of light malt! We then round out the flavor and create our own version of imperial stout by adding honey, black malt, roasted barley and chocolate malt. This is no different than an all-grain brewer using a pale malt as the back bone of his stout.

In our recipe, little color and flavor impact is derived from the dark malt — there is some, but not much. By adding specialty grains, determined by our own requirements for our beer, we ultimately create our own flavors, colors and aroma.

Almost everything in our brew-on-premise site is a "mini-mash," or partial mash. Roughly 50 percent of the fermentable sugars come from the mashed grain and the extract. One reason that we use the mini-mash is to achieve the desired flavor and color profiles of certain styles. The extract itself has already suffered a degree of flavor deterioration through processing, packaging, storage, transportation and age, so we use grain to bring some flavor freshness back into the beer.

Though utilizing the mini-mash is a great way to achieve your color targets, the alternative is to go all-extract. In this instance, grains with no enzymatic activity are going to provide your beer with color. Picking those grains is really a question of where you want to go with your beer. Do you want to make brown ale or stout? If so, chocolate malt is a good idea. Do you want to pick up colors of varying degrees in the ale category? Try caramel malt.

Our American Pale Ale, for example, uses Caramel 10 with a touch of biscuit malt for mouth feel. Choosing grains for color is a journey. Experience will teach you the appropriate amounts. Remember that color and flavor will generally move in tandem with each other. More black malt, for example, will make your beer darker with a more acrid flavor. It is usually smart to start conservatively and make small changes to successive brews. This way you can discover the true impact that your favorite grains have on color and flavor.

Besides grains, your heat source is another driving force behind the color of your extract beer. The temperature difference between the flame and the wort sugars can vary dramatically — by hundreds of degrees — and superheating those sugars with an extremely high flame will cause the sugars to caramelize. The differential between the heat source and the sugars is the key here, so you need to minimize that differential. Steam works best, but that is not feasible for most homebrewers.

With direct gas or electric heat, it is best to bring that heat up slowly. If you keep the flames to a minimum and slowly increase them as the wort comes up to temperature, your light extract will produce a light-colored beer (excluding the addition of any dark grains). You might get something with the color of, say, a Molson Golden. But really crank out the heat all at once and the sugars will scorch, resulting in your light extract producing an IPA-colored brew.

Brewer: Bret Kuhnhenn is the head brewer at the two and a half year old Kuhnhenn Brewing Company located in Warren, Michigan.

Kuhnhenn Brewing Co.

We always start out with a light liquid malt extract. We want an extract that will closest resemble a 2-row barley — something appropriate for producing a Pilsener or similarly light colored brew. A homebrewer making an average size batch of five gallons with three pounds of specialty grains would want to start with two gallons of water. To this, the brewer should add only about one-quarter of the total liquid malt extract. This will acidify the water to between 5.0–6.0 pH. This is a good range for soaking the specialty grains.

Water that is not acidified enough tends to pull tannins out of the husks of your specialty grains. This problem is made worse when you use darker malts. The resulting off-flavor is a common one for extract brewers, but one that is easily avoided if you monitor the acidity of your diluted wort.

Soak the specialty grains for 30–45 minutes. That is an adequate time to extract the qualities you need to achieve your flavor and color goals. I recommend rinsing the grains lightly when you remove them. This flushes any residual sugars that may be caught in the grains. Be sure to use acidified water — again between 5.0–6.0 pH. You only need a couple of quarts.

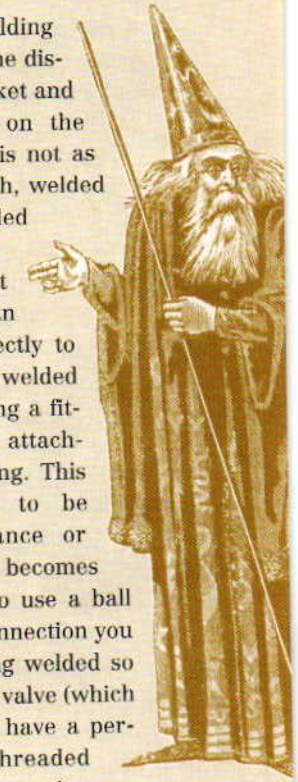
Bring this solution to a boil for one hour and add the remaining extract during the last twenty minutes of the boil. Remember that the extract was already boiled before it was evaporated, so there is no reason to boil it again. Adding the remaining extract in the last twenty minutes hydrates and sterilizes it. If you boil all the extract for one hour, then the beer ends up being darker than wanted.

This is because evaporators are hot. After evaporation, what might have produced a 1.8 °L beer would now result in a 5 °L brew. Boiling also adds oxygen and causes a Maillard reaction, which is basically a transformation of sugar to non-sugar (or caramelization). This makes the wort even darker.

Homebrewers should also conduct a whirlpool and a 30-minute rest. The hops, proteins and flour will separate during the whirlpool, which allows you to achieve a clearer beer. Extract brewers can substitute light liquid malt extract for all the malt that they would use in an all-grain beer and use specialty malts for color and flavor. ■

Keg Ethics 101

Dealing with yeast trub and a look into tyramine



Keg conversion

I recently have acquired a keg from a buddy at work. I'm not sure where he got it, but I was wondering if I should pay a welder to cut the top off the keg or if I can do it myself? Also, to add a spigot, does that have to be welded on the keg or could I use something else instead of welding?

Jeremy Sherman
Sterling Heights, Michigan

Jeremy, this sort of question comes about once a year and when I answer I always "beat up" the questioner . . . so I hope you're a good sport! Okay, just so I understand, your buddy at work found a "stray keg" that was abandoned at a party or behind some skanky bar and gave this keg a nice warm home in his basement. Now the keg has been donated to you since you are a homebrewer and can put this sad and lonely keg to good use. Is this a decent recreation of the facts of how you got this keg?

The true owner of the keg does not really care where your friend got this keg. The owners really just want their property returned. Most keg owners do not camouflage their identity to confuse prospective keg users with questions about who really owns the keg, rather they stamp the brewery name on the perimeter of the top (called the chime). Sometimes they even paint their name on the side of the keg. Boulevard Brewing Company in Kansas City, Missouri has clever stickers on their kegs asking customers to help return lost kegs to the brewery. These stickers also comically explain that keeping one of their kegs is theft.

The reality of kegs is that some are damaged to the point where they can no longer be used and are actually retired. For those readers interested in buying used kegs, start with your local craft brewer. This is a legal way of acquiring property. Many brewers, especially the larger guys who don't sell their used stuff to individuals, sell used kegs to companies like Sabco (www.kegs.com) who recondition and resell them. Reconditioned kegs typically have the original owner's name ground off of the chime, especially if they are resold to another brewery. Sabco even sells the parts required to convert a keg into a kettle, and actual keg-kettles.

This is the end of the prelude to the answer to your question and that is about paying someone to do the work versus doing it yourself. I know a lot of folks who work on stainless steel and not one of them would dream of paying someone to do something that they can do themselves. The fact that you ask about attempting this yourself leads me to believe that you have no experience cutting or welding stainless steel.

My recommendation on this project is to have someone do the work for you if you have never done this before. Or, at very least, have someone that does have experience help you do the work. If possible, I would cut off the top with a plasma torch for the smoothest cut that would require a minimal amount of grinding to remove burs and irregularities in the shape.

As far as outlet fittings, you can go with a welded outlet or a bulkhead fitting. A bulkhead fitting is inserted in a hole and sealed with a gasket and nut. The advantage of this style fitting is that it requires no welding and is easy to replace. The disadvantage is that the gasket and nut present a crevice on the inside of the kettle and is not as easy to clean as a smooth, welded connection. I prefer welded fittings for this reason.

If you have the outlet welded to the keg you can either weld a valve directly to the keg or have a fitting welded to the keg. I prefer having a fitting on the keg and then attaching my valve to the fitting. This allows for the valve to be removed for maintenance or replacement if the valve becomes damaged. If you want to use a ball valve with a threaded connection you can have a NPT coupling welded so that it will mate to a ball valve (which are readily available). I have a personal thing against threaded connections and prefer sanitary fittings. I would have a ferrule welded in the keg and attach my valve with a clamp and gasket. This method requires a more expensive outlet valve that is more difficult to find than the ubiquitous ball valve available at every home hardware store.

I hope this information helps in your decision making process!

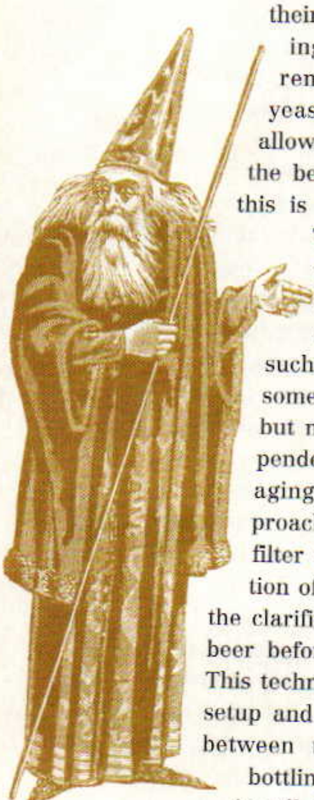
Cutting the yeast cake

I saw the ads for the Coopers carbonation drops and they seem like an easy alternative to the hassle of counter-pressure filling, but here's the rub: I don't like that little white layer of yeast in the bottom of the bottle. I actually like filtration to make my beers fairly clear. Is there a happy middle ground? Is there a beer filter with rougher filtration that would allow just enough yeast through to let the carbonation drops work without leaving the residue in the bottom of the bottle?

Mark Lashway
Moriah, New York

"Help Me, Mr. Wizard"

So you're one of those picky brewers who wants the best of both worlds! Fortunately, there is a way to have bottle-conditioned beer sans yeast cake, but rough filtration is not the method of choice. Most filters are designed to remove particles above a certain size and not all filters are successful in their duty. You are looking for a filter that removes most of the yeast, say 90%, but allows 10% to remain in the beer — a product like this is not on the market.



There is, however, an alternate approach. Some brewers producing cloudy beers, such as hefeweizen, want some yeast in the bottle but not the full load suspended in the beer after aging. A common approach to this quest is to filter or centrifuge a portion of the beer and blend the clarified beer with cloudy beer before bottling the mix. This technique is very easy to setup and can be done inline between the fermenter and bottling tank. To do this, install a bi-pass around the filter or centrifuge where the cloudy beer and clarified beer streams are recombined on the way to the bottling tank.

Another method is to filter the entire fermenter and remove all of the yeast remaining from fermentation and then to add fresh yeast prior to packaging. There are two different reasons for using this method. The first is aesthetic. Some yeast strains are very flocculent and settle in the bottom of the bottle into a tight pack of yeast. If the beer coming out of the bottle is supposed to be cloudy, it may not be if the yeast is too flocculent. If the yeast is disturbed the consumer may see chunks of yeast in their glass as opposed to a uniform cloudiness. Some weizen brewers remove the fermenting strain from the beer and replace it with a less flocculent yeast strain. In fact, some bottled hefeweizens actually

> "Some weizen brewers remove the fermenting strain from the beer and replace it with a less flocculent yeast strain."

contain lager yeast in the bottle since they are typically less flocculent than ale strains.

The other reason to remove the fermenting yeast from the beer prior to packaging is consistency. If I want to bottle condition my beer and control the amount of yeast in the bottle, adding fresh yeast to filtered beer is a very good method of accomplishing these goals. Sierra Nevada Brewing Company uses this method for these two different reasons. Like you, Sierra Nevada wants a very faint film of yeast in their bottles that is almost imperceptible to most consumers. They also want to bottle-condition their tasty ales and do not want to trust this final step of brewing to any old yeast hanging about in the fermenter. Instead, they use freshly cropped yeast with the highest viability for this purpose. This is important since the amount of yeast added is just enough to get the job done, hence the freshest yeast is selected. The yeast concentration in a bottle of Sierra Nevada is about 1 million cells per milliliter of beer. This equates to about ¹⁄₁₀ of the yeast added for primary fermentation. Assuming the same cell density in the yeast slurry is 100 million cells per milliliter (typical for a starter) you need to add 3.5 milliliters or ¹⁄₁₀ of an ounce of slurry per bottle — a very small volume indeed.

The easiest way to do this at home is to begin by growing up your yeast starter. Since you will only need about 200 milliliters (~7 ounces) of yeast you can simply buy a liquid starter if that is more convenient. Then, filter your beer and determine the volume of filtered beer by using a calibration strip on your bottling bucket. This step is important because you are going to add the priming sugar based on beer volume. Add the required amount of priming sugar to the bucket along with the yeast. The amount of yeast can be easily estimated by dividing the beer volume by 100. If you have 5 gallons (18.9 liters of beer) you will need 0.05 gallons (0.189 liters) of yeast slurry. Mix up everything and bottle.

One word of caution about beer handling in general is oxygen pick-up and its affect on beer oxidation. Minimizing air pick-up during racking is key and especially during filtration since yeast, which is a good oxygen scavenger, is removed. The small amount of yeast added in the method described above is insufficient to prevent oxidation and care must be taken during the process. Carbon dioxide blanketing and measures taken to prevent splashing are both recommended.

So now you can have your cake and drink it too!

Talking about tyramine

I have a friend who is a beer enthusiast who recently starting getting severe migraines after consuming a few beers. He then went to the doctor and was told that it was due to the tyramine found in beers. I have been doing some research and found that tyramine is created in the aging process and usually the longer that an item is aged the greater the levels of tyramine. As a result, beers on tap that are not stored properly have higher levels than bottled beers.

I was wondering if you knew of any lists or studies showing the tyramine levels found in different brands of beer. If not, in following the theory mentioned above do you know of any brands that have quicker brewing times but do not sacrifice quality storage methods in the process. Please let me know if you have any info that can help my friend out. Thanks!

Saj Simon
Hyde Park, New York

Thank you for the very interesting question. I usually do not attempt to answer questions that I know very little about unless I can find some really good information. I am breaking my own rule with this question because the topic is really quite intriguing. I consider myself well read when it comes to the topic of brewing science and I have never read anything about tyramine and beer. After a quick perusal of the web, I discovered many sites that give general information on the subject. I think I can shed some light on your question and hope that other readers find this topic as exciting as I do!

Tyramine comes from the decarboxylation of the amino acid tyrosine and acts as a vasoconstrictor in the body. Elevated levels of tyramine reportedly causes headaches, nausea and elevated blood pressure in certain people, for example migraine headache sufferers. The enzyme monoamine oxidase breaks tyramine and other monoamines into harmless metabolites in most individuals. Certain antidepressants contain monoamine oxidase inhibitors and people taking these drugs also experience negative side affects when consuming foods high in tyramine.

So what foods are high in tyramine? Basically any food high in protein where the protein has been degraded is high in tyramine along with other monoamines. This broad group includes fermented meats, meat liver, meats prepared using meat tenderizers (proteolytic enzymes), cheeses, especially aged cheeses, fermented soy products like miso, nato and soy sauce, yeast extracts such as vegemite (mmm, vegemite) and finally wine and beer. This is a pretty huge list that really should scare the daylights out of those Atkins diet folks wolfing down meat like there is no tomorrow!

I found some interesting literature with respect to monoamines in wine and the levels of these compounds in wine are mainly attributed to malolactic fermentation since lactic acid bacteria decarboxylate certain amino acids. This explains why fermented meats and aged cheeses are high in monoamines (both of these foods involve lactic acid bacteria). I did not find a good explanation of why beer is high in tyramine.

What I did find agrees with the information in your question related to aging. Note that vegemite, a paste of sorts made from yeast, is high in tyramine. My guess is that yeast autolysis unleashes a variety of enzymes into the decaying yeast mass and some of these enzymes are capable of amino acid decarboxylation. This is merely a guess, but it makes sense to me. The bottom line, is that the notion of prolonged beer storage or aging and high tyramine levels is easy enough to find and there is probably something to the idea.

I have never seen a table comparing the level of tyramine in various beer brands. Maybe some brewery will see this column and use their unusually low tyramine levels as a marketing tool! I really don't want to speculate on what commercial brands of beer may contain high or low levels of tyramine because I do not fully understand the mechanism of how this compound is produced. My knowledge of tyramine is not adequate to associate a brewing process or technique with elevated levels of tyramine in a finished beer.

If you believe that prolonged contact with yeast during aging is a believable explanation, then seek out beers with "normal" beer-yeast contact. A doppelbock aged in some cave or cold stainless aging tank for 3–4 months in the presence of yeast is a good example of a beer with a long beer-yeast contact time. Likewise, bottled conditioned beers or unfiltered beers that have been tucked away to age and improve with time may not be too friendly to your friend's head.

> "Elevated levels of tyramine reportedly causes headaches, nausea and elevated blood pressure in certain people . . ."

Most beers brewed commercially do not spend excessive time in aging because aging is expensive and breweries are businesses trying to make a buck. With that said, some large brewers remove yeast from beer as the beer is transferred from the fermenter to the aging tank with a centrifuge and there is no beer-yeast contact during aging. I wonder why these beers bother with aging after yeast removal since acetaldehyde and diacetyl reduction both require yeast to occur, but that's a different matter. Most brewers age the beer on yeast and this aging period typically lasts between 3–4 weeks after fermentation. I know that Miller and Rolling Rock remove yeast immediately after fermentation going into aging. I am not stating that these beers are low in tyramine because I do not know one way or the other, but they do fit the type of aging you asked about.

I do want to close by stating that this is an interesting topic that may affect some people. The limited reading I have done on the topic leads me to believe that a minority of people are sensitive to monoamines and that this topic should not "scare" the average beer drinker away from beer. When I have had complaints from customers about a certain beer "causing" a headache my first question is "how many did you have?" It never ceases to humor me when a beer drinker thinks that they should be free of pain the next morning after consuming 6–8 0.5 liter glasses of Mai Bock! ■

Berliner Weisse

The people's Champagne

by Horst D. Dornbusch

Berliner weisse is a sour, tart, fruity, highly effervescent, spritzy ale that is a tough style for homebrewers to pull off. Berliner weisse is still much more popular in its home base in and around Berlin than anywhere else. By law, it may be brewed only in the German capital, because, similar to the Kölsch ales of Cologne and the Trappist ales of Belgium, the name enjoys the legal protection of an *appellation d'origine contrôllée*.

Ich bin ein Berliner weisse

Nowadays, Berliner weisse falls into the category of a schankbier, which is the German equivalent of a session beer. The German beer tax law officially defines schankbiers by their original gravity, which must be between OG 1.028 and 1.032 (7 and 8 °P). However, about two centuries ago, Berliner weisse was made in any strength. It could be even weaker than schankbier or as strong as a bockbier, with OGs ranging from an anemic 1.008 to a solid 1.080 (2 to 20 °P).

All Berliner weisse comes exclusively in 0.33-liter (11.16-fl. oz.) bottles. There is no draft Berliner weisse. The Berliner weisse dates from a time before glass beer bottles. In those early days, the effervescent brew was sold in earthenware crocks closed with string-fastened cork stoppers to contain the beer's powerful carbonation. The crocks were often buried in sand during aging. Obviously, these crock-conditioned ales were unfiltered. Berliner weisse should be mildly yeast-turbid from at least three weeks to three months of bottle conditioning, yet the Berliner Kindl Brauerei omits bottle conditioning altogether and produces a crystal-clear, filtered Berliner weisse. The Berliner Schultheiss Brauerei, on the other hand, still produces a bottle-conditioned Berliner weisse.

There is no residual sweetness in a Berliner weisse whatsoever, which makes it an ideal summer drink. A Berliner weisse can be very refreshing, especially on a hot afternoon, when you might be sitting in an outdoor pub or cafe at the Kurfürstendamm, Berlin's showcase avenue, watching the elegant passersby parading their latest couture. Berliner weisse ought to be served in a wide-rimmed, bowl-shaped chalice, about twice the size of the bottle, because Berliner weisse will foam almost like champagne. The two weisse breweries in Berlin, Schultheiss and Kindl, issue their own weisse specialty glassware to their on-premise outlets. When Napoleon occupied Berlin in 1809, he dubbed Berliner weisse the "Champagne of the north." More down-to-earth Berliners just called it "the workers' sparkling wine."

Because of its tartness Berliner weisse is almost never consumed straight. Instead it is drunk *mit Schuss*, that is, with a shot of raspberry or woodruff-flavored syrup; the former being readily available and the latter being next to impossible to find in North America. However, a simple search on the Internet will return a number of outlets in the U.S. where both the raspberry and woodruff syrups can be purchased online. Add about a jigger (approximately 1.5 oz.) of syrup into the glass and pour the Berliner weisse over it. Because of the colors in the syrups, Berliners often order their weisse simply by asking for a red or a green one. In the 19th century, Berliner weisse was often served fortified with a shot of pure or caraway-flavored schnapps, a custom that has now fallen out of favor. Some restaurants now serve Berliner weisse with a straw, a practice that is severely frowned upon by the true weisse

BERLINER WEISSE by the numbers

OG	1.028–1.032 (7–8 °P)
FG	1.002–1.008 (0.5–2 °P)
SRM	2–2.7
IBU	4–6
ABV	2.6–2.7%

RECIPE

Der Weisse Spritzer
(5 gallons, all grain)
OG = 1.030 FG = 1.007 or lower
IBU = 5 SRM = 2.5 ABV = 2.6%

Note: the total grain bill of approx. 6.0 lbs. (2.7 kg) is based on a brew system with an extract efficiency of 65%.

Ingredients

3.5 lbs. (1.6 kg) Pils malt (1.5–2 °L)
1.9 lbs. (0.86 kg) pale wheat malt (2.8 – 4.3 °L)
0.625 lbs. (0.28 kg) Weyermann Acidulated Malt (1.7–2.8 °L)
2 AAU Hallertauer, Tettnanger, Spalter or Mt. Hood hops (bittering, 15 mins) (0.5 oz./14 g of 4% alpha acid)
1–2 level tsp. (5–10 g) gypsum
3 oz. (85 g) light dry malt extract for a starter
1 package each of Wyeast 1007 (German Ale) yeast and Wyeast 4335 (*Lactobacillus delbrückii*) bacteria

Step by Step

Three days before brew day, prepare a sterile, well-aerated starter from roughly 1 quart (1 L) of water, 3 ounces (85 grams) of light dried malt extract, and the Wyeast 1007 yeast. On brew day, add the Wyeast 4335 *Lactobacillus* bacteria to the starter. Mill the grains and dough in with about 2.5 gallons (or 9.4 L) of water at a starting mash temperature of roughly 95–100 °F (35–38 °C) for an acid and hydration rest of at least 2 hours (longer is better). Then, through the infusion

continued on page 20

continued from page 19

of additional, near-boiling water, take the mash up to 122 °F (50 °C) for a beta-glucan and protein rest of about 30 minutes. This helps degrade excess gums and proteins, especially from the wheat. Then infuse the mash again to raise the temperature to the optimum beta-amylase temperature of about 148 °F (64 °C). Let rest for an hour to ensure maximum conversion of starches into simple, fermentable sugars for a dry beer. A final hot-water infusion takes the mash to the mash-out temperature of 170 °F (77 °C).

Recirculate the wort for about 15 minutes to trap particulate and unconverted proteins and starches. Then add the bittering hops to the empty kettle and lauter the wort until the kettle specific gravity is about 1.030 (7.5 °P).

Add the gypsum and boil the wort for about 15 to 20 minutes. After shut-down, check the gravity and restore any evaporation losses if necessary by liquoring the wort down to the target OG. Let the wort rest in the kettle for about 15 to 20 minutes to allow the trub to settle. Then draw about 0.5 gallon (2 liters) of wort into a separate pot to be used as kräusen for bottle-conditioning.

Boil the kräusen to preserve sterility and pour it hot into a sealable plastic container with about 10% head space. Store in the refrigerator or freezer until needed.

Heat-exchange the wort to a fermentation temperature of 63–65 °F (17–18°C), add the starter, aerate and allow the yeast and bacteria to go to work. Let ferment until the brew has reached about 75–80% attenuation (the gravity in the fermenter should be around 1.012 or 3 °P). This should take about 4 days. At this point the *Lactobacillus* has done all you want it to do. Rack the brew and reduce the temperature to about 50 °F (10 °C), which inhibits *Lactobacillus* growth. Keep the brew at this temperature for two days to ensure that all *Lactobacillus* bacteria are dormant, then rack again.

Let the kräusen warm up to room temperature, add it to the racked beer, and bottle the brew immediately. Lager the beer in the bottles at 59–61 °F (15–16 °C) for two weeks, then at 46–50 °F (8–10 °C) for another two weeks to three months. Bottle-conditioning occurs during this lagering stage. The longer the lagering time, the mellower and more floral will be the beer's bouquet. If brewed and stored properly, a Berliner weisse may keep up to five years. Always serve a Berliner weisse at the lagering temperature. Most of the acid is formed quickly during fermentation, but it slowly and continually grows in the beer during aging until the bacteria simply run out of fuel.

Der Weisse Spritzer

(5 gallons/19 L, extract with grains)

OG = 1.030 FG = 1.007 or lower
IBU = 5 SRM = 2.5 ABV = 2.6%

Note: The total amount of 4.27 lbs. of liquid malt extract is based on a theoretical malt solid content of 75.5% and that there is no contribution to gravity by the steeped grain.

Ingredients

- 2.77 lbs. (1.26 kg) unhopped Pilsner liquid malt extract (such as Weyermann Bavarian)
- 1.5 lbs. (0.5 kg) unhopped pale wheat liquid malt extract (such as Weyermann Bavarian Hefeweizen, Briess Bavarian Wheat, Coopers Wheat or Muntons Wheat)
- 1 lb. (0.45 kg) Weyermann Acidulated Malt
- 2 AAU Hallertauer, Tettnanger, Spalter or Mt. Hood hops (bittering, 15 mins) (0.5 oz./14 g of 4% alpha acid)
- 1–2 level tsp. (5–10 g) gypsum
- 3 oz. (85 g) light dry malt extract for a starter
- 1 package each of Wyeast 1007 (German Ale) yeast and Wyeast 4335 (*Lactobacillus delbrückii*) bacteria

Step by Step

Prepare a yeast starter as for the all-grain recipe. Mill or crush the acidified malt and pour it into a muslin bag. Immerse the bag in 2 gallons of 170 °F (77 °C) water for about one hour. Give the steeping pot a periodic boost of heat to maintain the steeping temperature.

Next, lift the bag out of the liquid and rinse it with several cups of cold water, but do not squeeze the bag. Combine acidified brewing liquor with more liquor in the brew kettle and bring to a boil. Turn off and stir in the liquid malt extracts. To ensure a light-colored brew, make sure to stir until they dissolve completely.

Add the hops and gypsum and bring back to a boil. Shut down after just 15–20 minutes. After this, simply follow the equivalent instructions in the all-grain recipe for drawing the kräusen, pitching the starter, fermenting, lagering, priming with kräusen, packaging and serving.

cognoscenti. Berliner weisse can be stored in a cool dark place for up to five years, during which it maintains its quality and becomes gradually more fruity. It is best served at a temperature of 46–50 °F (8–10 °C).

The Berliner mash

The modern Berliner weisse is usually made from roughly 25–30% pale wheat malt, but in times past, it may have been made with as much as twice the amount of wheat that is common today. The rest of the mash is always barley malt — brownish in the old days, but pale pilsner-like today. Like most German beers, Berliner weisse used to be decoction-mashed, but today even the two remaining commercial weisse-makers, the Berliner Kindl Brauerei (the largest) and the Berliner Schultheiss Brauerei, use just a multi-step infusion mash.

The pH-value of the finished Berliner weisse is a low 3.2–3.4, and it is a lactic culture added to the fermenter (not the mash) that is largely responsible for the brew's acidic character. It is advisable still, for homebrewers to employ an acid rest of two hours (or longer) at 95–100 °F (35–38 °C) at dough-in, during which the enzyme phytase produces small amounts of phytic acid. As an option, you can follow the example of some German brewers, who dough-in the day before brew day and let the mash rest overnight. It also helps to add about 10% acidified pale malt to the grain bill. I use Weyermann acidulated malt, which contains 1–2% lactic acid. The addition of 10% acidified malt reduces the mash pH by 1%, for instance from 5 to 4.0. This malt contributes a pale 1.7–2.8 SRM to the wort color and thus complies with the weisse's dark-yellowish color specification. Berlin's water is fairly hard, which also enhances the beer's astringency. For this reason, I add about 1–2 level teaspoons of gypsum (5–10 grams) to the kettle.

Because there is no Berliner weisse liquid malt extract on the market and there is a need to acidify the brew, it is not possible to make a pure extract-only version of this beer style. At the very least, you must steep some acidified grain in hot brewing liquor (see the all-grain instructions in the recipe on pages 19–20). Considering that the steeping process is relatively less efficient than mashing, extract brewers should use about twice the amount of acidified malt than all-grain brewers (for quantities see the recipes).

Is it from France, Bohemia, Saxon-Anhalt or indigenous?

Beer historians are clearly divided about the origins of Berliner weisse. Some believe that it originated in Bohemia, slightly to the southeast of Berlin. Others claim that Berliner weisse is an evolution of the Halberstädter Broihans, a brownish wheat-and-barley ale brewed in the town of Halberstadt to the west of Berlin in the state of Saxon-Anhalt. Others maintain that the beer was brought to Berlin in the late-17th century by Protestant French Huguenots escaping the religious persecution of the Catholic Sun King Louis XIV.

Either way, by the 19th century, weisse had clearly become the favored drink of Berliners and about 700 breweries ensured that the populace never had to be without. Today the brew is merely an oddity, and there are only two weisse breweries left.

A deviant kettle procedure

Because of the Berliner weisse's extremely low bitter requirement of 4–6 IBUs, the bittering hop addition in this brew is correspondingly minimal and there are neither flavor nor aroma hops. In the old days, Berliner weisse brewers even added the hops to the mash, not the kettle. Some did not even bother to boil their wort. The amount of mash-hopping was roughly 0.5–0.7 oz. (15–20 grams) per 5 gallons (19 L) of wort, regardless of the hops' alpha-acid rating. Obviously only little of the alpha-acids were actually extracted into the wort by this process. For sterility's sake, however, I would depart from this traditional hopping regimen and follow the practices of modern weisse-makers: Add the hops to the kettle in the manner of a first-wort hopping and either boil the wort for a short 15 to 20 minutes, or merely raise the temperature for the same length of time to 185–190 °F (85–88 °C).

I have found that the precise choice of hops for Berliner weisse does not make a great deal of difference as long as the hops are fairly mild. The beer's lactic components are just too overpowering. Any German noble hops from the Hallertau, Tettnang, or Spalt will do, but Saaz, British, or Northwest hops are "out" except for such Northwest-grown German derivatives as Mt. Hood.

Berliner weisse requires kräusening to prime secondary fermentation later on, but you should prepare the kräusen on brew day. Kräusen is the inoculation of partially fermented wort with fresh, unfermented wort. Before transferring your Berliner weisse from the kettle to the fermenter, therefore, divert about 0.5 gallon (2 liters) of wort into a separate pot, boil it to sterilize it, and pour it into a sealable plastic container, with about 10% head space. Let the kräusening solution cool and store in a refrigerator, or better, in your freezer. Later, on the appointed day, (see step instructions in the recipe on page 19–20) let the kräusen solution warm up to room temperature and add it to the fermenter.

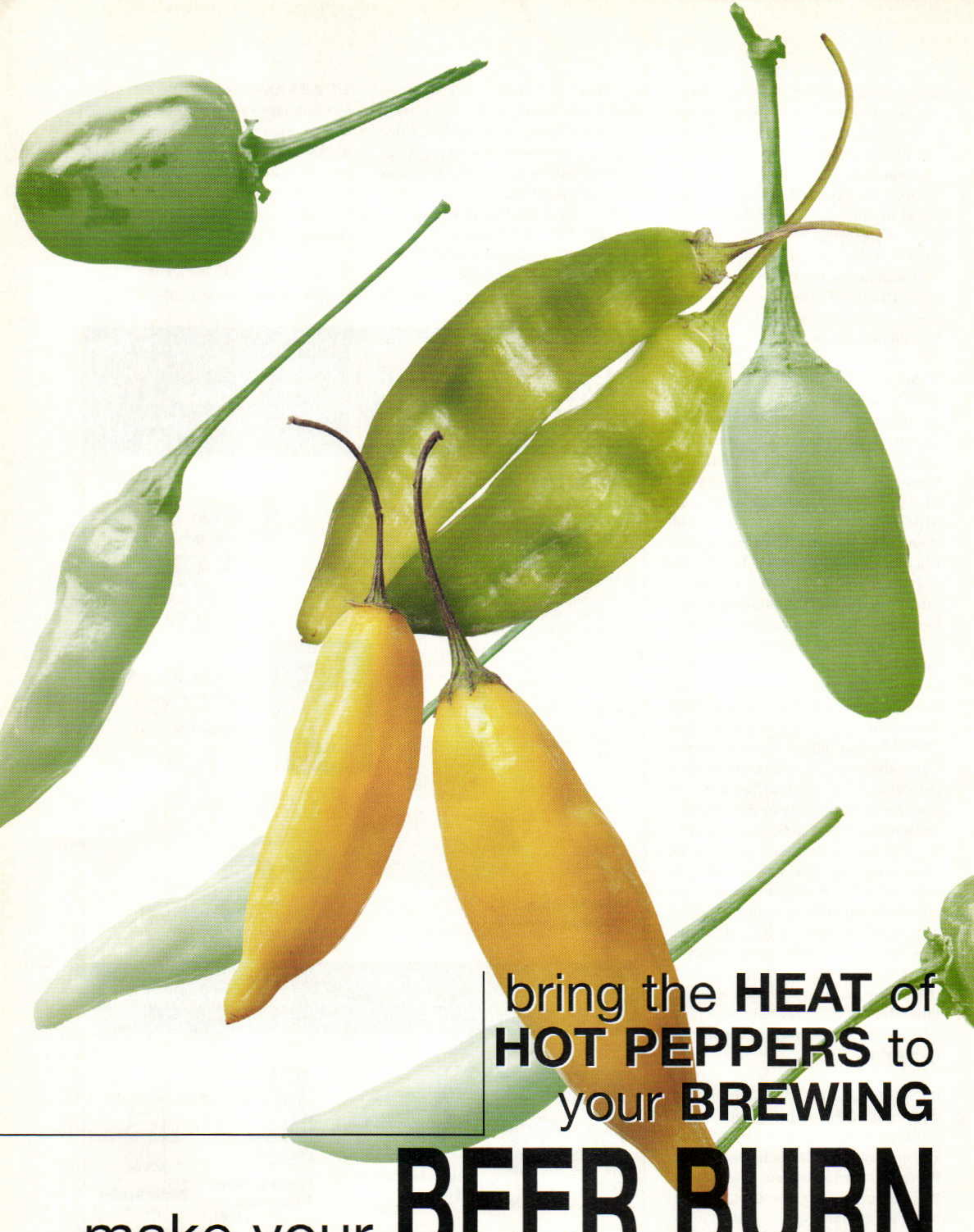
Yeast and bacteria: Two fermentations

Berliner weisse, like many Belgian ales, is fermented with both yeast and a lactic-acid producing bacteria. The weisse's closest relative in taste, though not in alcohol content, is perhaps the Belgian gueuze. The bacterial strain required for Berliner weisse (there is no choice here!) is *Lactobacillus delbrückii*, so-named after Max Delbrück (1906-1981), the biochemist and 1969 Nobel laureate in medicine, who isolated this *Lactobacillus* bacteria while he was head of the *Institut für Gärungsgewerbe* (Institute for Fermentation Tissue) in Berlin between 1932 and 1937. Wyeast offers these bacteria under the name of 4335 *Lactobacillus delbrückii*. The scientific literature on Berliner weisse recommends a ratio between yeast and bacteria of 4–6 to 1, in other words, the yeast cells should outnumber the *Lactobacillus* cells at least by a factor of four. I have had good luck with making a starter from a smack-pack of yeast added to a sterile and well-aerated solution of roughly 1 quart (~1 L) of water and 3 ounces (85 grams) of light dry malt extract, three days before brew day, and then adding the *Lactobacillus* to the starter on brew day.

Note that the Berliner weisse, though a wheat beer, is not fermented with the yeast strains that give Bavarian Weissbiers their phenolic flavor. Instead, phenolic, bubble-gum-like flavors are completely out of character in a Berliner weisse. For this reason, I make my Berliner weisse with Wyeast 1007 German ale yeast. This may not be entirely authentic, but has two advantages: the yeast is readily available and it works! The 1007 is a dry, crisp, and clean-fermenting ale yeast that is happiest at a temperature below 55–66 °F (13–19 °C).

Also, *Lactobacillus* is mostly responsible for the Berliner weisse's sharp, acidic, thin, and dry finish. It is also largely responsible for the brew's low alcohol content of roughly 2.5–2.8% ABV, because a portion of the fermentables in the wort is converted not to alcohol, but to lactic acid. Attenuation levels of a Berliner weisse are exceptional and may exceed 100%, which means that the final gravity may drop below 1.000, and the lactic-acid content may be between 0.25 and 8%. ■

Horst Dornbusch writes "Style Profile" in every issue of BYO.



bring the **HEAT** of **HOT PEPPERS** to your **BREWING**

make your BEER BURN

By **Bev D. Blackwood II**

Using chili peppers in beer may not be the typical combination you think of when you're contemplating an experimental brew. However, it's not unusual to find many homebrewers spicing up their brew days with uncommon additives. Where would Belgian beers be without their coriander and orange peel? Where would various Christmas ales be without the holiday spices that lend them that seasonal character?

Pepper beers have long been a novelty item in the brewing world, but few commercial examples have survived for any length of time. Those that remain are something of a curiosity rather than a commercial success.

Notable examples range from the serious brewing efforts of Rogue's Chipotle Ale, previously known as Mexicali Rogue, to the "novelty" beer aspect of Cave Creek's Chili Beer, which has a whole serrano pepper in every bottle. Drinkability is often sacrificed in the quest for heat, lending the entire style a frivolous reputation. The base beer tends to be a light beer, one that permits the scorching heat of the pepper to dominate all other flavors. The more serious examples strive for a sense of balance in the flavors, adding the subtle burn of the pepper to punctuate crispness of the hops and offset the residual sweetness of the beer. Think hop spiciness on steroids.

Pepper Heat in Foods

If you question whether the heat of peppers belongs in beer at all, consider the flavor combinations found in dishes from around the world. Closest to home is American barbecue. Often the flavors of rich, smoked meats are complimented by a sweet-spicy sauce with a peppery finish. This heat factor varies by region, but finds its hottest incarnations in the American Southwest. South of the border, the combinations multiply, ranging from the outright heat of hot sauces to the rich and spicy mole sauce, made using chocolate.

Sweet and spicy doesn't stop there, however, with excellent examples found wherever peppers are grown. Noteworthy examples are the potent jerk sauces from the Caribbean, the searing heat of Thai and Schezuan cuisine and the rich curries and spicy vindaloo sauces from India.

John's Peppered Honey Wheat

(5 gallons/19 L, all-grain)
OG = 1.055 FG = 1.014
IBU = 19 SRM = 5 ABV = 5.3%

Ingredients

6.1 lbs. (2.8 kg) German wheat malt
3.4 lbs. (1.5 kg) Belgian Pilsner malt
1.2 lbs. (0.54 kg) honey
1 Anaheim pepper
1 jalapeño pepper
4.4 AAU Tettnanger hops (55 mins) (1.1 oz./31 g of 4.0% alpha acids)
0.5 oz. (14 g) Tettnanger hops (15 mins)
1 tsp. Irish moss
2 tsp. yeast nutrient
White Labs WLP008 (East Coast Ale) yeast
0.75 cup corn sugar (for bottling)

Step by Step

Mash grains for 60 minutes at 154 °F (68 °C). Sparge for 6.5 gallons (25 L) of runoff and add honey five minutes from the end of the two-hour boil. Add Tettnanger hops at times indicated. Add Irish moss at knockout. After chilling, add yeast nutrient and pitch yeast. Ferment at 70 °F (21 °C). Make pepper tincture according to instructions in main text.

Wee Little Hottie

(5 gallons/19 L, all-grain)
OG = 1.085 FG = 1.021
IBU = 25 SRM = 29 ABV = 8.2%

Ingredients

14.5 lbs. (6.6 kg) Maris Otter pale malt
1.75 lbs. (0.79 kg) British dark crystal malt
0.5 lbs. (0.23 kg) Belgian Carapils
0.38 lbs. (0.2 kg) peat smoked malt
0.25 lb. (0.11 kg) biscuit malt
0.125 lbs. (56 g) chocolate malt
7.5 AAU UK First Gold hops (FWH) (1.5 oz./43 g of 5.0% alpha acids)
1.0 oz. (28 g) UK Fuggles (10 mins)
1.0 lb. (0.45 kg) jalapeño peppers
White Labs WLP007 (Dry English Ale) or White Labs WLP028 (Edinburgh Ale) yeast
0.75 cup corn sugar (for bottling)

Step by Step

Mash in for 90 minutes at 158 °F (70 °C). Sparge and runoff around 7–7.5 gallons (26–28 L) of wort. Boil for 90 minutes, with UK First Gold hops as first-wort hops and UK Fuggles added with 10 minutes remaining. Cut jalapeños in half, remove seeds and roast for about 20 minutes in a 250 °F (121 °C) oven. Steep peppers at the end of the boil for at least 30 minutes. Aerate and pitch yeast. Ferment at the lower end of your yeast's temperature range.

The Mole (Chipotle Porter)

(5 gallons/19 L, extract with grains)
OG = 1.053 FG = 1.013
IBU = 25 SRM = 49 ABV = 5.1%

Ingredients

2.5 lbs. (1.1 kg) Briess light dried malt extract
3.3 lbs. (1.5 kg) Muntons Light liquid malt extract
0.75 lbs. (0.34 kg) crystal malt
1.0 lb. (0.45 kg) chocolate malt
5.0 oz. (142 g) black patent malt
6.6 AAU Willamette hops (60 mins) (1.33 oz./38 g of 5% alpha acids)
Wyeast 1968 (London ESB) or White Labs WLP002 (English Ale) yeast
8 chipotle (dried, smoked jalapeño) peppers
0.75 cup corn sugar (for bottling)

Step by Step

Steep grains in 2/3 gallon (2.5 L) of water at 150 °F (66 °C) for 45 minutes. Add "grain tea" and dried malt extract to brewpot to make 3 gallons (11 L) and bring to a boil. Boil hops for 60 minutes. Add liquid malt extract for final 15 minutes of the boil. (Stir well to prevent scorching.) Cool wort, aerate and pitch yeast. Ferment at 70 °F (21 °C). Make pepper tincture by soaking dried peppers in vodka. See page 29 for details.

Peppers in Beer

All this talk about sweet, smoky and spicy food is all very well and good, but how does it relate to beer? The first two descriptors — sweet and smoky — suggest that there should be combinations within known beer styles that lend themselves to a flavorful pepper combination. Good examples of sweet styles would be the stronger Scotch ales, barleywines, strong Belgian ales, sweet stouts, Märzens, bocks and some wheat beers. Of course, nearly any beer can be brewed to balance to the malty side, so these are simply the more obvious choices. When it comes to smoke, there are fewer stylistic examples to work with, but the classic rauchbiers and Scotch ales with their smokier influences are a logical place to start.

On the opposite end of the scale are the "light" examples. A lighter beer permits the heat and delicate flavors of a pepper to be emphasized with few competing flavors. In this case it's not so much about the flavor combination, it's a case of letting the pepper's essence shine through. Light lagers, cream ales and wheat beers are all well suited to this role.

Pepper Varieties

Beyond choosing the beer's style, you need to decide on what pepper to use and the relative degree of heat you expect to get from it. Depending on the variety, you will also have to judge how much is necessary to achieve the desired level of pepper effect. Peppers come in a variety of shapes, colors and sizes. Red, green, yellow and orange are common colors, but the color doesn't necessarily have any bearing on the heat of the pepper. Spiciness, or pungency, is measured in "Scoville units." This form of measurement is named for a Parke-Davis scientist, Wilbur Scoville, who established a means to test the flavor concentration of capsaicin in various peppers. Pure capsaicin registers at a stunning sixteen million Scoville units, while the hottest pepper, the habanero (aka: Scotch bonnet) tops out at a mere 350,000 units! (For reference, the average jalapeño pepper is between 2,500 and 5,000 Scovilles.) Clearly, it will take more jalapeños than

habaneros to spice up your brews. An important fact to remember is that capsaicin is not very soluble in water, but is readily soluble in alcohol, which is critical in the beer flavoring process. When choosing your peppers, be sure to look for a smooth and glossy finish, with even coloration. They should also be firm to the touch, but not hard.

Preparing peppers

Once your peppers have been washed, you're ready to prepare them for the brewing process. It goes without saying that surface area is a factor in the uptake of the pepper flavors, but you should take care to leave pieces large enough to allow for easy racking between vessels. When preparing your peppers for use, simply cutting out the stem and removing the seeds and dicing them is usually sufficient. Be sure to retain as much of the white "ribs" as possible and as much of the stem end as you can if heat is a goal of yours. The highest concentrations of capsaicin reside in the ribs and stem areas (not the seeds, as is commonly believed). Roasting the peppers can add an extra dimension to their character, but be careful not to overdo it, unless you want a distinctly burnt character to the flavor from charred edges.

Handling raw peppers isn't something to take lightly. They can burn your mouth, certainly, but what many brewers fail to realize is they can also burn your skin. Wear impermeable gloves when handling cut peppers and be sure to not touch your eyes or nose unless you want a painful lesson. If you forget these precautions, you can expect painful, burning and swollen hands for several hours.

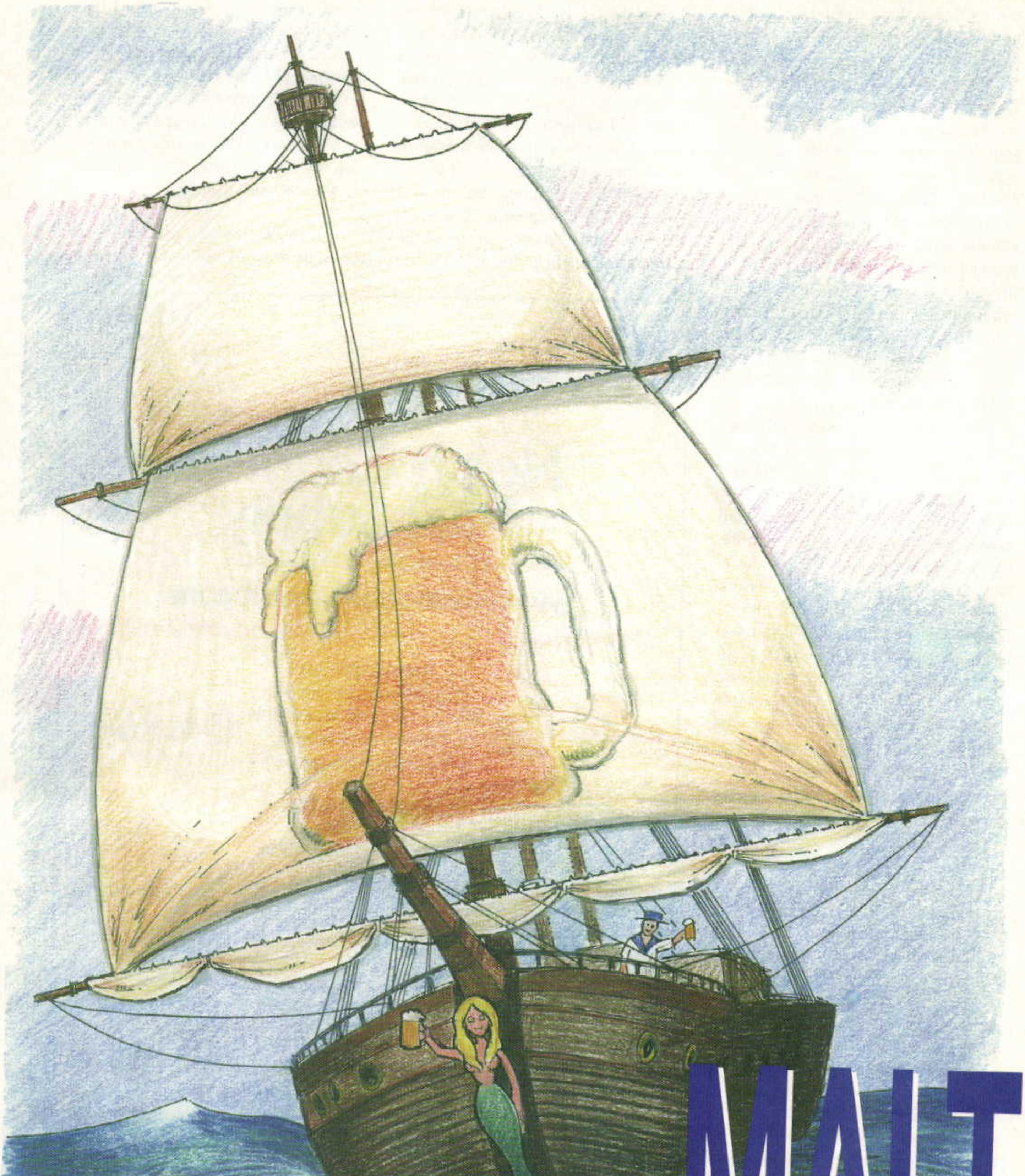
Choosing your method for flavoring your beer depends on several factors. First is the size of your batch. Very few people find 5 gallons (19L) of pepper beer useful or even desirable. However, it is certainly possible to make it in large quantities, since commercial producers have been doing so for years. For large-scale production, it's simply a matter of steeping the peppers in the beer or wort. Depending on your preference, this can be done after the boil, when the wort is still hot and can sanitize the peppers, or during secondary fermentation, when the risk of infection is lower (although not entirely absent.) The advantages to steeping in the kettle are obvious. First, you have very little risk of contamination and second, the heat tends to extract both the capsaicin and some of the pepper flavors, which add depth to the flavor profile. The chief disadvantage is the loss of aromatics during primary, resulting in a weaker pepper aroma. Adding the peppers in the secondary will allow the alcohol present to more readily bind with the capsaicin, but there's the added risk of infection and the lack of heat to break down some of the pepper flavors. The advantage of this method is that you don't have to use all your wort to make a pepper beer. Instead you can dose a portion of your batch and simply test the results until the desired level of heat is obtained. (This is covered in some detail in the recipe for Chili Head Fred in "8 Big Novelty Beers of the Dixie Cup," *BYO* December 2003).

A second strategy, and one that allows for more experimentation is to create a pepper tincture and then dose your beer with that solution until the appropriate level of heat and flavor is reached. Making tinctures is very straightforward. Depending on the amount of time you're willing to spend, you can make a pepper extract within the space of a few weeks. What's required is flavorless 80–100 proof vodka, peppers and patience. The risk of contamination is minimal and you have complete control over how potent the final product is. The basic process is very simple. Slice, dice, or puree your flavoring ingredient and place it into an airtight container. Then add sufficient vodka to cover it completely with about ¾ inch (2 cm) extra liquid above the ingredient. (Increase the amount of "overhead" if your flavorings are dried, as they will absorb some of the vodka during the extraction process.) Let the solution stand at least one week, ensuring that the flavoring ingredients are completely submerged the entire time. Don't hesitate to add more vodka, if necessary and you may agitate the solution to ensure thorough mixing. The longer the mixture sits, the more potent it will become. Also, using dried ingredients is supposed to increase a tincture's pungency by a factor of ten. When you're ready to create your pepper beer, simply strain the flavorings out of your tincture and dose the base beer with enough of the tincture to create the desired flavor profile. Be very careful when handling a hot pepper tincture; the liquid will sting badly if gets anywhere on your body.

This technique served John Jurgensen of the Bay Area Mashtronauts well, winning him a first place medal at the American Homebrewers Association's National Homebew Competition for his Peppered Honey Wheat. "I wanted a beer with flavors that aren't complex" he responds when asked about his choice of base beer. "I've tried lagers and I prefer the honey wheat." His tincture is simple, with a single Anaheim pepper, diced and immersed in Everclear (190 Proof) for several days, which is then augmented with a single diced jalapeño and steeped a further week or more. Using Everclear produces no advantage over plain vodka, and in fact can add an alcohol flavor to your final product if used in excess. Determining how much to use in your beer is simply a matter of a scaled taste test, adding a fixed number of drops to a known volume of the beer and evaluating the effect. Once the proper flavor is achieved, he determines the full-bottle proportions then doses his honey wheat beer (after bottle conditioning) with the tincture and caps the bottles again.

A well-balanced example of a pepper beer opens new horizons for many beer drinkers while providing a diversion to the brewer who wants to stretch their creativity. ■

Bev D. Blackwood II is a member of the Foam Rangers of Houston, Texas.



MALT

illstration by don martin

By **Terry Foster**

part I. Anchors Aweigh!

There is a problem with beer, at least to some number crunchers. The problem is that it is mainly water — 90% or more for most beers. If brewers could ship just an essence of beer, it would drastically increase profits by cutting packaging, storage and transport costs. The obvious alternative would be to produce a concentrated wort that could be cheaply transported, then diluted and fermented on site where it is to be drunk. In other words, what we inaccurately call "malt extract."

We take the shipping of perishable goods — such as beer and food — for granted, but this was much more difficult in previous centuries, where transport was at best a horse-drawn cart on badly made roads. Even worse, beer was shipped in wooden barrels, adding significantly to the weight that had to be carried. Barrels were expensive and were often lost or stolen, further eating into the brewer's profit. So it is not surprising that the idea of wort concentrate has a long history.

In the beginning

It could be argued that the first approach to a concentrated wort were the beer "loaves" thought to have been used by the Sumerians some 3,000 years or more ago, and later by the Egyptians. Preparations based on concentrated wort (and occasionally beer) were common in England by the 17th century. However, these were flavored with various roots and herbs and used as the basis of various patent medicines. In 1755, a chemist named Mr. P. Shaw proposed that the "surplus" water could be frozen out of beer. And brewers have told us that ice beer is a modern concept!

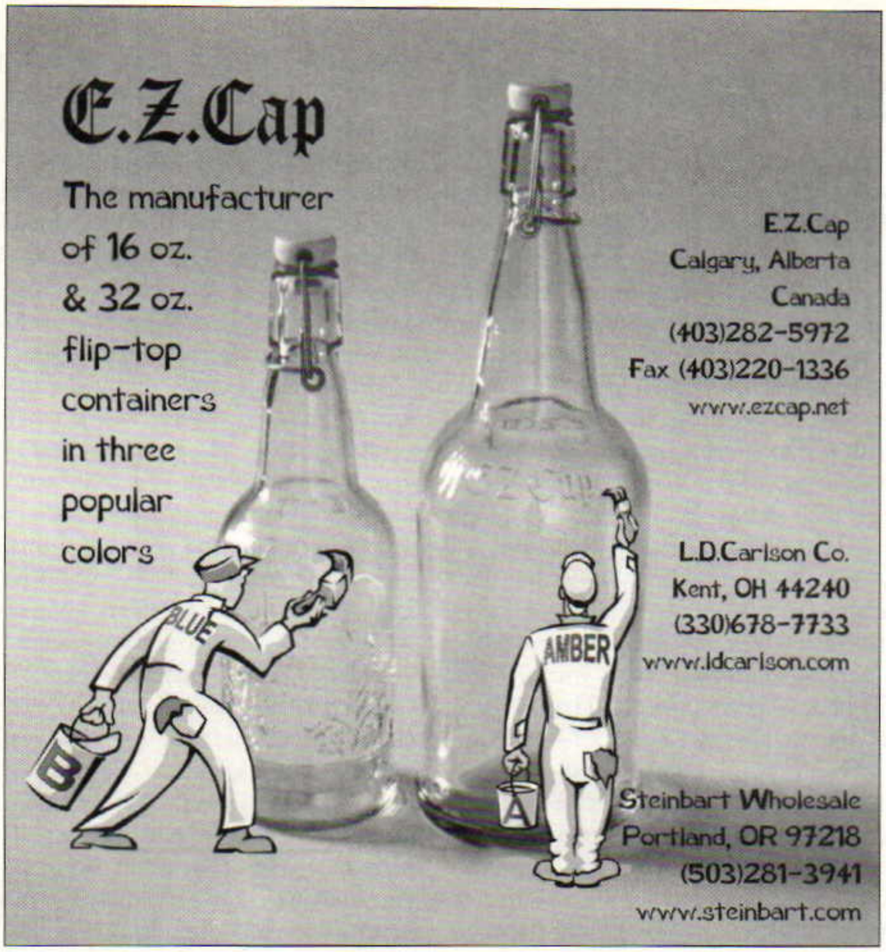
Endeavour, Resolution and Adventure

The organization with the greatest historical need for transporting beer over long distances was the British Navy. It's been said that the effective sailing range of a naval ship was only as far as its stock of beer would take it. Provisioning beer was a logistics problem for the Navy when a ship was away from dock for a month or more. There would a centuries-long connection between malt extract and the Navy.

In the 18th century there was another reason for making a beer concentrate. On long voyages, scurvy was a real problem. Beer and wort were thought to be excellent anti-scorbutics, so if an extract could be made that would keep longer than the normal two months that beer lasted, this problem would be solved. Thus, the Admiralty were very interested when, in 1772, Henry Pelham (with the grand title of Secretary to the Commissioners of Victualling) said that he had made samples of two different malt extracts. One was a hopped malt extract from wort, and the other was an extract from beer. Both were produced by evaporation, but the first needed to be diluted and fermented with yeast, while the second only required dilution and standing a few days before it was ready to drink.

The Admiralty thought this was a wonderful idea and a chemist, H. Jackson, was set to work to produce these extracts in sizeable quantities. He used some deep boilers, which had been used to produce a kind of soup extract to be used on ships, to make the malt extract. Because of the time it took to boil off the water, they were very dark and had a burnt taste. Jackson made some beer from the extract and said it tasted like beer made with treacle. He manufactured 25 barrels of the hopped extract, and six half-barrels of the beer extract. These went with Captain Cook on his

a HISTORY of EXTRACT



second voyage to the Far East (1772–1775), but the experiment was not a success.

The first problem was that both extracts started to ferment, even before dilution! A good deal of it was lost, as the escaping gas blew out the bungs of the cask. However, enough was saved to actually brew some beer, which raised the second problem. It had such a burnt and bitter taste that the crews of the ships (Resolution and Adventure) did not like it. A few years later, Captain Bligh took some of the extract with him on the ill-fated voyage of the Bounty. Could it be that the infamous mutiny was the result of Bligh cruelly forcing the men to drink beer made from the extract, rather than his more conventional harsh treatment of flogging and keel-hauling?

Captain Cook also made a spruce beer, using an infusion of spruce leaves along with molasses and one of the extracts (in 1:3 ratio), and then adding dried yeast for the fermentation. This must have been more successful, for it was made several times. I don't know if there is any connection, but Cook came from Whitby in Yorkshire and a spruce beer is still sold there. This is known as Black Beer and some extract is used in its production, but no molasses.

Despite these rather discouraging results, the Admiralty persisted in looking at the benefits of malt extract and Cook took more with him on his third voyage in 1778. This was not, of course, a successful trip for Cook himself as he was killed in Hawaii. Captain King, who brought back the Discovery, was forthright in his praise for the project, attributing the very good health of his crew "in great measure to the beer we brewed." This time the extract did not appear to have fermented in storage, so perhaps Jackson had refined his production technique by this time.

In 1778, Robert Thornton came up with an improved process, which he patented in that year. This used steam-heated double boilers and his product was a brittle, glass-like solid. This was stable on storage and the Admiralty loved it. According to the Commissioners of Victualling, beer made from this new extract had "the genuine pure flavour of the malt and hops" and was "remarkably agreeable to the palate."

We have to wonder about the accuracy of this statement. Thornton's extract was probably less burnt than Jackson's earlier effort, but it was still produced at atmospheric pressure, not under vacuum as extracts are today. It would have taken a very protracted boil to remove virtually all the water. At best, the product would have been highly caramelized.

Nevertheless, the Admiralty were sold on the idea and issued an order in 1779 that all ships on channel or foreign service should leave port with six months supply of the new extract — over three tons! According to the Commissioners, this would improve the health of the men without increasing the cost of supplying them with beer. Thornton, as the patentee, received this lucrative contract.

It was a grand scheme, but it didn't work. Just two years later the Commissioners had to admit that the scheme had failed. Their report to the Admiralty claimed success for the extract as an anti-scorbutic medicine, but also stated that this was the only reason for which it would be allowed on naval ships. It seems the beer made from the extract was not acceptable to the sailors.

But the Admiralty were not so easily discouraged. They decided to have another shot when in 1796, Sir John Dalrymple presented them with a plan for brewing beer "on board." The admiralty issued instructions that the ingredients and apparatus proposed by Dalrymple should be shipped to the West Indies so that a proper trial of the process could be carried out. One of his assistants was actually accredited with the rank of midshipman so that he could carry out the work. Sadly, there are no more details and it is not known what, if anything, the trial achieved. Just two years later, the Admiralty ordered a stop to issuance of malt extract as an anti-scorbutic, having found that lemon juice was more effective and much less expensive than extract.

Perhaps we should be aware that the problems might not have been wholly due to odd flavors from the extract. At that time there was a lack of understanding of the role of yeast in the process, unsanitary conditions on board and no means of controlling fermentation temperatures on a small ship rolling around in the South Pacific. In other words, the process may have been just as much to blame as the raw material. It would be 150 years before the Navy finally succeeded in brewing beer from malt extract on board ship.

Extract and the Porter Revolution

Around the time all of the above was happening, there had been an important change in brewing technology with the introduction of the hydrometer. For the first time, brewers knew what kind of yields they were getting from their malt. One thing they found out was that brown malt gave much less fermentable material than pale malt on an equivalent volume basis. Pale malt might cost more for the same volume, but it was actually cheaper to use than brown malt.

Brown malt had been the main staple in porter production, a beer that was then at the height of its popularity. This left the brewers with a problem — if they replaced all or most of the brown malt with pale malt, their porter just would not taste or look the same. To compensate for the change in base malt, they had tried all sorts of substitutes — including "burnt" malt or barley or burnt sugars. All sorts of other additives were also tried, some of them quite nasty. But the authorities reacted strongly to this. It was malt and hops that were taxed, not beer, and they did not want to lose out on a valuable source of revenue. Consequently, they introduced a whole raft of laws proscribing the use of anything other than malt and hops.

This made life difficult for the big porter brewers in London, who were also being pressed by big increases in the price of malt. The answer to their problem was blindingly simple; in 1802 Matthew Wood came up with a malt extract in syrup form that was intended for use as a porter coloring and flavoring agent. Exactly how Wood made his extract is not known. He had no

roast malt available, so did its coloring and flavor properties simply arise through caramelization as a result of long boiling time during evaporation? Given that the extract was made from malt and that water removal must have been expensive, it is difficult to see that it would have saved brewers any money, as compared to using brown malt in the usual way. It therefore seems likely that he used only a portion of malt in the extract, and supplemented it with something giving a much stronger and more powerful flavor.

There are two obvious ways in which he could have done this, and the first would have been to add something like molasses. And, indeed, he did later offer an extract made from molasses. The second is a little more sinister — perhaps he was adding one or more of the proscribed adulterants. This is merely supposition, and there is no direct evidence that Wood did doctor his extract. He did successfully sell it to various brewers, but at this time there had been a huge increase in the use of adulterants, as the price of malt and hops rose still further. That meant that the Excise clamped down heavily on the use of added chemicals, and also on Wood's coloring agent, prosecuting several brewers who had used it. But Wood, many country brewers and some of the lesser country brewers pushed Parliament to relax the rules on coloring additives after 1807. They were opposed by a few of the big London porter brewers, such as Whitbread. But even they gave up in 1810, when malt prices were set to rise still further. Finally, in 1811, coloring made entirely from muscovado sugar was permitted. The bill permitting sugar addition was repealed in 1816. Only a year later, Daniel Wheeler patented a process for making high-coloured malt by means of roasting it in a cylinder. All the porter brewers soon adopted his patent malt, which later became known as black malt and Wood's agent disappeared from the market.

Is this the end for malt extract? Did its use in brewing sink for good? Find out the startling conclusion in the next issue of Brew . . . Your . . . Own*!* ■

Cook's High Seas Ale

(Historical reconstruction)

Modern extracts are of a much higher quality and give a very different flavor than the extract Cook had. Given the reception this beer received from Cook's sailors, you might think it is not worth the effort to try to exactly duplicate this beer. I haven't tried to do so myself, but if you do want to have a go, here is a possible approach.

Ingredients (5 gallons/19 L)

6.6 lb. (3 kg.) plain amber malt extract
(or extract designed for mild ale)
5 oz. (142 g) pale dry malt extract
6.3 AAU Goldings hops
(1.25 oz./36 g of 5.0 % alpha acid)
Whitbread dry yeast
1 cup corn sugar (for priming)

Step by Step

Dissolve the malt extracts in 3 gallons (11 L) warm water, stirring well to ensure the extracts dissolve properly. Bring to a boil, add the bittering hops, and boil one hour. Strain, or siphon off from the hops, and add cold water sufficient to obtain the starting gravity. Now, using a shallow pan (such as is used for making maple syrup), boil over an open wood fire, until the volume has been reduced to about 0.5 gallon (1.9 L). Remove from heat, and carefully wash extract into a fermenter with cold water. Adjust wort volume with cold water to target gravity of 1.045, 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 corn sugar, and rack into keg or bottles. The beer should be ready to drink after conditioning for a week or so.

Captain Cook's Spruce Beer

The recipe below is pretty much as Cook quoted it in his journal, except that I have adjusted it to give five gallons of finished beer. Note the use of tea to moderate the spruce flavor.

Ingredients (5 gallons/19 L)

a few handfuls of spruce leaves
an equivalent amount of tea leaves
0.5 lbs. (0.23 kg) molasses
2.6 lbs. (1.2 kg) liquid malt extract
dried ale yeast

Step by Step

"Take a few handfuls of spruce leaves or small branches, and add the same amount of tea. Boil with 3 gallons (11 L) of water for 3–4 hours, and strain the liquor from the leaves or branches. To this decoction add ½ lb. molasses (0.23kg) and 2.6 lb (1.2 kg) malt extract, and bring the mixture just to a boil. Adjust the volume to 5 gallons (19 L) with cold water, and add dried yeast. In a few days the beer will be fit to drink."

A more convenient approach is to use essence of spruce (available from some homebrew suppliers), at the rate of up to 5 teaspoons per 5 gallons (19 L). This seems a very long boil, and I would recommend no more than an hour. I calculate this to give an OG of only 1.024!

I have not attempted to brew this beer (I don't particularly like the flavor of spruce!), but if I did, I should add more malt extract to balance the strong spruce flavor. I would recommend using another 3.3 (1.5 kg) lb of amber malt extract, giving an original gravity of about 1.045.

Porter Coloring Agent

This is pretty much a guess as to how Wood might have made his "porter coloring," so I cannot claim it to be original. For health reasons it does not include any of the head-retaining and flavor additives Wood might have added.

Ingredients

1.0 lb. (0.45 kg) blackstrap molasses
2.0 lbs. (0.9 kg) amber malt extract

Step by Step

Dissolve extract and molasses in 2 gallons (7.6 L) of hot water, and bring to a boil, stirring well to ensure their full dispersion. Boil vigorously until the mixture has reached a volume of 1–2 quarts (~1–2 L). Cool and store in a sealed, sterilized jar. Use the porter coloring agent as required to add "porter" color and flavor to a base beer made primarily from pale malted barley (or light malt extract).

We homebrewers love our recipes. We're always on the lookout for a killer clone of our favorite commercial beer or the right recipe to give us an edge at homebrew contests. A flip side to homebrew recipes, of course, is how you brew them. And, if you're an extract brewer, you've probably heard of a variety of ways to make your beer. How do the various methods stack up against each other? Does it even matter which way you brew an extract beer? I decided to find out.

Most homebrewers make their beer on their stovetop, boiling 2–3 gallons (7.5–11 L) of wort then diluting it with water in their fermenter to make 5 gallons (19 L) of beer. This method has been used for decades and has two main advantages — it's quick and requires very little specialized equipment. The problem with this method is that boiling a concentrated wort causes sugars in the wort to caramelize and brewing a light-colored beer is almost impossible. In addition, because hop utilization decreases with increasing wort gravity, extract beers made this way frequently are not bitter enough.

One way to solve the problems of the standard method is to perform a full-wort boil. In other words, boil enough wort so that you end up with 5 gallons (19 L) after boiling and cooling without having to add any water. In order to do this, however, you need a kettle large enough to hold the full volume of wort plus have enough space to accommodate foaming. You also need a heat source capable of bringing this wort to a boil and a method of cooling it once the boil is over.

Over the past two years, *Brew Your Own* has introduced two new methods of extract homebrewing — the extract late method and the Texas two-step method. These methods do not require any equipment beyond that used in the standard method, but purport to offer better results.

The extract late method was presented by Steve Bader in the October 2002 issue ("Boil the Hops, not the Wort") and involves withholding half or more of the malt extract in the recipe and adding it at or near the end of the boil. Liquid malt extract has already been boiled in its production, so why boil it again? In his article, Steve claimed that homebrewers could make lighter, more hoppy homebrew than with the standard method of boiling a concentrated wort.

The Texas two-step method was presented by me in the October 2003 issue and involves making two half-sized batches of wort and combining them. In my article, I claimed that the Texas two-step afforded stovetop brewers all the benefits of a full-wort boil, including the ability to make lighter-colored, more hoppy homebrew. The tradeoff in the Texas two-step is that it takes longer to brew your beer compared to the standard or extract late methods.

Since the publication of these articles, the response from homebrewers has been very positive. Stovetop brewers have been able to brew lighter, hoppier homebrews and have given the thumbs up to both methods. However, until now, nobody has tested all the various methods head to head (to head to head) and compared the results. (See the Step by Step instructions on page 38 for how, exactly, all the beers were brewed in this experiment.)

What I Did

Recipe In my experiment, I drew up an extra pale ale recipe and brewed it twice using each of the four methods mentioned (for a total of eight 5-gallon (19-L) batches of beer). The recipe was designed to make a light-colored, hoppy beer. I did not try to make the lightest, most hoppy beer possible. Rather, I tried to make a drinkable beer in which the differences between the methods would be obvious, if they existed. The recipe was the basically the same for all eight batches, with one exception. I did the first set of four brews using an "extract with grains" formulation of the recipe and the second set of four brews with a "partial mash" formulation. The only difference between the two was a small amount of extract was swapped for some pale malt in the "partial mash" formulation. (See the recipes on page 38 for the exact details.)

Ingredients The ingredients were bought in bulk and all the malt extract — an extra-light liquid malt extract — came from the same drum at my local homebrew shop. Most of the hops came from two bulk bags of pellet hops, although I did need to buy two smaller bags to get the total amount. The smaller bags were of the same type of hop and rated at the same alpha acid rating. The crystal malt was the same for all the beers. All of the yeast tubes purchased were fresh and had the same manufacture date except for one that was a week older than the rest. I used this tube to make a yeast starter for one of the full-wort boil beers.

I weighed the grains on my kitchen scale. For the hops, I used a laboratory three-beam balance. The amounts of each ingredient that went into each batch were well controlled. I also calibrated each bucket and marked the 5-gallon (19 L) fill line to ensure the volume of beer was the same for all beers (within reason). The fact that all the beers registered the same original gravity demonstrated that errors in ingredient measurements did not likely influence the results.

Methods For all four methods, the specialty grains were crushed by my homebrew mill immediately before brewing. The grains were steeped in the same soup pot at the same temperature and volume of water. The three stovetop beers were all boiled at the same volume in the same 5-gallon (19-L) stainless steel brewpot on the same burner of my stove. The full wort boil was done outside using a propane burner and 10-gallon (38-L) stainless steel brewpot. (I tried

by Chris Colby

EXTRACT EXPERIMENTS

Four Extract Methods Go Head to Head

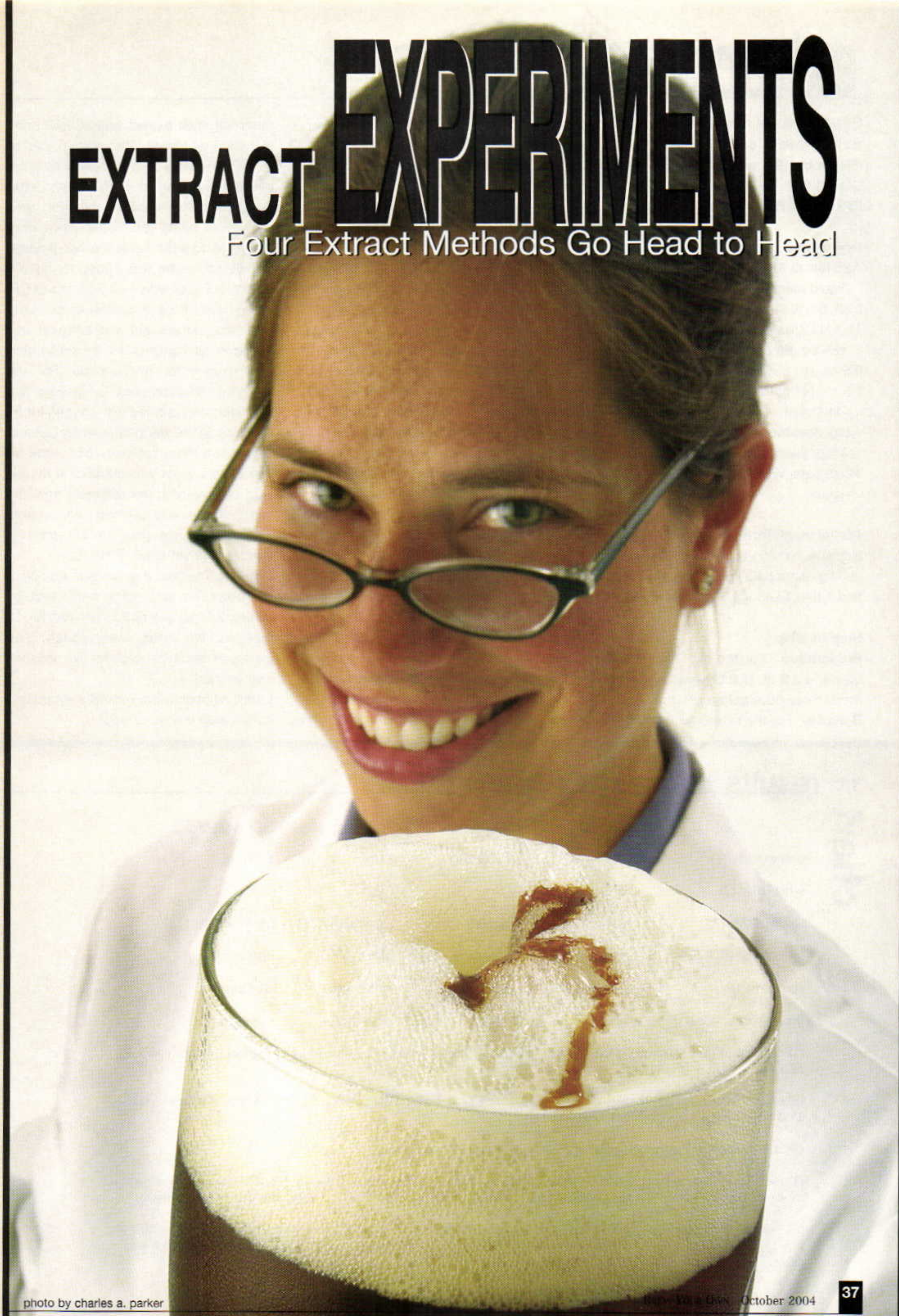


photo by charles a. parker

Experimental Extract Extra Pale Ale

(5 gallons/19L, extract with grains)
OG = 1.051 FG = 1.013
IBU = 48 SRM = 7 ABV = 4.9%

Ingredients

7.25 lbs. (3.3 kg) extra pale liquid malt extract
0.66 lbs. (0.30 kg) crystal malt (20 °L)
12 AAU Willamette hops (60 mins) (2.4 oz./68 g of 5.0% alpha acids)
0.5 oz. (14 g) Cascade hops (15 mins)
1.5 oz. (42 g) Cascade whole hops (dry hops)
1 tsp. Irish moss (15 mins)
1/4 tsp. yeast nutrients (15 mins)
White Labs WLP001 (California Ale) yeast

Partial mash formulation:

Replace malt extract above with 6.6 lbs. (3.0 kg) extra pale liquid malt extract and 1.0 lb. (0.45 kg) 6-row pale malt.

Step by Step

Preparation For the two full-wort boil brews, a 2.0 qt. (1.9 L) yeast starter was made three days before brewday.

Brewday For the extract with grains formulation, the crystal malt was steeped in 1 qt 11 oz. (1.32 qt) of water at 150 °F (66 °C) for 30 minutes for all the methods. For the partial mash formulation, the crystal malt and 6-row was steeped in 2.25 qts. (2.1 L) at 150 °F (66 °C) for 30 minutes. For all three stovetop methods, 2.5 gallons (9.5 L) were heated in my 5-gallon (19-L) brewpot. For the full-wort boil beers, 5 gallons (19 L) was heated in my 10-gallon (38 L) brewpot. In all cases, the "grain tea" from the steep or mash was added to the water in the brewpot and brought to a boil. The heat was then shut off and the extract was added. In the standard method beers, all the malt extract was added to the (just over) 2.5 gallons (9.5 L) in the brewpot. In the extract late and Texas two-step methods, half of the malt extract was added to the (just over) 2.5 gallons (9.5 L) in the brewpot. In the full wort boil, all of the malt extract was added to the (just over) 5 gallons (19 L) in the brewpot. In all cases, the hop and other additions were the same and done at the times listed in the ingredient list. All the beers were chilled with the same immersion chiller, which was submerged in the wort 20 minutes before the end of the boil. At knockout, the remaining malt extract was added to the extract late batches. The wort allowed to sit for 15 minutes before cooling. All other beers were chilled immediately after knockout. After cooling, the wort was allowed to settle for 15 minutes before siphoning to a bucket fermenter. If needed, distilled water was added to make 5 gallons (19 L) of wort — 2.5 gallons (9.5 L) in the case of the Texas two-step. In the standard, extract late and full wort boil methods, all 5 gallons (19 L) were aerated with oxygen for 60 seconds. For the Texas two-step batches, 2.5 gallons (9.5 L) of wort was aerated with oxygen for 30 seconds. In the standard, extract late and Texas two-step batches, one tube of White Labs yeast was pitched. In the full wort boil method, the sediment from the yeast starter was pitched. All buckets were placed in a chest freezer with the temperature set at 66 °F (19 °C).

Day Two The next day, the second half of the Texas two-step worts were made by boiling 2.5 gallons (9.5 L) of wort for 15 minutes. No hops were added. The wort was aerated again for 30 seconds with oxygen.

Later All beers were racked, kegged and carbonated the same way.

chart 1 results from extract brew off

	Standard	Extract late	Texas two-step	Full-wort boil
boil gravity (1)	1.102	1.051 (1a)	1.051	1.051
wort IBUs (2)	96	96	96 (2a)	48
color (SRM) (3)	darkest (15)	lightest (8)	intermediate (10)	intermediate (11)
bitterness (IBU) (4)	least bitter (25)	most bitter (40)	bitter (37)	bitter (39)
start time (5)	~19 hours	~20 hours	~14 hours	< 8 hours
time to brew (hours)	~3 hours	~3 hours 15 min	~6 hours	~4 hours

(1) calculated (not measured) for end of the boil; 1a: once late extract was added to brewpot, gravity would be 1.102

(2) number of IBUs required for final beer hit to it's target of 48 IBUs; 2a: value for Texas two step would be 48 if hops split across both batches

(3) color estimated from color transparency; average of two brews

(4) estimated from taste in side by side comparison with Sierra Nevada Pale Ale (35 IBU); the relative rank is more informative than the absolute numbers, which may be not be that accurate; average of two brews

(5) the full-wort boil was pitched with yeast from a starter; the Texas two-step start volume was 2.5 gallons (9.5 L), not 5 gallons (19 L) as with other methods; the small difference in start time between standard and extract late beers are likely due to chance; average of two brews

to eyeball the wort as it boiled and adjust the full wort boil to match, as best as I could, the boil vigor of the stovetop methods.) The amount of hops added and the timing of the hop additions were the same for all beers. All of the beers were cooled with the same copper immersion chiller. (Since there was more wort to chill in the full wort boil beers, cooling time for this beer was slightly longer.)

Each set of four beers were siphoned to identical buckets (with identical stoppers and fermentation locks). For the three stovetop beers, I pitched one tube of White Labs yeast. For the full-wort boil, I pitched the yeast from a ~2 qt. (2L) starter. As each set of four beers was brewed in a single weekend, they were all fermented at the same time and in the same chest freezer for temperature control. Likewise, each set of four beers was racked to secondary and kegged at the same time.

Experiment in a nutshell

So basically, all eight beers were made with the same recipe, the same ingredients, the same equipment (where possible) and by the same brewer (me). I did have some help on the second brewing weekend and I would like to thank Charles and Theresa Culp and Marc and Janet Martin of the Austin ZEALOTS for their assistance.

The only differences in procedures were the differences in the four methods. And, since each method was tried twice, I could judge if the differences between the methods were repeatable.

I suppose some people might question if I was biased and — consciously or unconsciously — favoring "my" method (the Texas two-step). All I can say to that is I believe I did the experiment fairly and encourage other interested homebrewers or homebrew clubs to try to replicate, and perhaps expand upon, these results.

What I Found

I took a variety of data for this experiment, but the main variables of interest are color, bitterness and flavor. I will discuss these in some detail.

From left to right, the two full-wort boil beers, the two Texas two-step beers, the two extract late beers and the two standard method beers. The position of the light exaggerates the differences in color somewhat, but the relative colors can still be accurately gauged. The tall glasses are filled with partial mash brew and the shorter glasses with extract with grain beers.

Table 1 (on page 38) lists some of the other results from the experiment.

Color One of the easiest aspects of the experiment to judge was the color of the resulting beers. As you can see in the photo above, there are obvious differences in color between the four methods. The two extract late beers were the lightest colored beers. The standard method produced the two darkest beers and the four other beers were all fairly similar in color. The Texas two-step beers were a bit lighter than the beers made with a full wort boil, but not by much.

So, as expected, adding your malt extract late in the boil does lead to lighter colored homebrew. In fact, this method produced the lightest two beers of the bunch. Performing a full wort boil — either all at once in a large brewpot or by brewing two stovetop batches as in the Texas two-step — also produced lighter-colored homebrew than the standard method. Why the full-wort boil batches and Texas two-step batches varied in color (if only slightly) is a bit of a mystery. In both cases, the entire wort was boiled at the same density. However, the Texas two-step brews were boiled on the stove and the others by a propane burner. I suspect that the boil intensity was a bit higher for the full-wort boil beers.

Given the results of this experiment, I think it's reasonable to suggest that if you are interested in brewing the lightest possible homebrews, you should use the extract late technique.

Bitterness The level of hop bitterness was the second major variable in which the methods were supposed to differ. Comparing two beers and determining which is more bitter can be difficult if the beers are of different strengths or styles. However, if all the

chart 2 recommended beer styles for extract brewing methods

Styles of beer	Standard	Extract late	Texas two-step	Full-wort boil
Amber to dark, not bitter	X	X	X	X
Light to amber, not bitter		X	X	X
Very light, not bitter		X		
Amber to dark, Bitter		X	X	X
Light to amber, bitter		X	X	X
Very light, bitter		X		
Light to Dark, Very bitter			X	X

beers sampled are of the same style — or, as is the case here, made from the same recipe — comparing relative levels of bitterness is not that difficult.

The most obvious difference among the beers was that the two beers made with the standard method were far less bitter than the others. The level of bitterness in the remaining six beers was fairly close. The extract late beers seemed the most bitter and the full-wort boil beers in turn seemed to have slightly more bitterness than the Texas two-step. Again, it is somewhat puzzling that the full-wort boil beers and Texas two-step beers would be different given that the details of the boil were the same except that the Texas two-stepper were made in two halves. However, I again suspect that the boil vigor is responsible for this small difference. Also, the full-wort boil beers took a bit longer to cool and this may have led to a few extra IBUs being extracted from the hops.

The reason that the extract late beers were the most bitter of the bunch may lie in the details of how the extract was added. In the extract late beers, the extract was added at knockout and the wort sat for 15 minutes before it was cooled. Thus, the hops were exposed to 15 more minutes of heat compared to the other methods. In retrospect, I should have let the full-wort and Texas two-step worts sit an equivalent amount of time before cooling. I suspect the differences in bitterness among the extract late, Texas two-step and full wort boil brews would disappear if the knockout procedure were the same for all the methods.

The results of this experiment show that if you are trying to brew a bitter beer, avoid the standard method. You are better off using either the extract late, Texas two-step or full wort boil method. In addition, logic suggests that if you are trying to brew a very bitter beer that you should try the Texas two-step or full-wort boil. This latter suggestion, however, was not tested in this experiment.

Flavor The most important result of the experiment was how the beers made with the various methods tasted.

Poured into pitchers, here's another look at the standard method, extract late, Texas two-step and full-wort boil beers. With more beer to look through, all the beers appear darker. However, in this photo — taken outside — all the beers are more evenly lit.

This is also, of course, the most subjective. I tasted the beer along with a few of my homebrew club members and there was no clear consensus. None of the methods seemed to yield any off flavors or aromas and all the beers tasted like fairly decent homebrew. (If I brewed any of these again, I would make some tweaks to get a better balance in some of the beers, but nothing major.) The extract late, Texas two-step and full wort boil beers were preferred over the standard method beers, mostly (or entirely) because they were more hoppy. The partial mash formulations were generally favored over the extract with grains formulations for each beer type.

The most interesting finding was that the extract late beer had a slightly different malt character than the other beers. The different character wasn't good or bad, just different. Some people preferred it to the Texas two-step and full wort boil; others preferred the other two methods. If I had to describe the character, which showed in both extract late batches, I'd call it very slightly "worty." I thought the character would work well in malty, full-bodied beers, but less well in drier beers (But of course, this experiment didn't test this.)

The results of the taste testing show that none of the methods produces faulty homebrew. The differences in preferences between the beers was mostly due to differences in the malt/hop balance in the beers, and this can be adjusted (within limits) with any of the methods. This suggests that you should use color and target bitterness as your main concerns when deciding on which extract method to use for any given beer. If you can hit the color and bitterness you want, all the available methods will produce palatable beer. See Chart 2 on page 40 for a set of recommendations regarding which methods to use for various types of beer.

Other results Chart 1 on page 38 lists some of the other results of the experiment. The specific gravity the wort is boiled at is given as well as the amount of IBUs required to hit the target IBU value when the wort is diluted (or not) to 5 gallons (19 L).

The Texas two-step was the most time consuming of the methods, with its two separate brewing sessions. The standard and extract late were the least time consuming. The full wort boil took a little more time than these methods due to the time it took to cool the larger volume of wort. (It took a little longer to heat the water, too, although I could have turned up the propane burner.)

There are any number of other variables I could have collected data on, clarity and head retention being two of these. Although I didn't formally look at these (and other) variables, I kept an eye out for differences that jumped out between beers. However, nothing really jumped out that separated one method from the others. For example, all the beers seemed about equally clear and yielded a reasonable head. As I said in the section on flavor, all the methods made some fairly decent homebrew.

What I Should Have Done

If I could go back time in time and redesign the experiment, I would add a lot more bittering hops. I believe that, at high hopping rates, I would have found a difference in bitterness between the extract late method and the full wort boil method. In both cases, the hops would be boiled in wort of the same density. However, in the extract late method, the alpha acids would be diluted when the wort was added to the fermenter. For example, let's say I was trying to make a beer with 80 IBUs. Using the full wort boil method, the 5 gallons (19 L) of wort would need to reach 80 IBUs by the end of the boil. In the case of the extract late method, however, the 2.5 gallons (9.4 L) of wort would need to reach 160 IBUs by the end of the boil and then be diluted to 80 IBUs in the fermenter. The problem is, the theoretical maximum level of IBUs you can obtain by boiling hops is thought to be around 120 IBUs. Thus, for beers over 60 IBU, you would need to do a full wort boil (or use the Texas two-step and boil half of the hops in each 2.5 gallon (9.4 L) step). With the low hopping rate of this experiment, however, I wasn't able to confirm this suspicion.

Conclusion

This experiment shows that the method with which you brew your extract beers influences their color and bitterness. Although all of the methods produce drinkable homebrew without any off flavors or off aromas, some methods may be more appropriate to use when light color or higher levels of bitterness are a priority.

The standard method of extract homebrewing produces decent beer, but frequently that beer is too dark and not hoppy enough. For some styles of beer — such as Scottish ale or brown ale — it may work well. For any beer that needs to be light in color or show much bitterness, however, there are better choices.

For most beer styles, the extract late method should work well. This method requires no equipment beyond what is needed in the standard method and should allow extract brewers to brew a wide range of beer styles. Like the standard method, the extract late method is also very quick. Even for beers that are not particularly light or bitter, the method has the benefit of exhibiting better hop utilization.

The Texas two-step and the full-wort boil method can also produce light-colored, bitter homebrew. The Texas two-step, however, takes more time to brew and the full-wort boil method requires equipment beyond what it takes to brew a stovetop batch of beer. However, both of these methods may be capable of producing the most bitter extract brew (although this experiment does not test this idea).

This experiment focused mainly on color and bitterness in a pale ale. However, there may be other differences between beers made with these methods that did not show up in this experiment. It's always possible that different recipes, beer styles, ingredients, accompanying procedures or equipment may cause different results for some brewers. So, always keep in mind that you have options when you brew extract beers.

Take good notes when trying something new while brewing and maybe you'll find the perfect way to brew your favorite beer on your system. ■

Chris Colby has a PhD in Biology from Boston University. He also has a Gibson Flying V electric guitar.

LAMBIC brewing

Lambic is a traditional Belgian style of sour beer. After boiling the wort — made from pale malt and 30–40% unmalted wheat — the brewers expose it to airborne yeast and bacteria overnight. Then it is pumped to casks (where it is likely inoculated with more microorganisms). The fermentation by many different wild yeasts and bacteria produce a beer that is not only sour, but shows a variety of other characters, including a horse blanket or barnyard character that varies from subtle to pronounced.

There is no detectable hop contribution in a lambic. Sorry, it just isn't a style for hop heads. Lambics range from nearly flat to effervescent. The beer may be cloudy or clear, the head may be strong to weak to non-existent. The color may be straw or pale gold, but I have also noticed some subtle hints of pink in some well-aged examples of straight lambic and gueuze. Fruit is added to some lambics to make fruit lambics, including kriek (cherry) and framboise (raspberry).

I have won several medals for my homebrewed lambic, so people often ask me about how I brew them. Although the traditional wort production techniques involve some unusual aspects — including using unmalted wheat in the mash and large doses of aged hops in the boil — the distinct character of lambic comes mostly from what occurs after the wort has been boiled.

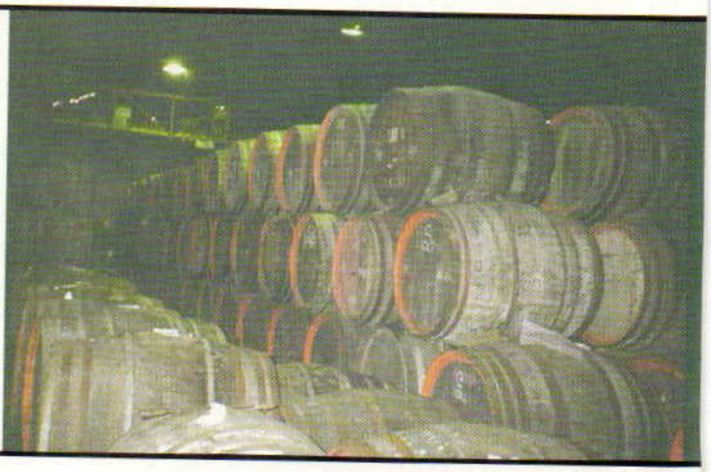
The Lambic Family

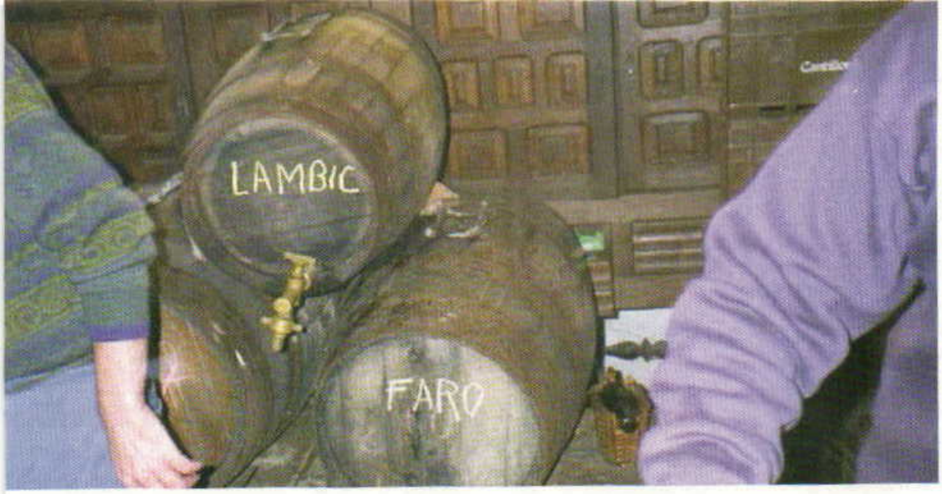
The starting point for the family is the traditional (straight or unblended) lambic — a complex, dry, sour, yellow or deep gold colored beer. A gueuze is a blend of young and old lambic, typically containing from 15% to 70% old lambic in the blend. Some, however, like the Boon Mariage Parfait, are much closer to 100% old lambic.

Various fruits are used to flavor some lambic styles. The original fruit lambic was probably the kriek (Flemish for cherry). A kriek lambic is traditionally made using the tart Shaarbeek cherries that are only grown in Belgium in a region to the northeast of Brussels. Now days the Shaarbeek cheery is fairly hard to find and expensive so some brewers also use the Moreno or Northern cherry as part of the fruit addition. Tradition calls for the use of whole cherries including pits. The belief is the pits add to the flavor depth. The framboise (French for raspberry), which apparently originated in the 20th century, is made from red raspberries.

The lambic family is the only one still in commercial production that uses spontaneous fermentation — the brewer does not pitch a cultured yeast strain into the wort. A spontaneous fermentation that produces the flavor characteristics of a lambic is said to only work in a small area around Brussels, where the proper microbiota exists in the air between October and May. Some writers claim the microbiota is in the brewery's equipment rather than the air. Major organisms involved in the spontaneous fermentation

story and photos by **Steve Piatz**



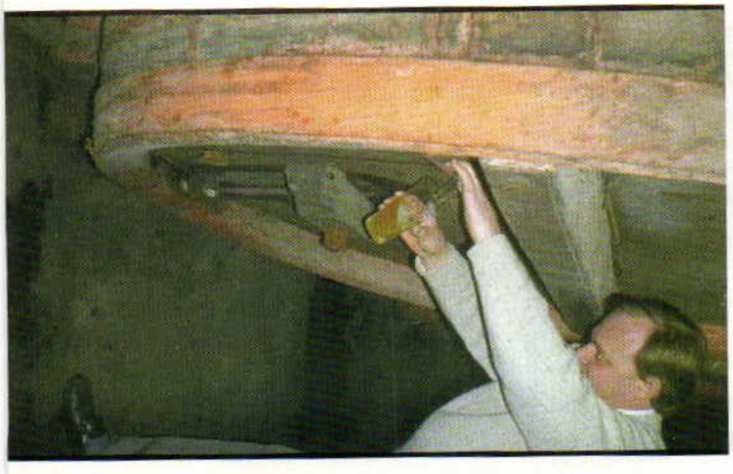


include the traditional brewer's yeast *Saccharomyces cerevesiae*, the "wild" yeasts *Brettanomyces lambicus*, *Brettanomyces bruxellinsis* and *Kloeckera apiculata*, the bacteria *Pediococcus* and *Lactobacillus* and various enteric bacteria such as *Enterobacter*, *Klebsiella*, and *Hafnia*. The *Brettanomyces* strains produce the signature horse blanket, leathery or barn-like aroma. *Pediococcus* and *Lactobacillus* produce lactic acid.

The acidity of a lambic can range from mild in commercial examples such as Lindemans or Timmermans to extremely sharp as in examples such as Hanssens or Cantillon. I assume that there is also a significant impact on the acidity from the brewer's barrels, since they are impregnated with the cultures from previous batches. In young lambic, the sourness is mostly from lactic and acetic acids. As the age of the lambic increases the acidity becomes more complex and balanced.

In many ways a lambic is a varietal product — even if the brewer was able to exactly control the brewing session and get exactly equivalent ingredients, each batch will vary due to the variation in the environment within the brewery over the several years between when the wort leaves the kettle and when the bottles leave the brewery. Most lambic breweries do not heat or cool the bulk of the brewery. The changes in the temperature and the humidity will change the growth rates of the various organisms that contribute to the flavors. Temperatures in the brewery can range from the mid 30s Fahrenheit (~2 °C) to the upper 70s (~25 °C). In addition, the atmosphere contains varying amounts of the various relevant organisms on different brewing days.

Finally, since the barrels are not coated on the inside, there can be barrel-to-barrel variation due to the organisms that have permeated the barrels. When it comes time to bottle, the commercial lambic brewer blends the product from various barrels and batches to achieve the desired charac-



Above: Small casks of lambic at the Cantillon Brasserie (brewery) in Brussels, Belgium.

Bottom row: Cask fermenters stacked high at Brasserie Frank Boon are shown in the middle photo. The surrounding two photos show Frank Boon sampling lambic directly from a cask in his brewery.

Piatz's Basic Lambic

(5 gallons/19 L, extract only)
OG = 1.056 FG = 1.016 or lower
IBU = 0 SRM = 3 ABV = up to 5.2%

Ingredients

3.0 lbs. (1.4 kg) light dried malt extract
3.0 lbs. (1.4 kg) wheat dried malt extract
0.25 lbs. (0.11 kg) malto-dextrin powder
3 oz. (85 g) well-aged hops
mix of brewers yeast, "wild" yeasts and bacteria
(Wyeast 3278 (Lambic Blend) or mixture of commercial cultures and microbes cultured from commercial lambics)

Step by Step

The malto-dextrin is to be sure there are a few complex sugars left for the extra organisms to eat after the brewers yeast gets finished with its work. I use the dried extract since lambic is a very light colored beer and most liquid extracts seem to be too dark for the style. The wheat extract is a poor man's approximation of the unmalted wheat used in the commercial lambic breweries. I don't know of an extract equivalent of unmalted wheat.

The water is brought to a boil and the extract and malto-dextrin are added. After re-establishing the boil, the hops are added and the boil is held for 90 to 120 minutes. I don't bother with Irish moss in a lambic, but you can use it if you feel the need. I run the hot wort directly from the kettle to the plastic bucket without chilling and will leave the wort in the bucket for a day or so with the lid partially open to the kitchen air, which is typically full of enteric bacteria. This exposure will allow the enteric bacteria present in the air to add their components to the beer. After the exposure to the air, I place the lid on the bucket and wait a few days before I pitch a normal brewers yeast. The variety doesn't matter very much; I either use yeast from a prior "normal" beer or a packet of dried yeast. By this time the beer is starting to get a little "funky" and the surface may look a little oily. At this point I also add the treated piece of oak back into the bucket — do not run the hot wort onto it or you will be sanitizing it. The brewers yeast will rapidly change the pH and generate ethanol, both of which will help kill off the enteric bacteria but their byproducts will still be there. After a few weeks I add the other organisms, the *Brettanomyces*, *Pediococcus*, *Lactobacillus* and the dregs from commercial lambics and prior batches of homebrewed lambic.

ter. The palate of the brewer or blender is really what determines the "house" character of a lambic brewery.

Contrary to what you may read in many articles, lambic is not fermented in large, open-air fermenters. After boiling, the wort is pumped into the traditional shallow coolship that is usually in the top floor or attic of the brewery. The wort typically stays in the coolship overnight where there is a limited exposure to the atmosphere. Within 24 hours, the wort is typically transferred to wooden (continental oak or chestnut) barrels.

Advanced Planning Details

Brewing a lambic does take a little advanced planning as lambic is the only style that needs well-aged hops. There should be no hop aroma, flavor or bitterness in a lambic, but you do need the hops for their preservative properties. You want old hops that have aged beyond the "cheesy" state. Since pellets don't age as rapidly, you should plan on using one to three year old whole hops. I store my hops for lambics in paper bags in the attic of the uninsulated garage. On sunny summer days it gets well over 120 °F (49 °C) in the attic, so the hops age rapidly.

You also need to acquire the proper brewing yeasts and other organisms. You can and should buy pure cultures of the main lambic cultures, including a *Brettanomyces* strain, *Lactobacillus delbrükii*, and probably *Pediococcus damnosus*. As additional research into the style, and as a source of some of the other microbiota found in a lambic, it will be necessary to drink some commercial examples of the style. Yes, it is hard work but it is research that must be repeated over and over again. I keep a starter that I add the dregs of the bottle to after pouring the beer into a glass. Beware that some of the less traditional examples seem to be pasteurized and therefore have nothing left to culture. You need to use a little care to avoid contaminating the dregs. I wipe the neck down with vodka before opening and then flame the neck with a small butane lighter after pouring the beer into the glass. The starter will probably develop a pellicle (skin) from the *Brettanomyces* and *Pediococcus*. If you see green floating mats, however, you have probably collected some undesirable mold. I also save the dregs from a batch when I bottle it and use those dregs in the next batch.

Fermentation Peculiarities

Traditional lambic is brewed in wood (continental oak or chestnut) barrels. Wood is somewhat porous and will allow a slow penetration of oxygen into the fermenting beer. I use the plastic bucket fermenters available in homebrew supply stores. Like the wood barrels, most plastic is also slightly porous to oxygen. I have taken to placing a small, approximately 1 by 3 by 6 inch, piece of American oak in barrel to become a home for the microorganisms. Initially, the oak pieces were soaked in water treated with sulfite (1 Campden tablet per gallon) for a few months, soaked until no color or flavor was extracted from the wood. The wood is rinsed in hot water between batches, but is not sanitized since that would evict all the microorganisms.

In Belgium, the barrels and even the bottles in aging are subjected to some temperature variations with the seasonal changes though the changes are probably gradual due to the large size of the barrels and the large numbers of bottles stacked in the brewery. Many of the best examples of the styles are aged for extended periods in the bottles. The wall of bottles on their side aging is impressive to see.

While the beer is in the fermenter, the pellicle provides some protection from oxygen. There are indications that barrels stored near vibrating machinery can end up more vinegary due to the vibration breaking the pellicle allowing more activity by acetic acid bacteria.

Brewing Specifics

You can brew a lambic with an all-grain process or with extract, but I take the easy approach — I brew extract versions. (For all the details on a traditional lambic mash, see Jean-Xavier Guinard's book, "Lambic," 1990, Brewers Publications)

Fermentation

My fermenters are normally in the basement that ranges from the upper 50s in the coldest part of winter to the upper 70s in late summer. The beer is never transferred or racked until it is time to bottle. In commercial lambic breweries, the beer might be coarse filtered on the way to the bottling line. For a homebrewer, a racking a day or so prior to bottling should be sufficient to remove most of the sediment. Priming can be with the typical corn sugar dose. However, it is a good idea to prime your lambic with the addition of a package of dried yeast just to improve the likelihood of getting some carbonation in the bottle. Since the pH is out of the norm for brewers yeast there is always a chance that the beer will never carbonate. I have had some batches carbonate with no problem and other batches that haven't carbonated after several years.

If the lambic is to become a fruit lambic, the fruit will go in sometime around one to two years after brewing and the beer will sit on the fruit from three months to a year or more. If trying a kriek, a few months on the fruit should be sufficient. Some people claim the lambic will pick up too much bitterness from the pits if left in contact with them more than a few months. Other authors claim that kriek is left on the cherries and pits until the pits dissolve. In Belgium, after a beer sits on the cherries for a few months, it will be racked off the pulp and pits and a second batch will be racked onto the remaining fruit.

Of the fruit lambics, the framboise is the easiest for US homebrewers to approximate. Raspberries in the US are very similar to those used in Belgian lambics.

The cherries we are able to obtain in the United States don't really do justice to the kriek style. If you want to try making a kriek, tradition calls for a kilogram or more of whole cherries per 5 L (~1.6 lbs./gallon) of lambic. Given the time required to produce a lambic, I would avoid the bottled fruit flavors sold in most of the homebrew shops.

For a batch of framboise, I typically use three cans (just over nine pounds) of Oregon Fruit Product's Raspberry Puree. Since the puree is seedless, Oregon claims you can use 10 percent less puree than whole fruit. So, the three cans are equivalent to just over ten pounds of fresh raspberries. My most recent framboise used 20 pounds of frozen raspberries. I think the presence of the seeds in the frozen raspberries may also help provide some of the astringency noted in some of the classic commercial framboise examples.

I have just started a couple batches of fruit lambic using fresh wine grape juice, but at this point I have not determined the proper amount of juice for the best results. I have also tried blending several different (young and older) batches of lambics to produce a true gueuze. It is interesting to see how the flavors and aromas meld. Blending is an area of experimentation that could last a lifetime.

There are other opinions on how to produce a homebrewed lambic. All I have provided is a technique that seems to produce a decent homebrewed lambic for me. My process isn't quite the same as the brewers at Cantillon, De Cam or Boon use. There is no one tried and proven correct way to produce a homebrewed lambic-style beer. Remember the commercial examples have a pretty broad range. Please feel free to experiment and share your results with other lambic homebrewers. ■

Steve Piatz is a member of the Minnesota Home Brewers Association.

Sour Beers

A tongue-tingling treatise on tart

Story by **Chris Colby**

In the vast majority of beer styles, the only microorganism that should be present in wort or beer is brewers yeast, *Saccharomyces cerevisiae*. However, in a few sour styles of beer, lactic acid bacteria are encouraged to grow. Lambic (see page 44), oud bruin, Flander's red ale and Berliner weisse (see page 19) are all styles of beer that get their sourness primarily from lactic acid bacteria. (The first three also have other "bugs" growing in them that influence the character of the beer.) In this article, I'll tell you how to manage the production of sour homebrew, with the focus on the lactic acid bacteria.

Meet the Lactos

There are six principal genera of lactic acid bacteria — *Streptococcus*, *Enterococcus*, *Leuconostoc*, *Lactococcus*, *Pediococcus* and *Lactobacillus*. (Genera is the plural of genus, the taxonomic level above species.) Bacteria from the genera *Pediococcus* and *Lactobacillus* are the most common brewery contaminants of the lactic acid bacteria. Unlike most bacteria, they can grow in beer containing moderate amounts of hops and alcohol.

All of the lactic acid bacteria grow in the absence of oxygen. (They are anaerobic, in the lingo.) Unlike most anaerobes, however, they are not inhibited by oxygen. (They are aerotolerant anaerobes, in the lingo.) As such they can grow whether or not oxygen is present. They don't, however, switch from fermentation to aerobic respiration in the presence of oxygen.

All lactic acid bacteria ferment glucose and produce lactic acid. Some also produce ethanol and CO_2 along with the lactic acid. Bacteria that produce only (or mainly) lactic acid are called homofermentative. (The prefix homo indicates that they only produce one fermentation product). Bacteria that produce other products along with lactic acid are called heterofermentative. For a brewer, the big difference is that heterofermentative "bugs" produce carbon dioxide (CO_2). If you've ever had a sour, gushing beer, it's fairly likely you had one of these bacteria as the contaminant.

Bacteria from the genus *Pediococcus* are homofermentative. The genus *Lactobacillus* is comprised mostly of homofermentative species, although there is a subgroup of heterofermentative species. Beer contaminated with any of these bacteria will turn sour from the production of lactic acid. Beer contaminated with heterofermentative bacteria will also have excess dissolved CO_2. In addition, lactic acid bacteria — especially *Pediococcus* and *Leuconostoc* — may also produce other products such as diacetyl.

The genus *Lactobaccilus* is divided into three major subgroups. The species of *Lactobaccilus* most relevant to brewing belong to a group in which lactic acid is produced from over 85% of the glucose fermented. This group — including the species *L. delbrückii* and *L. acidophilus* — grows well at higher temperatures (90–120 °F/32–49 °C), but much more slowly (if at all) at cool temperatures (below 60 °F/16 °C). *L. delbrückii* is a common brewery contaminant and a microorganism used in the production of Belgian lambics and Berliner weisses.

Lactic acid bacteria are, of course, more resistant to acidic conditions than most bacteria. The *Lactobaccilli* are, in turn, more resistant to acidic conditions than most other lactic acid bacteria. Most are able to grow well at pH values in the 4 to 5 range and grow more weakly at lower pHs. The pH of lambics varies from 3.3 to 3.9 whereas the pH of most "regular" beers varies from 4.0 to 4.4.

As contaminants

When lactic acid bacteria is encountered in a brewery, it is most often an unwanted contaminant. Lactic acid bacteria, especially those from the

recipe

Heuuuuuuza

(5 gallons/19 L, all-grain)
OG = 1.053 FG = 1.005
IBU = ~0 SRM = 5 ABV = 5.2%

Ingredients

7.0 lbs. (3.2 kg) 2-row pale malt
4.0 lbs. (1.8 kg) wheat malt
~0 AAU Tettnang hops (45 mins)
(2–3 oz. (57-85 g) of hops aged for 3 years at room temperature)
Wyeast 3278 (Lambic Blend) mix
Wyeast 4335 (*Lactobacillus*) bacteria
Wyeast 4733 (*Pediococcus*) bacteria
1.0 cup corn sugar (for priming)

Step by step

Mash grains at 154 °F (68 °C) for 60 minutes. (Use 3.4 gallons (13 L) of water at 165 °F (74 °C) for your strike water.) Collect 6.0 gallons (23 L) of wort, add 1 gallon (3.8 L) of water and boil for 90 minutes, adding hops for the last 45 minutes. Cool wort, aerate and pitch Wyeast lambic blend. Ferment at 68–72 °F (20–22 °C). After primary fermentation has ended, add 1/2 tube of Wyeast bacterial strains and let condition 3–4 months at 70–80 °F (21-27 °C). Rack to secondary and let age another 6–9 months before bottling.

Extract option:

Use 2.25 lbs. (1.0 kg) of light dried malt extract and 5.0 lbs. (2.3 kg) wheat liquid malt extract. Boil 3 gallons (11 L) of water and dissolve the dried malt extract in the water. Boil for 60 minutes, adding hops with 45 minutes left in the boil. Add the liquid malt extract when you turn the heat off. Stir for 3 minutes (with a sanitized spoon) to completely dissolve extract. Let sit for 15 minutes, then cool and follow remaining instructions in the all-grain recipe.

Gueuze option:

Brew this beer once a year every spring for three years. Each year after primary fermentation has finished in the newest batch, take 1 pint (473 mL) of it and add it to batch(es) from the previous year(s). Once the third year's batch has aged for a year, blend all three together and bottle.

species *Pediocccus damnosis*, are common beer spoilers. They are often found in lager fermentations and can cause elevated diacetyl levels. Another species of lactic acid bacteria common to breweries is *Lactobacillus delbrückii*. In addition to producing sourness, beers contaminated with lactic acid bacteria may also go turbid.

Sources of lactic acid bacteria

If you are looking to purposely add lactic acid bacteria to your beer, there are many different sources you can turn to. Wyeast makes *Lactobacillus* and *Pediococcus* cultures as well as a lambic blend (of brewers yeast, *Brettanomyces*, *Lactobacillus* and *Pediococcus*). Your own mistakes may also provide you with a culture. If you encounter a contaminated batch of homebrew that exhibits a sour character you like, keep some bottles around for culturing. The sour flavor may not work well in the beer you find it in, but any contaminated beer that tastes nicely sour — and lacks other fermentation faults, such as diacetyl or DMS — is a candidate for your own private sour culture. Likewise, any intentionally sour beer that turned out great is a bacterial source. Keep a few bottles of this beer around and they should be usable for at least a year.

You really only need a small amount of a lactic culture to make a sour beer. Even a small amount of bacteria will flourish in time and sour your beer if the conditions are favorable. Making a starter with lactic acid bacteria requires that you plan ahead as it takes at least a week to get any appreciable growth. I generally just pitch half of a tube of Wyeast bacteria or all of a 12–22 oz. (355–651 mL) bottle of sour beer.

You can pitch the bacteria along with the brewers yeast or wait and inoculate the beer after primary fermentation has occurred. Brewers yeast works quickly compared to the amount of time it takes for a lactic acid culture to really take hold, so it really doesn't matter too much. Either way, the lactic acid bacteria will be growing primarily by utilizing the carbohydrates in your beer that the yeast could not ferment.

. . . although it's impossible to completely eliminate lactic acid bacteria from a brewery, they can be equally difficult to grow . . .

(If you made a large starter, the bacteria might be able to get at some of the simple wort sugars before the yeast consumed them.) It would probably not be a good idea to pitch the lactic acid bacteria before the brewers yeast. Brewers yeast is inhibited in solutions with low pH values. Thus, adding the bacteria first could lead to a very sluggish or stuck fermentation.

Fermentation

It's ironic that, although it's impossible to completely eliminate lactic acid bacteria from a brewery, they can be equally difficult to grow when you really want them to. At best, sour beers take time to develop. At worst, a suitable level of sourness never develops. This is because lactic acid bacteria have strict growth requirements. They require amino acids and trace vitamins and both of these are scarce in finished beer. There are a couple ways homebrewers get around this limitation when making a sour beer. The first solution is to simply let the beer sit on its yeast sediment for long periods of time. As yeast cells die, they release nutrients that get scavenged by the lactic acid bacteria. After six months on yeast, most sour beers will have a substantial amount of sourness. After a year, they will likely be sour enough for all but the biggest sour fiends. A benefit of this method is that it is simple — just leave your beer in primary. A draw back is that dead yeast can add an undesirable nutty flavor to beer.

Homebrewers who rack their sour beers off the yeast and into secondary can take care of the nutritional needs of their lactic acid bacteria by "feeding" it. To "feed" 5 gallons (19 L) of conditioning sour beer, add 4–8 oz (118–237 mL) of wort to your fermenter every month or so. The "feeder" wort should be roughly the same gravity — and, of course, roughly the same color — as your main wort. The easiest way to ensure this is to make an extra couple of quarts (liters) of wort on brewday and save it in four to six sanitized 12-oz. (355-mL) beer bottles. Just bottle the wort before pitching any yeast, cap the bottles and store them in your refrigerator. When it's time to feed your sour beer, just pop the cap and pour a little in. You can recap and store the remaining wort until the next feeding time. Keep an eye out, though, for contamination in refrigerated wort samples, especially those that have been opened.

It's interesting to note that lambic brewers add fruit to some of their lambics and Berliner Weisse brewers add spiesse to their beers when they package it — this can be viewed as "feeding" for a different stated reason.

Heat makes it sour

The strains of lactic acid bacteria that grow in wort or beer grow best at high temperatures (90–120 °F/32–49 °C). To speed the production of lactic acid, it is desirable to let your sour beer condition at relatively high temperatures (70–80 °F/21–27 °C) once primary fermentation is done. Spring is a good time to brew a sour beer as primary fermentation can take place at relatively cool temperatures and then the beer can condition at higher temperatures over the summer.

Contaminants

The low pH of sour beers renders them uninhabitable to most stray contaminants. However, sour beers are prone to surface contamination by *Acetobacter* and other aerobic bacteria and yeasts. *Acetobacter* can only live on the surface of beer, where it has access to oxygen. As its name implies, it produces acetic acid, which can yield a vinegar flavor to beer. Because sour beers take a long time to age, occasionally the fermentation lock will dry out and a bloom of *Acetobacter* will appear. Likewise, many times sour beers will be opened (for "feeding" or to add fruits) and this presents an opportunity for contamination.

If you get an *Acetobacter* or other surface contamination, there is no need to panic. A small amount of acetic acid in a sour beer is not going to wreck it. (In fact, in a lambic, a surface-covering bloom — from a variety of microbial species — called a pellicle is supposed to form.) If you were planning to bottle the beer soon, just leave it alone. Stop opening the bucket for any reason and keep the airlock full. If you wish to age the beer further, but minimize the impact of an *Acetobacter* bloom, carefully rack your beer out from under the surface contamination and into another container. Leave the last little bit of beer behind. Minimizing the beer's subsequent exposure to oxygen will also help you keep surface blooms in check. Racking to a carboy with little or no headspace is a good way to do this.

Decontamination

Many homebrewers worry that if they make a sour beer, all their subsequent beers will turn sour. I've been brewing sour beers for 4–5 years now and haven't found that to be the case. Good cleaning and sanitizing is enough to decontaminate glass, stainless steel and plastic that's in good shape. You can mark and isolate any porous items (stoppers, scratched buckets) and use them only for sour beers if it makes you feel better. (I should mention that I don't even bother to do this and have never had a problem.) Finally, for a little piece of mind, you can treat your next non-sour beer with a dose of lysozyme. Lysozyme kills all Gram positive bacteria, including lactic acid bacteria. A small preventative dose — just 1 teaspoon per 5 gallons (19 L), added to the fermenter — will do the job.

Other sources of sour

Whenever people are faced with a long process in which risks are involved, it's common for them to ask, "can't I just cheat?" In the case of sour beers, yes you can. If you want to skip the long aging times — and not actively grow lactic acid bacteria in your brewery — you can simply add lactic acid to your beer to sour it. In a 5-gallon (19-L) batch, it only takes a few ounces (~60 mL) of an 88% lactic acid solution to get a noticeable "tang" to the beer and a few more to get a pronounced sourness. The "acid blends" used by mead makers could also be tried. A straight acid addition, however, will yield a beer with a different flavor profile than one soured by bacteria. Lactic acid is the same whether you get it from growing lactic acid bacteria in your wort or from a bottle. (The lactic acid in a bottle also came from bacteria.) However, a bacteria-soured beer will have a dry mouthfeel as the bacteria will have consumed some of all or the residual carbohydrates in the beer. A beer soured by adding acid will have a fuller body and likely have a bit sweeter edge to it. This is not necessarily a bad thing; sweet and sour are two flavors that go well together. However, you cannot closely reproduce any classic sour beer style simply by adding lactic acid to a "regular" beer. A dose of lactic acid added to a wheat beer does not make it a lambic or Berliner weisse.

Lactic acid can also be used to "punch up" a sour beer. The best way to add acid to a beer is to quietly (slowly and without splashing) stir some acid into the beer in your bottling bucket right before bottling. Taste the beer and add a little more, if needed. Keep in mind that excessive amounts of lactic acid may prevent the beer from carbonating adequately.

Packaging

There are two fairly common problems that occur when bottling sour beers — lack of carbonation or overcarbonation. Because the pH of sour beers gets low, and because they condition for awhile, there may not be enough healthy yeast to carbonate the beer after packaging. Adding a teaspoon of fresh yeast per 5 gallons (19 L) of beer at bottling can help. Any dried ale yeast will work well for this.

Conversely, because some carbon dioxide producing lactic acid bacteria can continue to work on residual carbohydrates in a beer, sour beers can sometimes overcarbonate. This is usually only a problem if the beer is bottled too soon. Before bottling, taste a sample of the beer. If it does not taste very sour and still has nearly as much body as you would expect without the bacteria added, don't bottle it.

Summary

Brewing a sour beer takes some patience. You will need to condition the beer for 6 months to a year. Some conditioning time at warmer temperatures (70–80 °F/21–27 °C) and a source of nutrients — either the "slow release" of nutrients from dying yeast or periodic feedings — are needed to encourage the lactic acid bacteria to reach their full souring capability.

Once bottled and carbonated, though, your patience and preparations will be well rewarded. Sour beers can be consumed immediately or aged for a couple of years. Commercial sour beers, because they are typically fairly expensive, are often reserved for special occasions. However, when you've brewed a tasty homebrewed sour beer, days ending in the letter "Y" can be special. A single batch of sour base beer can be used to make a number of smaller "spin off" batches, with different fruits or other additives. (I have even made sour beers with Jolly Rancher candies added). Just be sure to start your next batch of sour beer before you bottle the previous one. ■

Chris Colby is the editor of BYO.

Mash/Lauter Tun

A combination tun that upgrades for heat

story and photos by Thom Cannell

The combination mash and lauter tun is a time and space saver. Add heat to the tun and you have a RIMS.

Time has a way of revealing flaws in our efforts, mine included. This is true of the RIMS mash tun that was built in the December 2001 issue. I've used that prototype for two years and discovered a need for change. Our new version should benefit every home brewer contemplating the switch to all grain brewing.

English brewers and most US microbrewers use what is called a "single infusion mash." In practice, a heap of skillfully malted barley is crushed, placed into the mash tun and warm water is stirred in. After a brief wait while natural enzymes convert starches to simple sugars, the miracle is complete and you have wort! Next, the mashed barley malt heads for a lauter tun to separate liquid from solids and the resulting wort goes into the boil kettle. This wort is boiled, hops are added and you know the rest of the story.

Many smaller micro-breweries operating on a limited budget use a combined mash/lauter vessel to save space and equipment costs. Once the basic mash/lauter tun is built you may decide your needs don't include anything more. For those who want greater control over the brewing processes, we'll describe ways of adding a different filtering method (called a false bottom) and a way to add heat to your mash tun.

Project One: The mash/lauter tun

Insulated coolers make ideal mash tuns. They are inexpensive and made from food-safe plastics. To convert a cooler to a mash tun you need a way for the wort to be removed, leaving solids behind. If you have never mashed, milled grain includes large particles, flour-sized bits and various sizes.

Step One: Coolers come equipped with a drain hole. Unscrew the original self-closing tap. This leaves a ½" hole ready to accept a bulkhead fitting.

Step Two: Make a bulkhead fitting from a close nipple (½" x ½"), two O-rings, ½" ball valve, and ½" x ½" compression fitting. This will create a leak resistant pathway from inside the cooler to outside.

Step Three: Cover threads at each end of the close nipple with 2–3 wraps of Teflon tape (or food safe pipe dope) and screw everything together a bit more than finger tight. You may have to make a plastic washer to add enough thickness to create a seal. Over tightening will compress the O-rings too tightly and damage them.

Making a filter is simple (most brewing texts refer to a device called a manifold made of slotted pipes. Our filtration device replaces this.) It requires copper tubing (⅜" in our example) extending from the ½" x ½" compression fitting that leads downward to a length of stainless steel flexible tubing below. Wondering how the tube is ⅜" and the compression fitting is ½"? Me too. I'll guess that tube is measured by I.D. or inside diameter, the compression fitting by O.D. or — you guessed it — outside diameter.

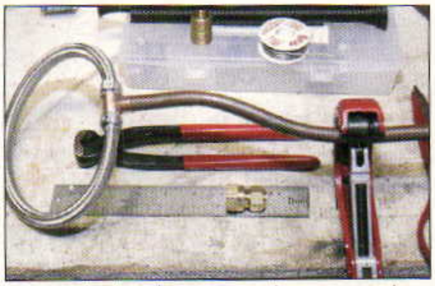
Step Four: Cut the original fittings from a 12-24" x ½" length of stainless steel flex covered water supply line — longer is better. Be sure you purchase ½" tubing or it will be difficult to expand to wrap over a ⅜" T fitting.

Step Five: Cut a 4-6" (100-150 mm) length of ⅜"copper tube and solder on a ⅜" T fitting. Be sure the flux and solder are rated for food use and do not contain lead. Using a tubing bender, gently curve the copper tube to the bottom of your cooler/tun. Using stainless steel ring or clamp fittings, copper or stainless steel wire (ordinary "stainless" hose clamps contain iron parts, which are very bad for beer) secure the

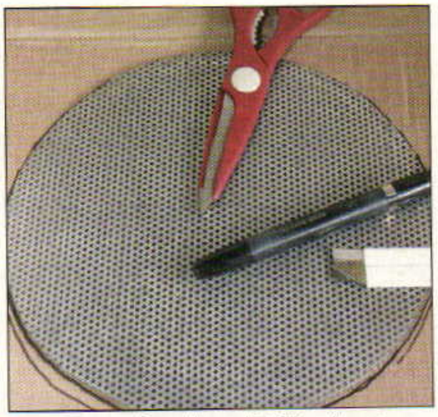
PARTS AND TOOLS

Tools
- Hole saw(s)
- Hacksaw
- Tin snips / aviation shears
- Screwdrivers
- Soldering iron, plumbing-grade solder, and flux
- Wrenches

Parts	
Rubbermaid or Gott cooler	$20
False bottom	$15
Heating element – varies	
Chromalox SGW 2207 Under available from service parts companies	$30
Power cord 12 gauge	$3
Controller Ranco ETC 111000 approximately	$75
For bulkhead fitting:	
Close nipple	$1.25
Compression coupling "½" x ½ tube to FIP"	$2.50
O-rings	$1.50
Type L copper pipe, ⅜" I.D. x 10'	$9.00
Stainless Steel flex tubing (covering ½" pipe)	$4.00
T-fitting ⅜" I.D.	$1.50
½" ball valve, stainless steel (Brass <$10.00)	$25.00
Teflon tape	$2.50
False Bottom	$15
For Thermowell:	
90° fitting ⅜" I.D.	$1.00
⅜" I.D. cap	$0.50
⅜" I.D. copper tube (from above lengths)	



Use a tube bender to curve the copper tubing to the bottom of the tun and cut to fit.



Cut a piece of cardboard 10" in diameter as a template for the false bottom.

mesh tube over the open ends of the T. Insert the tube into the compression fitting and tighten.

That's it. You have a functional mash tun. It is ready to use after you thoroughly clean anything that has been handled or soldered. Use a strong cleaner like TSP or PBW to remove all traces of oil and soldering flux.

If you find that you get bits of grain in the runoff — I haven't — a circle of copper window screen or several stainless steel scrub pads laid atop the flex should help create a dense and free-flowing compacted-grain filter bed even quicker. If you like this filter for your mash tun, it works wonderfully in a boil kettle.

Project Two: Adding a false bottom

If you are familiar with lauter tun descriptions, most mention a false bottom. The false bottom — whether a layer of spruce needles used in ancient brewing, or the slotted stainless steel sheet used at your local microbrewery — supports the grain bed, which serves to filter the wort.

In the mash tun (or mash/lauter tun) crushed grains are added to warm water. The result is thin barley porridge. If you were to drain the thin part, the desirable wort, it would include chunks of grain. Fortunately, this porridge will act as its own filter as it compacts and compresses.

Recirculation is a process of draining freshly produced wort from the mash tun. It will initially contain many tiny particles. Collected wort is added back to the mash tun and drains through an increasingly compacted layer of grains. The false bottom encourages the formation of a thick bed of large grain particles — a natural filter.

Most experts suggest that a smaller grain particle is easier to convert into wort. However, you may have to adjust the crush of your grain mill to a coarser grind, or risk a stuck mash.

That's what happened to me on my first use of the new mash tun with stainless steel false bottom. A coarser setting on my grain mill solved the problem.

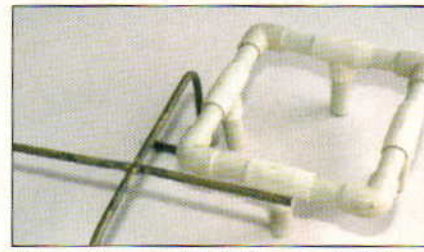
The cooler I purchased is 10.25" in diameter at the top and tapers to less than 10". The false bottom is 10", perfect for kettles and mash tuns made from 15-gallon stainless steel kegs. You must cut the screen to fit.

Step One: Cut a cardboard circle 10" in diameter.

Step Two: Measure upwards from the bottom of the mash tun 2–2¼". This depth allows for insertion of a heating element in project three. If you are doing all of this in one project, read all of project three before proceeding.

Step Three: Fit the circle into the mash tun and adjust the size until your cardboard template precisely reaches the depth mark. It is very easy to cut undersized and the fit must be tight; the mash tun will expand as it heats. Then cut the stainless steel false bottom to size.

Step Four: Though your false bottom is friction fit to the mash tun, heat will expand the vessel by 1–3 mm in diameter. The false bottom could tilt or fall. You need a support device built of bent brass or CPVC pipe. I've used both and prefer the bent and welded brass.

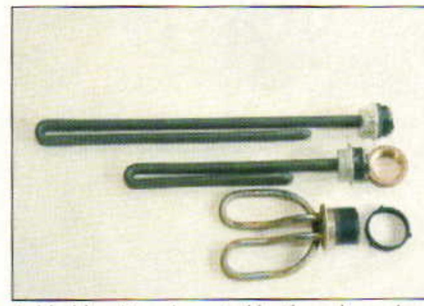

Either of these materials (brass or CPVC) can be used for the false bottom support.

Project Three: Adding heat — RIMS

The third addition to the basic mash tun provides an internal heat source to the mash tun.

There are two common methods of adding heat to your mash tun. The RIMS (recirculating infusion mash system) has become a standard in home brewing. The HERMS or Heat Exchange Recirculating Mash systems are gaining popularity.

HERMS systems recirculate liquid


Folded heating elements like these leave less opportunity for scorching wort.

Using the appropriate size hole saw, cut a hole in your cooler for your heating element.

After you have inserted the O-ring and hex nut, the heating element will be secure.

between two vessels, a hot liquor tank and the mash tun. A coil of metal tubing is placed into one (or both) vessels and heated liquid is pumped through the coil. This moves heat to the cooler vessel. HERMS has some attractive features. Maybe we'll build one next year.

Traditional RIMS systems place the heat source outside the mash tun. Our system puts the heating element into the mash/lauter tun and moves liquid (wort) past the heat source.

Systems similar to ours are very common in the UK, where the mash tun, lauter tun, and boiler are all one vessel (don't try boiling in a cooler, the plastic is not as heat resistant as the British polyethylene tubs.)

Several styles of heating elements are available. You can use elements like those in British BruHeat, Electrim and similar systems, or purchase Chromalox water heater elements. Every element is designed to run on 220/240 Volt current; driving them with US voltages, 120V, results in less heat output, which is preferable. The less heat produced per inch means less opportunity to scorch your precious wort. Double or quadruple folded elements are best as burnt wort is not palatable.

We used a doubly folded element that fits the diameter of our mash tun. It's a Chromalox SGW 2207 (2000 Watts) and is made of nickel alloy. It produces 500 Watts of heat.

Any heating element requires control. UK homebrewers have access to the previously mentioned systems that include a controller. We Colonials must use one of their systems, or build our own controller. You could make a simple controller (Build a simple RIMS: Projects (*BYO* Dec, 2001) but why not use a sophisticated controller? See "Lager Climate Control" in May–June 2004 *BYO*. The Ranco ETC 111,000-based controller will be equally happy controlling a heating element as a heating pad! Stay within its capabilities: 120VAC, 16A, or 208/240VAC, 8A.

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The thermowell is a waterproof structure that will stabilize and protect the heat sensor.

Interior RIMS-style Heating

Step One: Drill a hole in your cooler. Measure the interior depth and mark the exterior to reflect the interior bottom. Depending on the heating element used (1"–1 ½" diameter or 25–37 mm), measure up at approximately ½" above the center of the hole to allow for the curvature of the interior bottom.

Step Two: Drill (or cut) through the exterior wall of the cooler with an appropriate sized hole saw (large enough for a 1–2" PVC protective plastic cap.)

Step Three: Remove the foam insulation carefully and then cut a smaller hole (using a 1"–1 ½" hole saw) for the heating element.

Step Four: Place an appropriate-sized O-ring around the threads of your heating element, insert through the cooler wall, and secure with a brass or stainless steel hex nut of matching size. (Water heater elements will have the nut on the inside of the mash tun, and a securing nut will be on the outside.)

Step Five: Drill a hole through a PVC cap and insert a power cord. Wire the cord to the heater element and be sure to include a ground connection. Push the cap into the large hole after you have completed leak testing. An installation using a BruHeat controller will require a larger exterior opening to accommodate the controller box.

Project Four: Building A Thermowell

To best control either heating element, we need to place the controller's heat sensor inside the mash tun. It's not waterproof so we need a device called a thermowell. It is a closed-end copper tube inserted into the mash tun. If you have access to stainless steel tube, it's even better.

The thermowell could be loosely placed into the mash, but vigorous stirring would dislodge it. We need a method of holding the tube upright. You might devise a more clever restraint device; I used semi-circles of flattened copper tube, soldered to the upright thermowell.

Step One: Measure from the top of the mash tun to your false bottom. Cut a length of copper tube to similar length. Solder a cap to one end, forming a waterproof thermowell tube.

Step Two: Cut two lengths of copper pipe that are larger than half the circumference of your cooler, approximately 17" or 432 mm. Flatten the tube and solder each hoop to the upright. One should be near the bottom, the other near the top.

Step Three: Thread a 90° L onto the thermistor, then dry fit to the thermowell. Your temperature probe may not pass through the right angle. If so, use a 45° fitting or just ignore it. The purpose is to prevent the thermowell from filling with liquid or debris.

The Final Piece — A pump

The recirculating mash system is driven by a pump. A wort pump must be capable of moving boiling hot liquid against the force of gravity and resist injury from grains. Your local homebrew shop can advise you in the purchase of a new pump and how to use it.■

Thom Cannell writes "Projects" for every isssue of BYO.

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Last CaLL

Exalted Malted

Brewing with water blessed by the Pope himself

Marlon Lang
Baton Rouge, Louisiana

photo and art courtesy of Marlon Lang

The three wise men (left to right): Marlon Lang, Bumblebee and Ed the Printer are the holy brewers of Exalted Malted. Let no man's thirst be unslaked!

We refer to the house next door as "the Doctor house" because four of its six owners have been PhDs at the local university. The present occupant – let's call him Bumblebee – is a double PhD, specializing in biological things associated with cloven-hoof animals. He is a real mover and shaker in his field. During the anthrax scare after 9/11, he was whisked off to Washington to brief the heavy hitters. His expertise takes him to such vacation dream sites as rural Korea, Azerbaijan, Hungary and Patagonia. Isn't fame a wonderful thing?

In the summer of 2001, Bumblebee did a Europe circuit. He presented a paper in Paris, moderated a discussion in Dortmund, inspected udders in Uzbekistan, and received an award in Amsterdam. At home he is very active in the Catholic Church, so the local Bishop arranged for Bumblebee to have a private audience with the Pope. At the appointed hour, Bumblebee arrived at the Vatican. Two unsmiling Swiss Army guards with UZIs checked his body and his briefcase. Assured that he held no peril for the Pontiff, the guards admitted Bumblebee to the interview room. After receiving Papa's initial blessing, Bumblebee opened his brief case and removed his rosary. John-Paul II blessed the beads, followed by his wife's rosary, his daughter's rosary, a Bible, and 3 two-liter bottles of water. After all the blessings, Papa and Bumblebee communed, discussed, and otherwise hobnobbed until the appointment was over.

The Saturday after Bumblebee returned to the good ol' USA he strolled over to my house. I was brewing pale ale, assisted by Ed the Printer. Bumblebee is a dark-beer dude; he is originally from Pennsylvania and especially likes East Coast Porter. After a pint of my Yeungling Porter clone, Bumblebee began to relate the tale of his trip. When he mentioned the blessing of the water, both Ed the Printer and I leapt up and proclaimed that a cupful of the holy liquid would be the crowning touch to our IPA. Bumblebee kindly obliged.

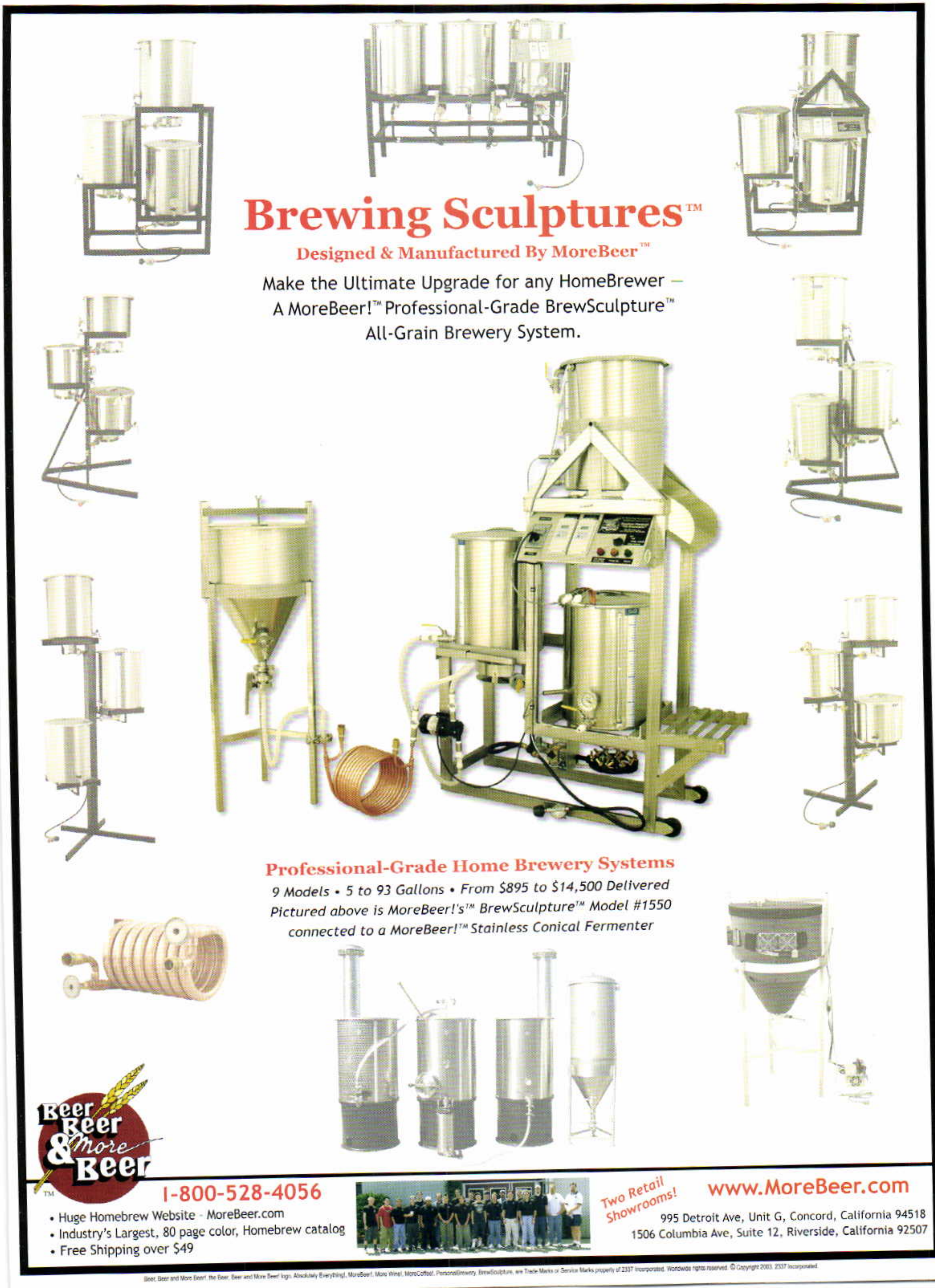
I usually only mark my beer bottles with a batch number on the crown cap. But Ed pointed out that this beer would be special and needed a name and a label. So we held a contest to select a one.

We decided the name should reflect a quality brew with Papal overtones. It should be modest and unoffensive, yet memorable. "Catholic Kölsch" was rejected for being politically incorrect. "Ale ala Vaticia" was deemed un-pronounceable after drinking a few of them. "Blessed Be Thy Beer" held promise but was ultimately rejected as verbose. Finally, "Exalted Malted" was proposed — it was perfect. It alludes to religion without referring to a specific faith, it rhymes and it has flavor and aroma connotations. All hail: Exalted Malted!

For those of you interested in such mundane things as recipes, here's ours:

11 lbs. (5 kg) 2-row malt
1 lb. (0.5 kg) Caravienne
2 oz. Columbus, bittering hops
1 oz. Amarillo, flavor hops
1 oz. Amarillo, dry hops
White Labs WL1056 yeast
1 oz. holy water (this is most crucial!)

I saved the yeast slurry and have re-pitched it many times. I wonder if there is a point when my beers will become un-blessed? I contend that if I use at least one drop of Exalted Malted, I will still be brewing a sacred beer! ■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