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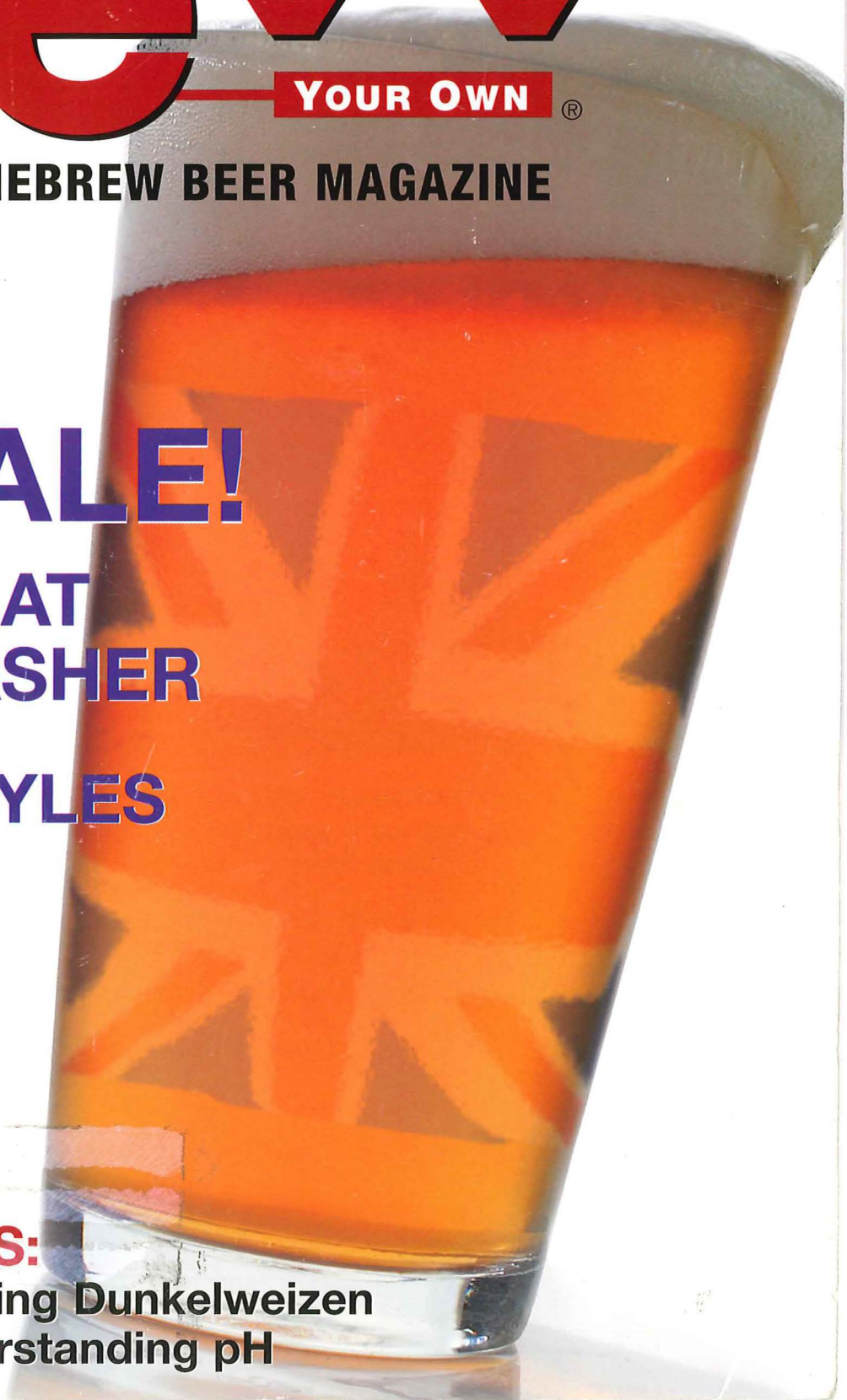
SEPTEMBER 2003, VOL.9, NO.5

THE HOW-TO HOMEBREW BEER MAGAZINE



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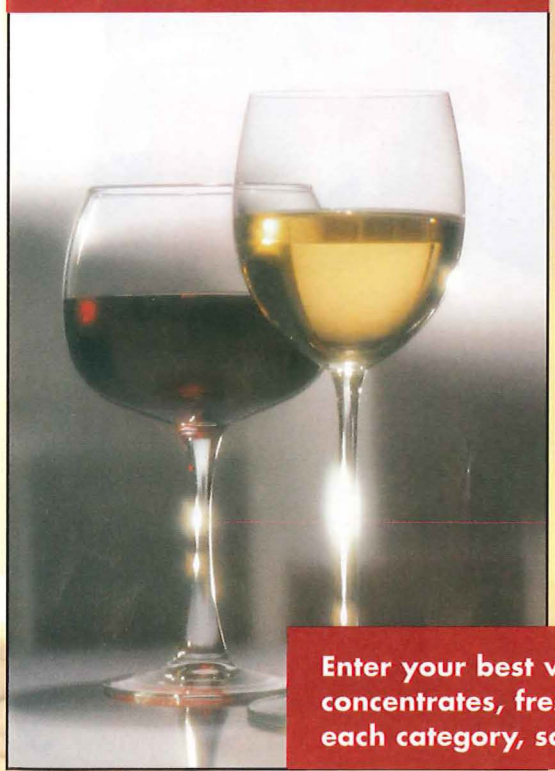

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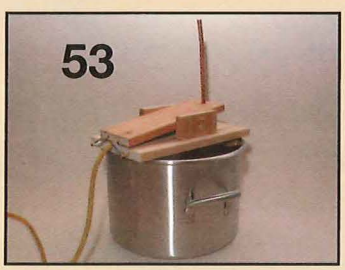

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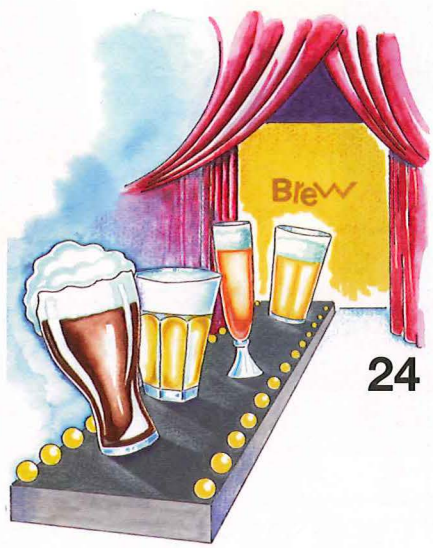

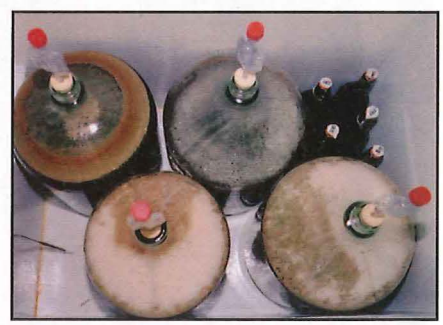

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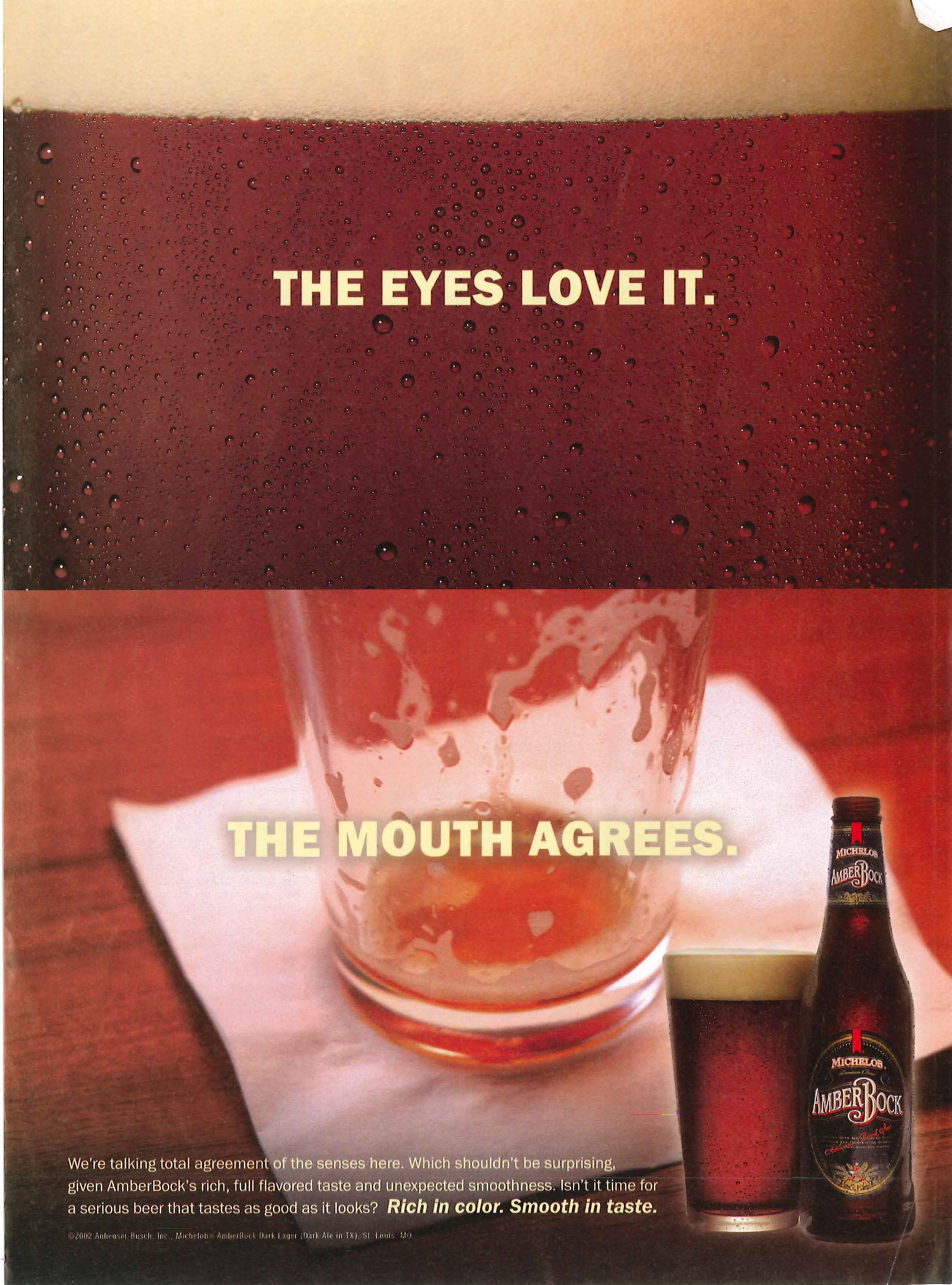

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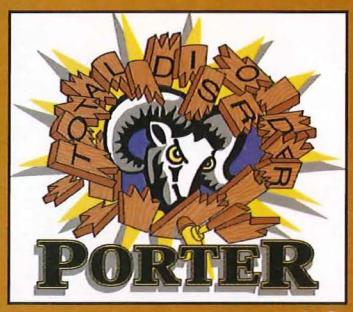

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THE HOW-TO HOMEBREW BEER MAGAZINE

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

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Volume 9, Number 5: September 2003

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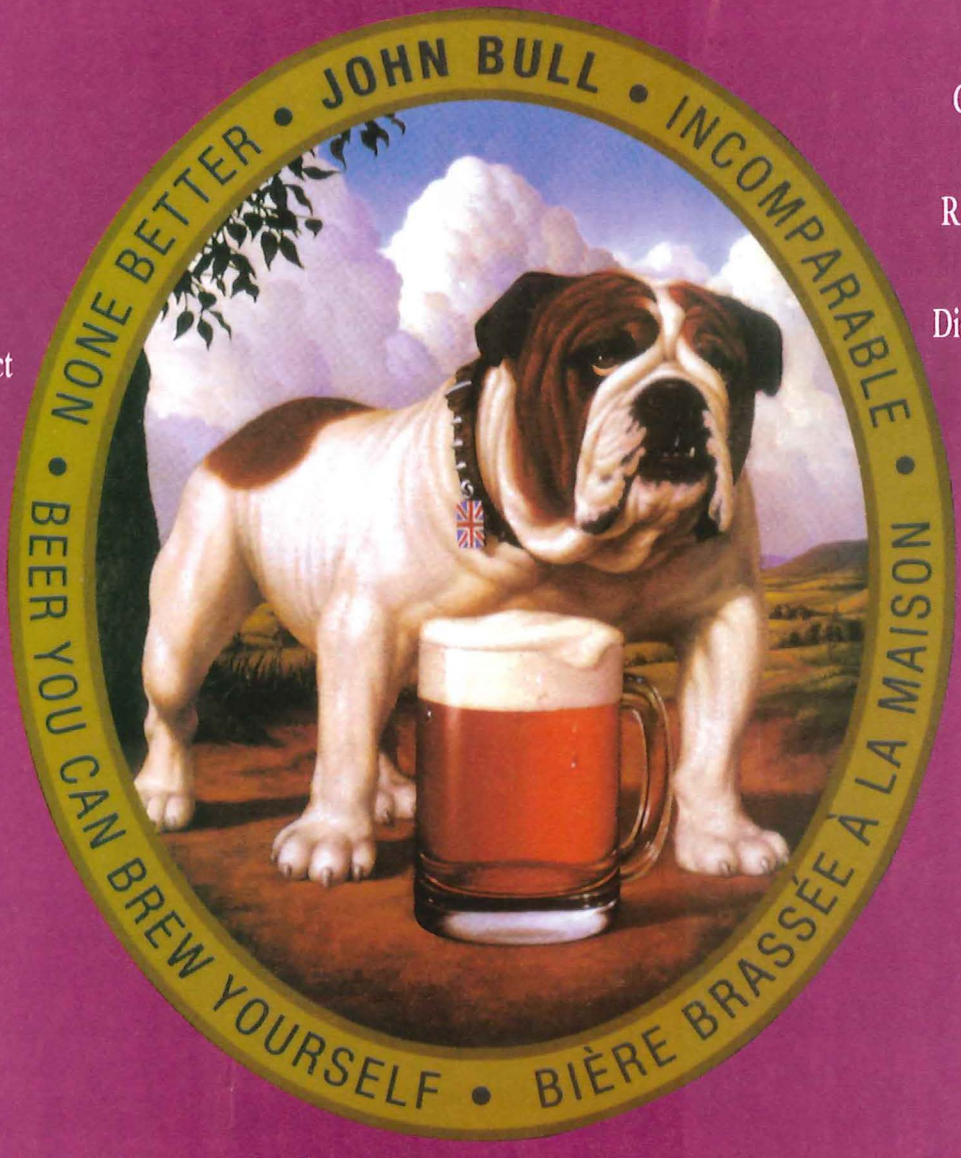

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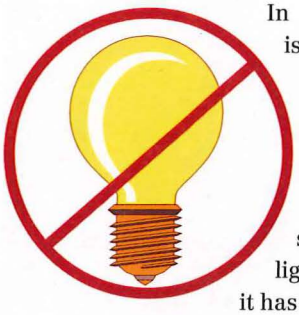
Keg Idea is Kicked

In the July-August 2003 Mail column, a reader asked about using an old copper fire extinguisher as a keg. While you may be able to overcome some of the mechanical problems of doing this, you still have to deal with the fact that, after the copper is rolled and riveted, it is sweated with lead solder to seal the cylinder. These were all made well before anybody knew the dangers of lead in any kind of food or beverage container. I would not recommend using one of these as a keg.

Andy Jaeger
Fire Chief
Rogers, Arkansas

Stay Out of the Light



In the July-August issue, your sidebar on yeast starters (Homebrew Nation, "Yeast Starters") said to keep the starter out of the light. Why is that? If it has no hops in it, how can it get skunky?

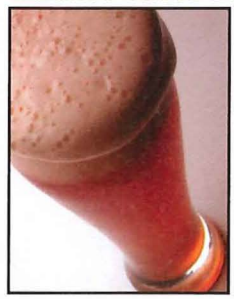
Nils A. Hedglin
via email

Protecting a yeast starter from light is meant to protect the yeast from DNA damage, not to prevent skunking. Yeast cells are transparent to most wavelengths of light and laboratory strains of Saccharomyces cerevisiae are sensitive to DNA damage from light, especially UV light.

To the best of our knowledge, brewing strains haven't been tested for UV sensitivity, but we feel it's better to be safe than sorry.

Of course, hopped wort and finished beer should also be shielded from light because of the possibility of skunking the beer.

Balance Those Bananas!



In the July-August 2003 issue of *BYO*, Mr. Wizard claims that when brewing a hefeweizen, "The level of banana and clove aromas can be increased by fermenting at higher temperatures." I believe this explanation is incomplete. Banana aromas come from esters, which are very evident in beer fermented at the high end of the temperature range for hefeweizen yeast. Clove is a phenol, which is dominant in beer fermented at the lower end of that range. To get a balance of both, one would need to choose a temperature in the middle of the range of acceptable temperatures.

Dr. Andrew C. Nix
Christiansburg, Virginia

The levels of both phenols and esters — responsible for the clove and banana aromas, respectively — increase with fermentation temperature. However, as fermentation temperatures increase, "banana esters" eventually overwhelm the clove aromas. So yes, the brewer needs to choose an intermediate temperature that produces a balance of these two aromas.

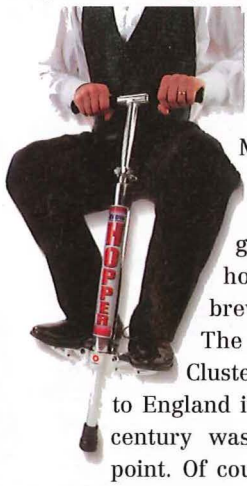
Skip the Secondary?

In the July-August issue of *BYO*, there was a recipe for Märzen-Oktoberfest. In the last paragraph of the recipe it states, "Hold at 55 °F (13 °C) until fermentation is complete — about two weeks. Rack and lager at 35 °F (1.6 °C)." Does this mean a secondary fermentation is not required? Should I rack to bottles at the end of two weeks and lager at 35 °F for one month plus?

Tom Brooks
Dousman, Wisconsin

Lagering is essentially conducting a secondary fermentation at cold temperatures. So yes, you should do a secondary fermentation. But, since it's a lager beer and the secondary fermentation is carried out cold, it's called a lagering period. After primary fermentation is done (about two weeks), rack the beer to another fermenter and lager at 35 °F (1.6 °C) for at least a month. You could lager in bottles. However, we think you'd be better off lagering in bulk (in the carboy) rather than in bottled beer.

Hops from England

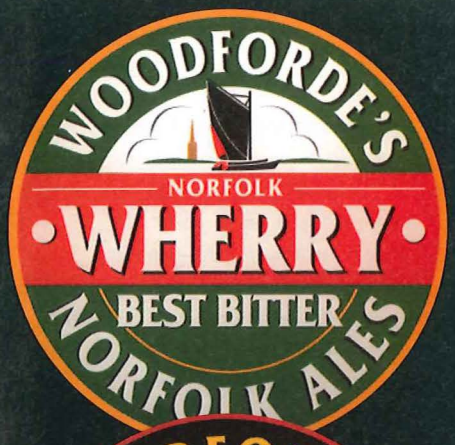


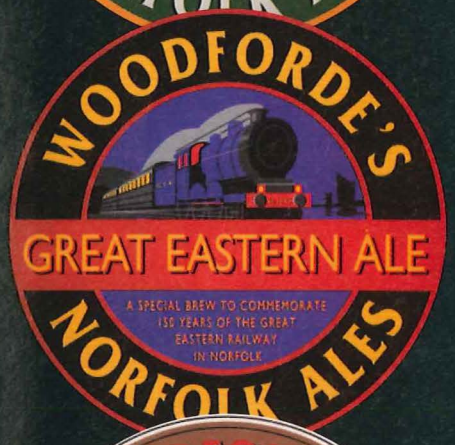
We enjoyed Mark Garetz's article ("Hop to Style") in your March-April issue. It illustrated well the great diversity of hop varieties the brewer is offered.

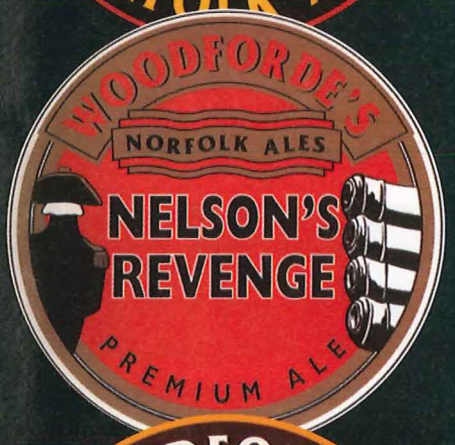
The export of Clusters from the USA to England in the early 20th century was an interesting point. Of course the production of hops in those days was centered in New England — an area, as its name implies, with some similarities to the UK. Subsequently, problems caused by foliar diseases caused production to die out in this part of the country. The Western states, most notably Washington, were found to be more productive. The irrigated desert, which is the Yakima Valley, is a very different situation from the UK climate or most continental hop production areas.

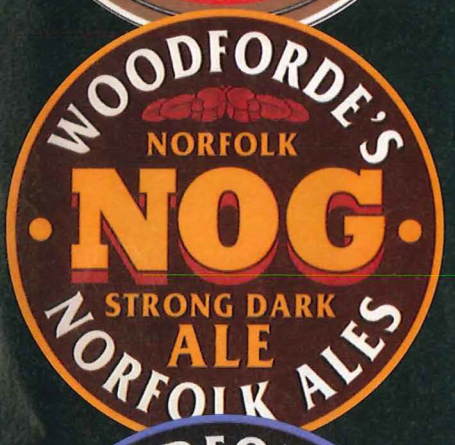
Interestingly, there is a word in the vocabulary of a UK hop trader that describes the strong and sometimes rank flavors, such as those that are associate with, for example, Brewers Gold. The word is "American," and we all know what it infers. This use of the word arises due to the use of males originating in the USA (in the breeding program). Alpha acids were raised, but with a negative effect on aroma.

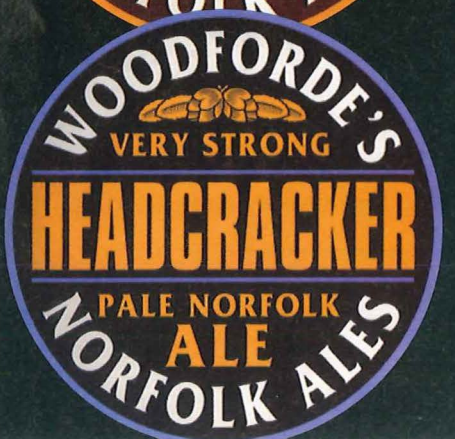
We have one point of disagreement that must be aired. In general, the UK hops are full-bodied and more full of flavor than the equivalent American











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varieties. This is attributed to the deep valley soils and temperate climate in which they are raised. For example, some English brewers who used American Fuggles in the mid-1990s found it necessary to increase hopping rates quite substantially in order to achieve the desired floral "nose."

UK hops are transported to the USA for the craft brewer and the homebrewer as pellets, leaf hops in Freshpaks and plugs. In all cases, they are in convenient-sized evacuated foil packs. They cross the Atlantic via the northern route without getting anywhere near the warm temperature in the equator, and are then kept in refrigerated stores. Goodness knows where Mark got his UK hops. We recommend that he get in touch with Crosby and Baker of Westport, Massachusetts, for first-class product.

Thomas Hawkins
Hops from England
Ledbury, Hereford, England

Help with Hard Lemonade

Can you help me find a recipe for hard lemonade? My husband likes them, but they are expensive.

Holly Meeker
New Britain, Connecticut

We get at least one request a month for hard lemonade or other "alcopops." Strangely, every single letter we get claims that the request is for someone else.

Commercially, "malternative beverages" are made from a light colored beer base that is carbon filtered until it is flavorless and colorless. Then, artificial flavors and colors are added and the beverage is packaged. Homebrewers can't replicate these methods, but you can do something similar.

Brew the lightest colored beer you can manage. A mix of 2-row Pilsner malt and 20% rice syrup solids should work. So should a wort made from extra-light malt extract and 10% corn sugar. Don't add hops. The sweetness of this concoction should be balanced with acidity (as in wine), not bitterness. Ferment with a clean ale yeast or, preferably, a lager yeast.

After primary fermentation, rack the beer to secondary and let it clear. Next, keg the beer and cool it down to serving temperature. Then mix lemonade concentrate into the cold beer. Pick a lemonade without pulp so it doesn't block the keg's pickup tube. As long as the beer stays cold, the yeast should not referment any sugars you add to the keg.

You may need to add sugar and/or citric acid to adjust the flavor. For a test run, you could do a bench test with a pitcher of American Pilsner to estimate the correct proportions of beer, lemonade, sugar and (perhaps) acid.

If you bottle your beer, you could mix the beer with lemonade mix at serving time. Or, if this sounds like too much work, there is a kit manufacturer that makes hard lemonade kits. See www.Vinoka.com for more info. ■

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brewer PROFILE

A Shaggy Dog Story

By Rob Dewhirst • Lawrence, Kansas

PHOTO COURTESY OF ROB DEWHIRST

Rob Dewhirst and canine companion Zack brew a nice Crotchsniffer Pale Ale.

Bill Frazier, a longtime friend of the family, first exposed me to homebrewing seven years ago. He would tell me how his family got together to make beer on his stovetop and how the brew always turned out better than the available commercial brands.

When I first started brewing in a small house, I couldn't keep the dog hair out of my equipment. I gave up and accepted it as an ingredient. For this reason, I named my brewing setup the "Hairy Dog Brewery." I have since moved to a new brewery, leaving the dog hair behind, but the name will not seem to shed.

I found a local brew club called the Lawrence Brewers Guild and took my first batches to its meetings. Either the club members were hiding their distaste for my creations or I had actually made drinkable beer. I've been hooked ever since.

I am now the vice president of the Lawrence Brewers Guild. My newest system is a multi-tier RIMS (*R*ecirculating *I*nfusion *M*ash *S*ystem) that I enhanced with an idea of my own: hanging my counterflow chiller from the ceiling. I've never seen anyone else do this, but I find it to be more convenient than using stands or placing the chiller on brackets.

As far as my beer is concerned, I suspect I differ from many brewers. I deliberately avoid making clones of commercial beers. What's more exciting; saying your pale ale is "just like Sierra Nevada" or describing your pilsner as "a pre-Prohibition pilsner that German immigrants brought to the US and adapted to available ingredients?" The slim alcohol market in Kansas doesn't provide good commercial examples to clone anyway.

Here in the Sunflower State, the last to eliminate Prohibition, commercial beer selection is quite limited. Backward beer laws result in a ridiculously complex wholesale distribution system. New craft brews on the market are rare. If it wasn't for a few world-class breweries (the Free State Brewery, the High Noon Saloon, and Boulevard Brewing Co.), Kansas would be a commercial beer wasteland.

My homebrew doesn't always turn out perfectly either though. I once managed to make a volcano of beer by reversing hoses on a carboy and using CO_2 pressure to move the beer. Whenever friends ask what hop leaves look like, I just point to the ceiling of my kitchen.

Other beers have turned out much better. My biggest surprise success was a batch of ordinary dry stout. A homebrewer friend dropped off some unmalted barley that his brother had grown, and I toasted it in the oven for several hours until the house reeked of burnt popcorn. The gravity was off and the roasted flavor was overpowering. Nonetheless, I kegged it and aged it for a few months. When I decided to try it again, it was the most delicious beer I ever made. It barely lasted two days — one homebrew club meeting was enough to clobber the entire keg.

My homebrewing friends and the club have helped me make some very nice beers, despite our location in this beer-backward state. I believe that you should first brew the kind of beer you like to drink and then get real good at it.

reader RECIPE

A really, really cold one

Beer in ice cream has reached the mainstream. Newcastle Brown Ale ice cream is now sold in England. The product was dreamed up by Neill and Jackie Maxwell at their small farm-based dairy in the village of Doddington in Northumberland. Although the ice cream is made using the ale, under licence from brewers Scottish and Newcastle, the frozen delicacy contains less than 1% ABV.

Sweet cream, whipped and frozen, is a perfect foil for the malty, slightly bitter flavors of beer. Blended with chocolate, or tropical fruits, beer can be a good stand-in for other liquids typical ice cream recipes call for.

Scotch Ale Ice Cream:
2 cups heavy cream
1 cup brown sugar, firmly packed
1 teaspoon vanilla or almond extract
12 oz. (355 mL) Scotch ale
½ teaspoon guar gum
Ice cream freezer
Melted malt extract
Grated bittersweet chocolate

Step by step

Melt brown sugar in heavy cream in a medium saucepan over low heat until sugar is dissolved. Strain the mixture into a mixer bowl. Let cool and then chill. While cream cools, add guar gum to Scotch ale and whisk well. Let stand for 30 minutes to hydrate, then whisk again.

Stir the Scotch ale and vanilla extract into the cream base. Strain again into a quart-sized ice cream freezer bowl. Freeze in ice cream maker according to manufacturers instructions. The mixture will seem gummy when frozen — it needs to ripen. Scrape it into a sealable container and freeze overnight.

The ripening process will stabilize the mixture and make it smooth. Serve as a sundae with a topping of warmed unhopped malt extract and grated bittersweet chocolate.

Recipe courtesy of Lucy Saunders. Saunders edits the award winning site www.beercook.com.

beer BASICS

BYO RECIPE STANDARDIZATION

Every recipe in BYO lists the projected original gravity (OG) and International Bittering Units (IBUs). From this issue forward, all recipe statistics will be calculated based on a standard set of assumptions. Here are some of the key assumptions:

Extract Values

The *potential extract* of an ingredient is the gravity of wort achieved by using one pound of that ingredient in one gallon of water. The potential extract of grains is the maximum yield possible for the grain. This is never achieved in brewery settings. *Extract efficiency* is the amount of sugar extracted from the grain expressed as a percent of the total possible. BYO recipes assume a 65% extract efficiency. Thus, a mash of 1 pound of 2-row pale malt, which has a potential extract of 1.037, in one gallon of water would yield a wort of 1.024.

The extract values for malt extract reflect the specific gravity acheived by dissolving one pound of extract in one gallon of water.

Extract Values for Malt Extract

liquid malt extract (LME) = 1.037
dried malt extract (DME) = 1.045

Potential Extract of Grains

2-row base malts = 1.037–1.038
wheat malt = 1.037
6-row base malts = 1.035
Munich malt = 1.034
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

BYO recipes use pellet hops unless otherwise specified. We calculate IBUs based on 25% hop utilization for a one hour boil at specific gravities less than 1.050.

brewer PROFILE

Chef Buck • By Russel "Buck" Reed • Thurmont, Maryland

PHOTO COURTESY OF RUSSEL REED

Chef Russel Reed (Right) loves to cook, brew, and teach others to do the same.

As a chef, homebrewing goes well with my career. Just as eating and drinking are like a marriage, so are cooking and beer making. Making good beer and experiencing the flavors of each style has given me a better palate. This is a great advantage for all cooks. In a perfect world of food and beer lovers, more chefs would talk about what they drank and more brewmasters of what they ate.

I first took interest in homebrewing in 1989 while attending the Culinary Institute of America in Hyde Park, New York. One of my classmates was a homebrewer and gave my Wines and Spirits class a presentation on his hobby. I was fascinated to say the least.

Although I was interested in the presentation and beer in general, I didn't seriously consider brewing it myself until four years later. When I saw a TV commercial advertising a brewing kit, I decided to give it a try. A mere $100 would buy me all the ingredients and equipment needed to brew my first batch of beer.

I placed my order and waited faithfully by the mailbox for my kit to arrive. The equipment was okay, but the ingredients and instructions proved to be dreadful. This is what I was instructed to do: Put one three-pound can of malt extract and corn sugar in the fermenter bucket and add water and yeast, making sure to hold back a cup of sugar for priming.

After closing the lid and waiting 10 days, I bottled my first batch of brew. The beer, of course, was terrible. In my ignorance, I actually tried the same method twice more, thinking I must have done something wrong. The beer turned out horrible each and every time.

I gave up for about a year until I met Bob Frank of The Flying Barrel in Frederick, Maryland. After acquiring some reading material including a couple of brewing magazines and Charlie Papazian's book, "The Complete Joy of Homebrewing," I jumped back into brewing with a vengeance.

When The Flying Barrel moved into a new facility and became a brew-on premises operation, I found the opportunity to put my culinary brewing skills to work. I was already teaching cooking classes for the Frederick County Department of Parks and Recreation, so it was not difficult to make the transition to teaching homebrewing at The Flying Barrel.

I have now taught over 150 people how to make beer. The best part is that I actually get paid to make beer. To paraphrase Lou Gehrig . . . "I consider myself the luckiest homebrewer on the face of this earth."

Throughout my years of brewing, The Flying Barrel and my homebrewing club, Frederick Original Ale Makers (FOAM), have been great resources in my quest to become a better brewer. My philosophy for beer making is simple: There is always something more to learn about this hobby. I find that the more I educate myself, the better my beer becomes. Learning to enjoy and appreciate good beer is a satisfying lesson in life.

Members of the Frederick Original Ale Makers (FOAM) enjoy a club brew.

homebrew EVENT

The Dixie Cup. Hosted by the Foam Rangers • Houston, Texas

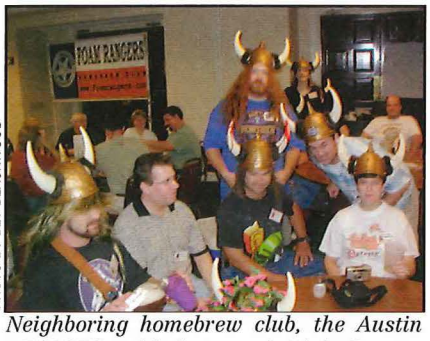


PHOTO BY BEV BLACKWOOD

Neighboring homebrew club, the Austin ZEALOTS, raids last year's Dixie Cup.

When the Houstonwide Homebrew Competition was held in November of 1983, there were a whopping 79 entries in nine categories. Nobody knew that a monster had been born. Twenty years later, the Dixie Cup stands as the world's largest single-site homebrew competition, with over 900 entries in 43 categories.

The Foam Rangers, who host the competition, plan all year for the event. This year, it will be held October 17-18, 2003 in Houston, Texas. Despite its size, the Dixie Cup is not about being the biggest; it's about being the most unique and entertaining homebrewing competition in the country.

Dixie Cup Two-0, the 2003 edition, has a Hawaiian motif and the theme beer this year is "The beer that will get you lei'd." How do they define this elixir? You know the one. The one that's deceptively strong but oh so smooth.

Beers in this category should have strength, a minimum specific gravity of 1.080. It may have adjuncts, which should be specified when entering. Base style isn't important, but panache and effect is. Alcohol should not be evident, but should be abundant.

Is this beer sexist? Decidedly. Is this beer drinkable? Absolutely. Is it going to be judged by a panel of women? Of course!

Past Dixie Cup brewing wackiness has included: "The Beer that Burns Twice" (high gravity pepper beers), "The Monster Mash" (high gravity beer made with Halloween candy), malt liquor (controversially judged from the bottle out by the hotel dumpster) and "Big and Stupid" (high gravity beer made with a "stupid" ingredient . . . 24 Carrot IPA anyone?).

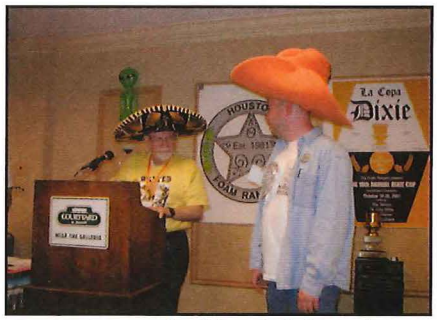
It's not all fun and games though — there is a serious side to the Dixie Cup. The event is a qualifying event for the Master's Championship of Amateur Brewing (MCAB) and features the best judging talent the state of Texas can muster. A broad panel of judges converge on the event from across the country — this is fortunate given the size of the entry-count!

It is also the final event in the Gulf Coast Circuit. The GCC starts with the Bluebonnet Brewoff in Dallas, moves to the Crescent City Competition in New Orleans, then to Orlando for the Sunshine Challenge and finally back to Texas for the Dixie Cup.

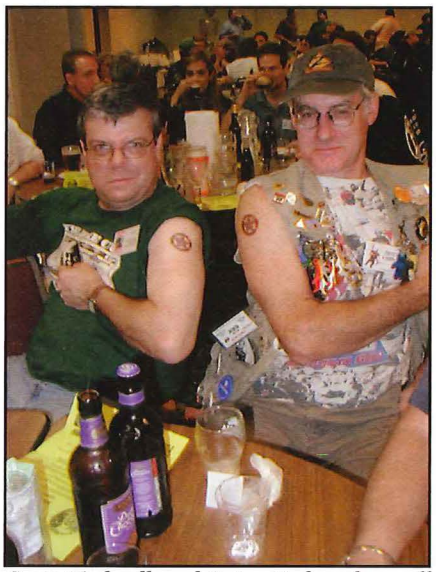
Saturday morning's "milli-conference" has featured many noteworthy speakers. Fritz Maytag, Greg Noonan, Dave Miller, Ray Daniels, Pierre Celis, John Maier, Chris White, Randy Mosher and the late Dr. George Fix are but a few of the speakers who have bestowed their wisdom upon the groggy Saturday morning homebrewers. This year's speakers include beer historian Gregg Smith, back for another round, Adam Avery of Avery Brewing, Ron Ryan from Cargill Malting and Brad Farbstein of Real Ale Brewing.

The offbeat nature of the Foam Rangers doesn't stop at the Dixie Cup. How many clubs are led by a Grand Wazoo? The person wearing "the Fez" is jokingly referred to as "the most powerful person in homebrewing," although few take the job seriously enough to make that moniker a truth. The Secondary Fermenter dispenses beer and style wisdom at monthly meetings while the Purser collects the funds.

With its 100 brewers, the club has been competing aggressively in MCAB competitions across the country. For Dixie Cup Registration information, drop by our website at www.foamrangers.com. You will also find the Brewsletter Urquell, the official organ of the Foam Rangers!



Beer writer Fred Eckhardt (left) and Steve Moore (right) at the 2001 Dixie Cup.



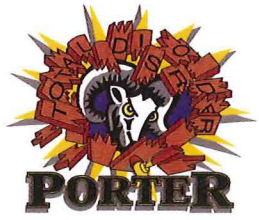
Scott Birdwell and Peter Cadoo show off their Foam Rangers tattoos.

Send us your story!

If we publish your article, recipe, club news or tip in Homebrew Nation, you'll get a cool messenger bag (compliments of White Labs) and a *BYO* Euro sticker.

replicator TOTAL DISORDER PORTER

by **Steve Bader**



Dear Replicator,

We recently tried Total Disorder Porter from Big Horn Brewery in Tacoma, Washington. We brought home two growlers and are now hooked enough to make the two-hour drive for refills . . . but we'd love to try our own. How can we find the recipe? I drive a Suburban so it would be better for the environment if I could brew my own!

Jim Jeffers and Ken Winkley
Felida, Washington

I talked to head brewer Larry Cash at Big Horn Brewing to get the low-down on this awesome beer. Total Disorder Porter was the silver medal winner at the 1996 Great American Beer Festival and continues to be a favorite at Big Horn Brewing, and all of the other Ram International pubs. It is considered one of their "regular taps."

Larry said this beer has distinct roasted flavors of chocolate malt and some caramel malt flavor (from the crystal malt). It is a dry, yet sweet, beer with a low level of hop bitterness. The dryness and roasted flavors comes from the generous use of chocolate malt, while the sweetness comes from the low attenuation rate that the yeast gives it.

Larry highly recommends that you use the White Labs WLP002 (English Ale) yeast. Big Horn has tried many other types of yeast over the years, but none has provided the right flavors. For more information visit www.theram.com or give them a call at (253) 756-7886.

Big Horn Brewing Total Disorder Porter

(5 gallons, extract with grains)

OG = 1.055 FG = 1.016
IBU = 17 SRM = 44 ABV = 5.0%

Ingredients

6.0 lbs. (2.7 kg) Coopers Light malt extract syrup
0.33 lbs. (0.1 kg) wheat malt
1 lb. (0.5 kg) crystal malt (80 °L)
1 lb. (0.5 kg) chocolate malt
2.8 AAU Cascade hops (bittering) (0.5 oz./14 g of 5.75% Alpha acid)
6.25 AAU Willamette hops (flavoring) (1.25 oz./35 g of 5.0% alpha acid)
5.75 AAU Cascade hops (finishing) (1.0 oz./28 g of 5.75% alpha acid)
1 tsp. Irish moss
White Labs WLP002 (English Ale) yeast
0.75 cups of corn sugar (for priming)

Step by step

Steep the crushed grains in 3 gallons (11.4 L) of water at 152 °F (67 °C) for 30 mins. Remove grains from wort, add malt syrup and bring to a boil. Add Cascade (bittering) hops, Irish moss and boil for 60 mins. Add Willamette hops for last 15 mins. of the boil. Add Cascade hops for last 3 mins. of the boil.

When done boiling, add wort to 2 gallons (7.6 L) cool water in a sanitary fermenter, and top off with cool water to 5.5 gallons (21 L). Cool wort to 80 °F (27 °C), aerate beer and pitch yeast. Allow beer to cool over the next few hours to 68–70 °F (20–21 °C). Hold at these cooler temperatures until yeast has fermented completely. Bottle your beer, age for two to three weeks and enjoy!

All-grain option:

This is a single infusion mash. Replace the light syrup with 7.5 lbs. (3.4 kg) 2-row pale malt, mash your grains at 152 °F (67 °C) for 60 mins. Collect enough wort to boil for 90 mins. and have a 5.5-gallon (21-L) yield. Lower the amount of Cascade boiling hops to 0.33 oz. (9.2 g) to account for higher extraction ratio of a full boil. The remainder of the recipe is the same as the extract version.

homebrew calendar

September 20
Blue Ridge Brew Off
Asheville, North Carolina
The Mountain Ale and Lager Tasters will be hosting the Blue Ridge Brew Off, the largest homebrew competition in the midsouth. The BRBO is the qualifying event for the North Carolina Brewer of the Year and the Mid South Brewers of the Year awards. Recent years have included nearly 300 entries for beer and mead in 25 flights. For more information, contact judge coordinator Brian Cole at (828) 669-4356.

September 25-27
Great American Beer Festival
Denver, Colorado
The Association of Brewers' 22nd Annual Great American Beer Festival starts early on Thursday, September 25 with the first of three nightly general admission beer tastings. General admission to the Colorado Convention Center includes unlimited one-ounce tastings of over 1,500 beers from 300 of the United States top brewers. Beers will be entered in 58 categories of the competition, and the Saturday afternoon awards ceremony will honor gold, silver and bronze medallists in each. For more information check out the event's official Website at www.beertown.org/events/GABF.

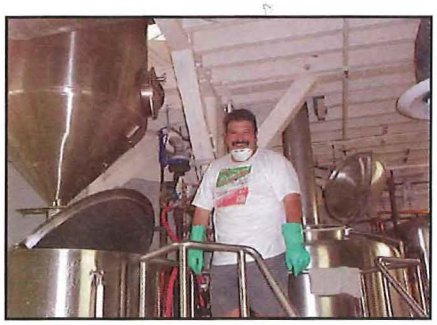
October 3-4
Northern California Homebrewers Festival VI
Dobbins, California
This year the Northern California Homebrewers Festival is being held at the Lake Francis Resort in the Sierra Foothills. The one and a half day event begins as always with a six-course Friday night dinner, which wouldn't be complete without some of Northern California's best homebrews. On Saturday, the festival begins with live music, raffles, speakers and of course, the club-only homebrew competition. For information visit www.mksgrist.tripod.com/nchfweb.

All-American Hops

Uncle Sam wants you (to brew with his hops)

by Thomas J. Miller

American hops are unique. Consider, for example, the aromatic, floral and citrus qualities of Cascade and Centennial. Other American hops are hybrids of their European cousins and are able to convey similar characteristics to your beer. Why use American hops? The reasons are many, but here's the simplest — to make some great beer. Try making sample batches where the only thing you change is the hops. Run a series of blind tastings and see which hops please your palate.



Brewer: Tom Munoz began studying at U.C. Davis in 1991. He has since put together over 12 years of professional brewing experience and opened four breweries of his own. Munoz is now the head brewer at Far West Ireland Brewery in Redmond, Washington.

What makes American hops different from, say, European hops is the fact that they have been genetically isolated over the centuries. Sure, natural crossover with transplanted European hops is inevitable and there has certainly been spontaneous crossbreeding in the wild. But America, nonetheless, produces hops that other parts of the world do not.

Some American hop examples include Chinook, Cluster, Galena, Horizon and Nugget. These are all high alpha hops. Columbus, Millennium, Warrior and Zeus are considered super high alpha hops. Cascade, Fuggle, Liberty, Mount Hood, Perle, Santiam, Sterling, Vanguard and Willamette, like German and Czech hops, have specific characters that result in great, indigenous beers.

American hops have contributed to definitive qualities in the craft beer movement. One big difference is that American hops are spicier than other hop varieties and this is one reason I like using them.

Cascade is the classic American hop. It's a good hop that is versatile. It has the perfect level of essential oils, allowing it to lend excellent flavor and aroma to almost any beer style.

A malt combination that works well with Cascade is this: Munich, a bit of caramel, and some Biscuit malt. It creates something like a Bass or a Whitbread in terms of flavor.

Willamette is another well-known American hop. I consider it a seedless Fuggle, though Willamette is more flavorful and spicy. It is definitely a finishing hop. In fact, USA Hops describe it as a "quality aroma hop" with a mild, pleasant and slightly spicy aroma.

There are all kinds of exciting, lesser-known American hops on the brewing scene. One of them is Crystal, a wonderful hop that usually has about 2.5–4.5% alpha acids. It is grown as an American substitute to Hallertauer Mittelfrueh and has a mild and pleasant aroma. It is also substituted for Mt. Hood and Liberty hops.

Mt. Hood falls into the 5–8% alpha acid range with an aroma often described as pleasant, clean, and light. Liberty is a 3–5% alpha acid hop and is also considered a mild and pleasant aroma hop.

Crystal was primarily developed and grown in Oregon. It was released about seven years ago. John Maier at Rogue was one of the first to really use it. He made the "Brutal Bitter," which featured 100% Crystal hops. I would describe the flavor as nice, mild and noble. It can be used for lagers, but we use it mostly when brewing ales.

RECIPE

English Strong Bitter (with Crystal hops)

(5 gallons/19 L, all-grain)

OG = 1.066 FG = 1.017

IBU = 29 SRM = 26 ABV = 6.4%

This English Strong Bitter showcases the use of Crystal hops in a delicious, classic brew. It also blends in Munich and chocolate malts for a complex flavor you are sure to enjoy.

Ingredients

10.5 lbs. (4.8 kg) Briess pale ale malt
2 lbs. (0.9 kg) Munich malt (10 °L)
1 lb. (0.5 kg) crystal malt (60 °L)
4 oz. (0.1 kg) chocolate malt
8.3 AAU Crystal hops (first wort) (2.5 oz./71 g of 3.3% alpha acids)
2 oz (56 g) Crystal hops (aroma)
1 tsp. gypsum
Wyeast 1056 (American Ale) or White Labs WLP001 (California Ale) yeast

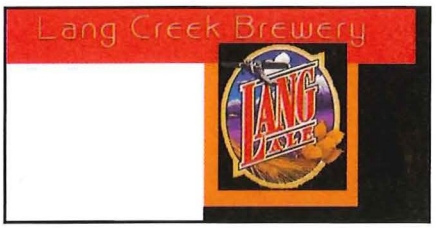
Step by step

Mash into conversion temperature at 156 °F (69 °C). Hold for one hour and sparge at 172 °F (77 °C). Add the first 2.5 ounces (71 g) of hops as you begin transferring wort into the kettle.

Boil the wort for at least 60 minutes, adding the second 2 ounces (56 g) of hops in the last 5 minutes or less. Add a teaspoon of gypsum at the end of the boil.

Cool the wort to 68 °F (20 °C), then transfer it to a fermenter. Aerate and pitch the yeast. Hold at this temperature throughout fermentation.

Dry hopping is always an option, but use Crystal hops if you choose to do so.



Brewer: John Campbell opened Lang Creek Brewery in Marion, Montana in 1993. He is the owner, salesman, beer deliverer, and brewer (sometimes). Lang Creek produces 2,000 barrels annually and proudly sports the slogan of "America's Most Remote Brewery."

There are no secrets in brewing. If you taste a beer you like and want to reproduce it, you'll be successful with a little bit of trial and error. Hops are one of the ingredients that you'll experiment with the most.

Centennial is my favorite American hop, though Cascade comes in a close second. I use Centennial for bittering and dry hopping. I find it gives sort of a grapefruit taste and, even when you use it only for bittering, some of this quality finds its way to the finished beer. Centennial is best when used as a bittering hop.

Our IPA and pale ale reflect how strongly we feel about this – our hop schedule with both is Centennial for bittering, Mt. Hood for flavor and Cascade for aroma. Centennial is a 9.5–11.5% alpha acid hop, and is usually described as having medium flower and citrus notes. It's mostly used as an aromatic but its high alpha content makes it suitable for bittering.

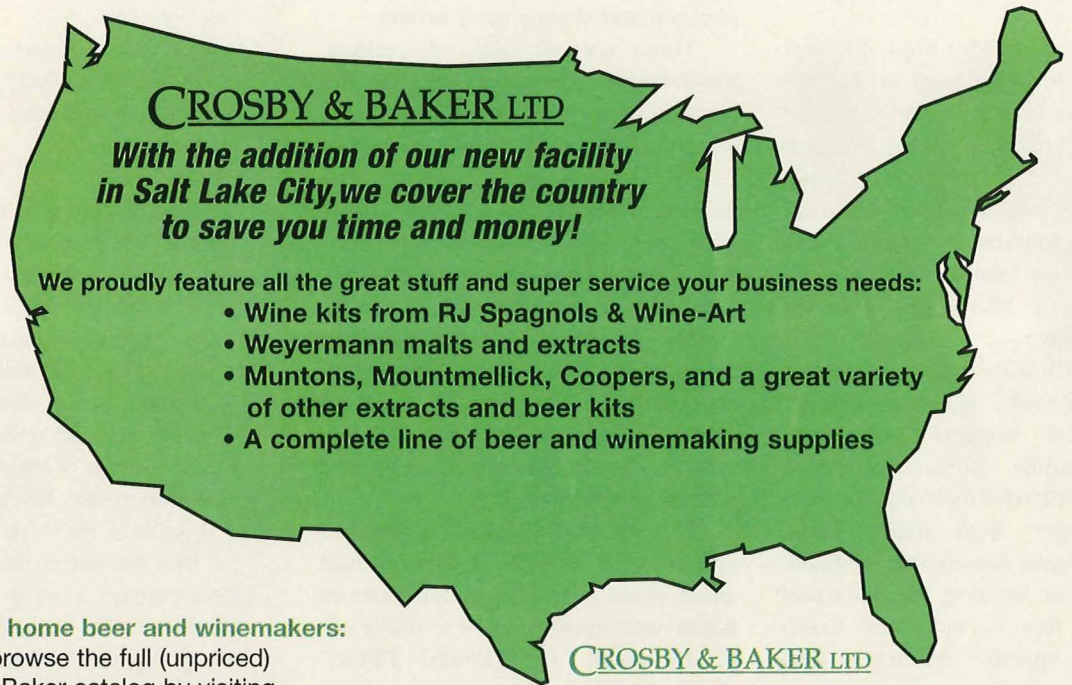
Our signature beer is the Trimotor Amber, an English amber ale. We went through a number of different hops in the process of deciding which we liked best — it was, after all, our first production beer and we wanted to make sure we did it right. We finally got the nose we were looking for with Willamette. This is typically an aroma hop and it suited our needs perfectly.

Eventually, however, we found that the hop character was slightly more pronounced with English Fuggles. The Fuggle aroma is usually described as spicy, soft and woody.

In sample brews, but never in production, we have tried Columbus hops when Centennial wasn't available. This is a bittering hop of recent origin and is classified as a super alpha hop. With alpha acids between 14–18%, it is gaining acceptance as a world-class bittering hop. The sample brews we made with Columbus turned out to our satisfaction — we only noticed a minimal difference from Centennial in the bitterness levels.

When we were trying to create a blonde ale, we tried lots of samples and eventually selected Liberty hops. This isn't a very bold hop. It's from the German Hallertauer variety with alpha acids between 3.5–6.5%. The aroma character of it is, in fact, very similar to the Hallertauer Mittelfrueh. We use it as a mid-addition hop. ■

Retailers; Wherever you are, we're probably closer!



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Hardest Homebrew?

Forced fermentations and delayed carbonations

"Help Me, Mr. Wizard"

Please solve an argument between my homebrew buddies and myself. What, in your opinion, is the hardest kind of beer to brew at home and what's the easiest?

Erik Beal
Edina, Minnesota

I can't believe a couple of homebrew buddies would argue over such a thing. I suppose these discussions are just part of this great hobby! I view beer in a similar light as music.

Music combines different individual sounds into a total sensory experience. In music, the extremes of this total sound combination seem the most challenging to produce. On one end of the spectrum, compositions that sound excessively simple (don't you love oxymora?) are often difficult to play. The jazz standard "Four" by Eddie Vinson (often credited to Miles Davis) is an example of a really simple composition that requires an excellent group of musicians to play successfully.

The other musical extreme is huge orchestral compositions where disaster occurs if every note is not played at the right time and tune. Johann S. Bach composed pieces with amazing complexity that challenge both musicians and the instruments they play. Bach's intricate compositions were commonly used in his day to tune organs.

In the middle are tunes like Sir Mack Rice's "Mustang Sally." This catchy little ditty is one that almost every local blues band can crank out with confidence and few mistakes.

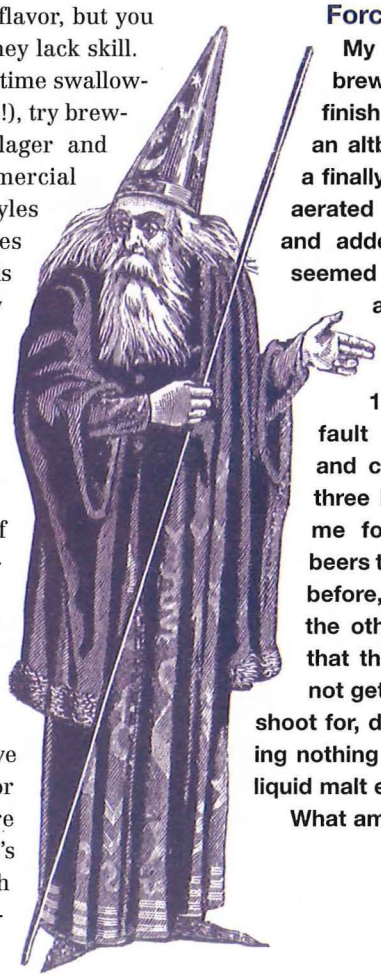
The Mustang Sallies of homebrew are beer styles like pale ale, American-style wheat, hefeweizen, stout, porter and brown ale. If you have good ingredients, an appropriate yeast strain and know the basics of brewing, you can brew these styles at home with ease and consistency. These are the types of beers that are great to offer friends and watch the expressions on their faces. It's like they are saying, "Wow! You brewed this at home?"

Notice that none of these beers are lagers. Since lagers are fermented and aged at temperatures that are much cooler than the average home, they require special equipment that put them into a more advanced homebrew category. The other commonality among these beers is that they have enough flavor intensity to cover up minor faults.

Styles that have light, subtle or refined flavor complexity are much more difficult to brew than big beers with over-the-top flavor. This is a point of debate among many brewers because it suggests that the big commercial brewers are actually producing a difficult beer style. You can beat up the "budmillcoors" of the world for brewing beer with little flavor, but you really can't argue that they lack skill. If you are having a hard time swallowing this (no pun intended!), try brewing an American-style lager and compare it to a commercial example. European styles like Pilsner and helles lager also fall into this category because they have few ingredients and a simple, yet elegant flavor profile. Faults in these beers stand out like a coffee stain on a white shirt.

The symphonies of beer include heavy hitters like barley wine, doppelbock, all sorts of Belgian ales and styles that are intentionally soured by bacteria. Although these beers have a lot going on in the flavor department, they require balance to taste good. It's tempting to go nuts with these beers and to over-emphasize one component of the beer. For example, over-hopped barley wines, cloying doppelbocks, over-spiced Belgian ales and soured beers that taste like some microbiology experiment gone awry seem more common than exquisitely balanced versions of these same styles.

I am sure that I have not solved your argument, but I have presented my opinion to this "no-right-answer" style question. I can honestly say that my best beers usually fall into the Mustang Sally category, although I have brewed really tasty lighter beers and some equally delicious big beers. I tend to be my own worst critic and find more faults with beers that venture towards the lower and upper extremes of flavor . . . happy debating!

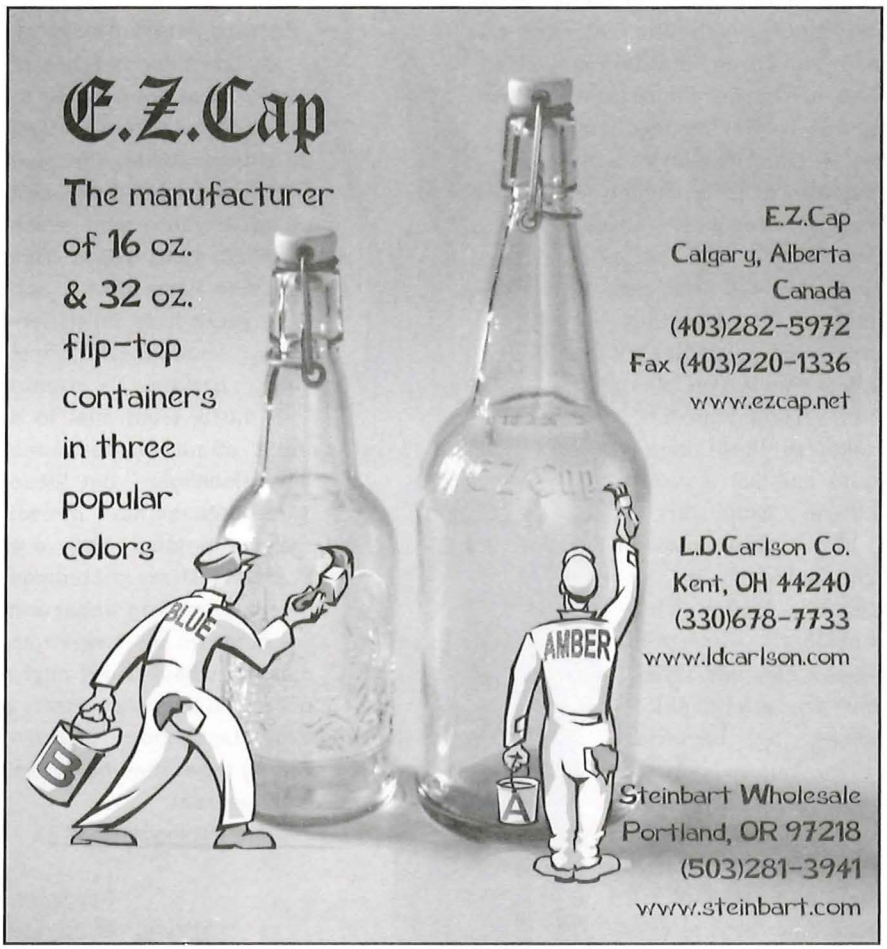


Forced Fermentations

My last three batches of brew have not seemed to finish fermenting. I brewed an altbier recently that had a finally gravity of 1.028, so I aerated it with a wire whisk and added more yeast. This seemed to jump start it and allow it to finish fermenting with a final gravity around 1.015. I am anal to a fault about temperatures and cleanliness, but these three batches have thrown me for a loop. They are beers that I have not brewed before, two being wheat and the other an alt. I was told that the wheat beers might not get to the finish gravity I shoot for, due to the recipe having nothing other than hops and liquid malt extract.

What am I doing wrong?

Jim Storm
Springfield, Illinois



"Help Me, Mr. Wizard"

The finishing gravity of a beer is an important number to hit. Bottle a beer with residual fermentables and you are likely to end up with overcarbonated beer and perhaps even bottle grenades. Beers that do not completely ferment are also likely to taste worty and oversweet. This can make an undesirably cloying glass of beer. Perhaps the most important piece of information related to this question is knowing where a beer should stop fermenting.

The term "wort fermentability" refers to the percentage of fermentable sugars in wort. A solution of table sugar, unlike wort, contains no unfermentable sugar and is 100 percent fermentable. Wort fermentability typically ranges between 65–85 percent. Fermentability depends on three variables of the mash: grain types, mash temperature and mash time.

There is a rather broad range when you look at the finish gravity of beers at the lower and upper ends. For example, a 12 °Plato wort (1.048) that is 65 percent fermentable finishes at 4.2 °Plato (1.017) compared to 1.8 °Plato (1.007) when the fermentability increases to 85 percent. (By the way, I am referring to "apparent fermentability" that is gauged using a hydrometer.)

When extracts are used for brewing, you really don't know how they were made and cannot predict the fermentability of the wort. One way to control this is to experiment with different brands of extract.

Brewers that mash can look at a few key variables to get an idea how their wort should ferment. Worts with a lot of unfermentable sugars typically contain a high percentage of special malts (like crystal malts) and are made using a single temperature mash between 155–158 °F (68–70 °C). Highly fermentable worts usually contain little or no special malts and are made using multi-temperature mashes with extended steps in the temperature range from 140–150°F (60–65 °C). This is how dry beers (remember Bud Dry and Asahi Super Dry?) and some light beers are made.

One easy method of assessing the fermentability of a wort sample is running a forced fermentation. To do this,

take a sample of wort from a batch, pitch a healthy dose of yeast (at double the normal rate) and proceed with a quick, warm fermentation. Most brewers who rely on this method put a magnetic stir bar in a flask and use a stir plate to continuously stir the fermentation. This helps to speed things up. At home you can just swirl the fermenter periodically. When signs of fermentation end, measure the finish gravity and you have an indicator of where your actual fermentation should end.

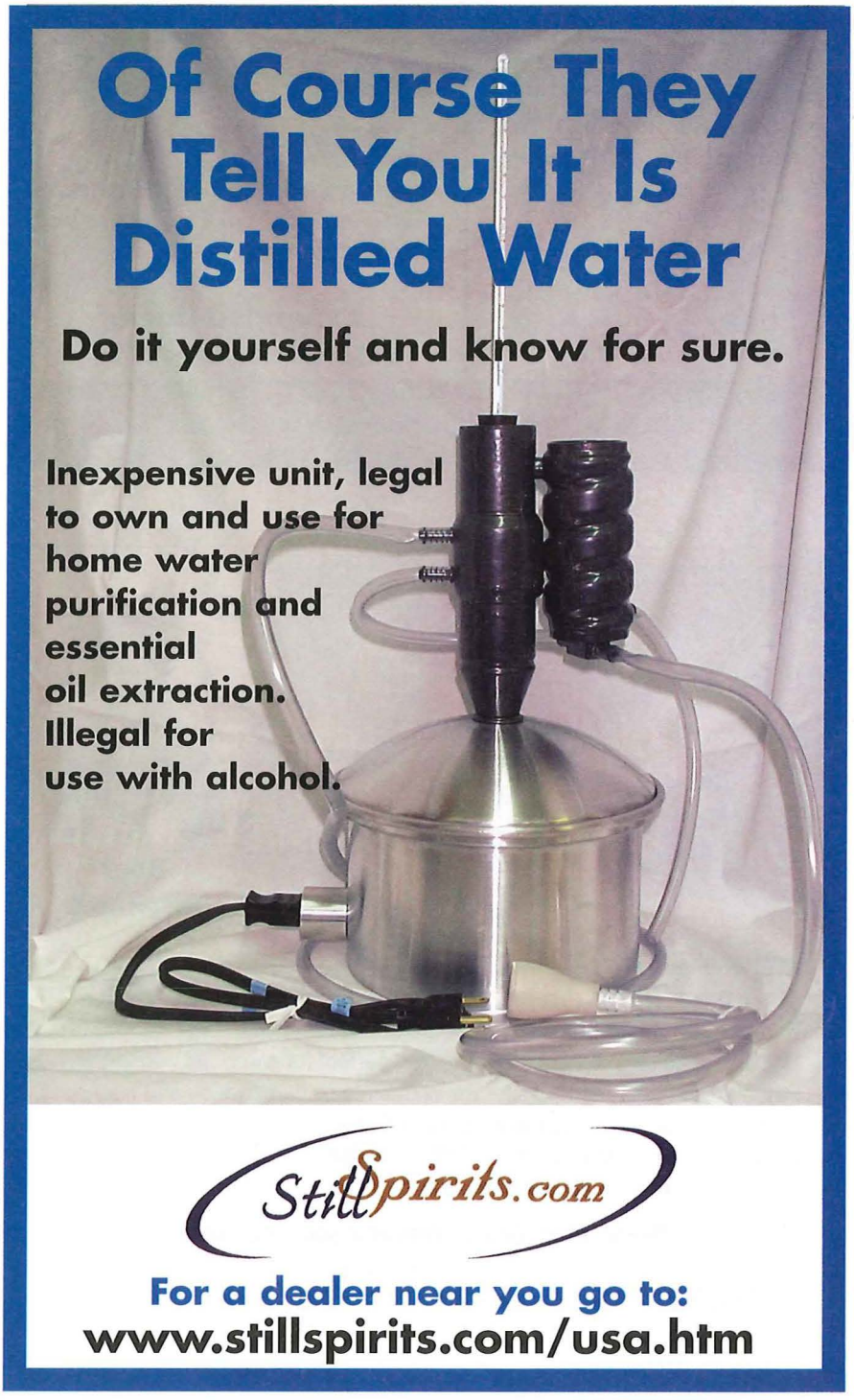
Let's assume that you run a forced fermentation test and determine that the wort has a low fermentability. Extract brewers don't have much of a choice to address this problem other than choosing a different extract. The companies who make extracts make wort the same as all-grain brewers, so the factors affecting fermentability hold true for both. I suggest talking to your local homebrew store about their selection of extracts with respect to fermentability before purchasing.

The other possibility is that you run a forced fermentation and the test indicates a high fermentability, but the actual fermentation fails to finish properly. This test result would indicate a problem with the fermentation itself. If I had to place a wager on the root cause of your problem, I would put my money in this category. Factors such as wort aeration, yeast pitching rate, yeast health (viability and vitality) and yeast strain (flocculation and attenuation traits) dramatically affect the properties of fermentation. The one batch of alt you were able to jump start by adding more yeast and rousing with a whisk obviously had problems associated with the fermentation and not the wort (although 1.015 is a pretty high finish gravity for that style).

In my experience, a normal ale fermentation should ferment to completion in 3-5 days. Sometimes fermentations that seem slow and lack vigor do not make it to the finish. The key factors here are having enough healthy yeast to handle the task and properly aerating your wort. Meeting these needs should set the stage for a strong fermentation. Don Million has a great article in this month's issue on yeast and you can get information to the yeast side of your question by reading his article!

Bubbleless brewha

I brewed my first five-gallon batch last month. Prior to this I had been using two or three-gallon kits. I followed the instructions in the kit, brewed it and cooled the wort in the sink. When it reached 80 °F (27 °C), I moved it to the fermenter along with enough cold water to equal five gallons. I put the fermenter in the spare bathroom closet at 68–71 °F (20–22 °C) in the dark and fermented it for a week. Then I transferred the beer into another bucket and let it sit for another week at the same temperature and in the dark. Lastly, I took two cups of beer and boiled it with the corn sugar for five minutes and put it into the



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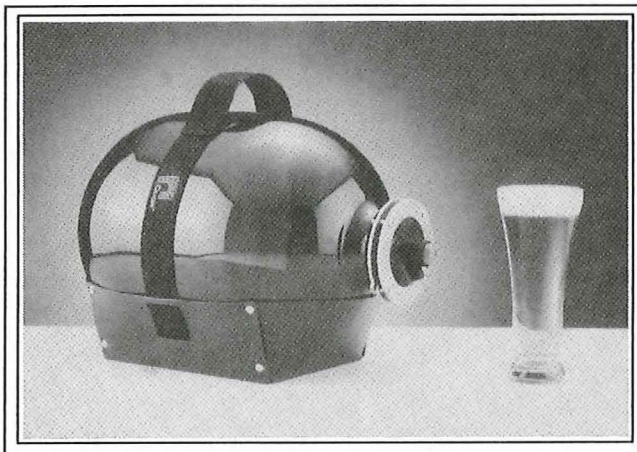

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"Help Me, Mr. Wizard"

bottling bucket. I siphoned the rest of the beer into the bottling bucket and bottled it. I bottled two Tap-a-Draft kegs (6 liters each), six 16-ounce bottles, and two one-quart bottles. The bottom inch or so I just dumped out. I let them all sit in the same closet for another week. When I opened one of the quarts it was flat. I put one keg in the fridge and it's flat too but the CO_2 cartridges are force carbonating it. The sixteen ounce bottles were flat as well. The beer tastes great except it's flat. Is there anything I can do to correct this batch or is it a lost cause?

Chris Moore
St. Augustine, Florida

At this stage of the game you really have only one option and that is to wait and see if the beer will carbonate with more time. One week is often too short for beer to carbonate in the bottle. If a batch has a relatively high concentration of healthy yeast and the bottles are conditioned at room temperature, it is common to have fully carbonated beer in a week's time.

However, if the yeast count is low or in poor condition (like old yeast from a batch that has been aged for several weeks prior to bottling), carbonation may take much longer. If this batch remains flat, a quick fix that would make the beer drinkable would be to blend it with a carbonated beer. If this is a flat pale ale, blend it with a carbonated porter in your favorite mug and have a half-n-half. The blend will have a lower carbonation level but it won't taste quite so flat.

This batch may be a lost cause with respect to its drinking qualities, but it does present a good lesson on bottle conditioning. The only thing I know from reading your question is that you packaged this beer in a variety of containers and they all had the same problem. For brewers who put the entire batch in a keg and wind up with flat beer, I would suggest checking the keg for gasket leaks — after all, if the keg doesn't hold pressure the beer won't carbonate! You (Chris) didn't have this problem.

The other thing I always question when dealing with weights and

volumes is accuracy. You topped your batch up to five gallons — are you sure it was five gallons? My self-imposed rule on measuring is to err on the skeptical side. I like to see calibration tape on the outside of containers (typically in one-liter increments) so I have a good idea of my volumes. Recipes always give priming sugar suggestions based on a five-gallon batch, but a five gallon batch rarely contains five gallons of beer when it comes time to bottle. When you measured your priming sugar are you sure you measured out the right amount? I don't like relying on sugar volumes for priming (⅔ cups, for example) because powders do not pack or settle consistently. That's the main reason why bakers measure flour volume after sifting. I prefer working with weight measurements.

Finally, think about the yeast. These little critters are responsible for pumping out the carbon dioxide needed for carbonation and can only do that if they are active. For many years, I thought that there should always be enough yeast remaining at bottling time to condition the beer. As I have gotten older and perhaps a little wiser (does that make me an Altweiser?) I have come to the conclusion that this is not always a safe assumption. If you have healthy yeast, it really does not take much for conditioning.

Sierra Nevada shoots for around 250,000 cells per milliliter in its bottle-conditioned brews, which are filtered prior to adding priming sugar and yeast. That's ¼₈ of the pitching rate used during fermentation of the wort. When I bottle condition, I add some fresh yeast from a batch that has just finished fermentation for extra security. The amount needed is so minute that you don't have to worry about your yeast cake on the bottom of the bottle getting heavier. This practice also helps ward off the problems caused by dead yeast.

Finally, when you do bottle, it is best to leave most of the yeast in the fermenter. You may be tempted to bottle your beer with a high yeast load, which may guarantee complete carbonation. But beware: this is a recipe for yeast death and autolysis.

Many of those expensive beers from Belgium that don't always fly off the shelves are good examples of what can happen to a good beer that has seen better days. Time and temperature have their ways of changing things. Bottles of beer with a high yeast load may not oxidize like filtered beers, but they do lose their freshness over time and develop other not-so-nice flavors. Good luck in your future brews! ■

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

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Dunkelweizen

A complex symphony of rich flavors

by Horst D. Dornbusch

RECIPES

Dunkelweizen Symphony

(5 gallons/19 L, all-grain)

OG = 1.054 FG = 1.013
IBU = 18 SRM = 16–17 ABV = 5.2%

Ingredients

7.2 lbs. (3.3 kg) pale wheat malt
2.7 lbs. (1.2 kg) Pils malt
0.5 lbs. (0.23 kg) Vienna malt
0.5 lbs. (0.23 kg) Munich malt
0.3 lbs. (0.14 kg) caramel wheat malt
0.1 lbs. (0.05 kg) dehusked chocolate malt
0.25 oz.(7 g) SINIMAR color extract
5 AAU Hallertauer Mittelfrüh hops (bittering)
(1.25 oz./36 g of 4% alpha acid)
1 oz. (28 g) Hallertauer Mittelfrüh
1 tsp. Irish moss
Wyeast 3068 (Weihenstephan Weizen) or White Labs WLP380 (Hefeweizen IV) yeast
1 quart (1 L) sterile wort (for priming)

Step by step

In your kettle, dough in to around 96 °F (36 °C) with 2.7 gallons (10 L) of water. Raise the temperature, over two hours, to 170 °F (77 °C) by both infusing the mash with near-boiling water and applying direct heat.

Once at mash-out temperature, transfer the mash to your lauter tun. Recirculate until the run-off is clear, then start lautering. Sparge with hot water until you reach a kettle gravity of about 1.046 for a 2-hour boil, keeping the sparge water hot enough to maintain grain bed temperature. Add bittering hops half way through the boil. Add flavor hops half an hour before shut-down. Siphon off 1 quart (~1 L) of wort for priming at bottling time. Add 1 tsp. Irish moss and 0.25 oz. (7 g) of SINAMAR color malt extract to the kettle. Whirlpool the wort for about an hour. Siphon the clarified wort off the debris into a sanitized bucket and chill

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As beer lovers, most of us probably drink several thousand beers as we pass through life and we try to make all of them count. Every now and again we hit upon a beer moment that is truly memorable — an instant in time when we have a rarified beer experience that stays with us forever. For me, one such moment occurred about two decades ago on a sunny Sunday afternoon in August. It happened in the town of Erlangen, not far from Nürnberg, in northern Bavaria. I met up with a business friend who had chosen the spot, a beer garden smack in the center of town. He was a local and knew all the right places. So when it came to ordering, I let him pick the beer.

Dunkelweizen by the numbers

OG	1.054 (13.5°P)
FG	1.012 (3°P)
SRM	approx. 16-17
IBU	20
ABV	5.4%

What arrived at the table were two half-liter mugs of an opaque, darkish brew with a head so creamy that you would think it belonged to a nitrogenated stout. I was a bit skeptical, because I was really more in the mood for a nice, cool Bavarian helles than for the deep tawny and seemingly heavy beer that stood before me. Then it happened. I had my seminal moment, a beer taste that I will never forget. This was the first time in my life that I consciously experienced the refreshing, complex and satisfying taste of a dunkelweizen.

As the first sip percolated unhurriedly past my welcoming taste buds, my friend said, "Ah, Herr Dornbusch, such a beer is one of the beautiful things in life." And he was right.

Here was a brew that was surprisingly light and mild tasting despite its dark color. It was smooth and thirst quenching with a perfect balance of sour, fruity tartness and residual sweetness (of a chocolaty, raisiny, caramel nature). All of this is supported by a mildly clovey, spicy undertone with a faint wisp of noble hops in the background. Surprisingly, none of these flavors was dominant. The brew was the culinary equivalent of a rich symphony. Its taste was as complex as the sound of a hundred instruments playing in perfect harmony. As if in a trance, I even forgot to ask him which brand I was drinking.

Dunkelweizen is the dark version of the regular weizenbier or weissbier, — the creamy Bavarian wheat beer with pronounced clove, vanilla, banana, apple, bubble-gum and nutmeg flavors. In German, "dunkel" means dark (as opposed to "weiss," which means white) and weizen means wheat. Like a weissbier, dunkelweizen is made from a mixed mash of wheat and barley malts. Unlike a weissbier, it contains an array of lightly to thoroughly caramelized malts that translate into color and complexity.

A dunkelweizen, therefore, not only has the characteristic and differentiated flavors of a sophisticated wheat ale, but also the additional layers of flavor from the dark malts. This feat offers endless opportunity for variations on the same theme. If you have ever explored the dozens of commercial dunkelweizens on their home turf in Bavaria, or if you happen to live in an area where cosmopolitan beer assortments are available, you may have realized that each dunkelweizen brand — much like the different stout brands — seems to have its own, very individual, flavor orientation.

Like a yeast-turbid hefeweizen, a dunkelweizen is always unfiltered and bottle or keg-conditioned. This is great news for homebrewers, who usually condition their brews through priming rather than CO_2-pressurized bottling or kegging. For conditioning, Bavarian brewers innoculate all their finished wheat beer with fresh wort. This fresh

wort is called speise, the German word for meal . . . for the yeast, not the drinker, of course! At home, draw about a quart or liter of hot wort off the kettle at the end of the boil and store it in a tightly sealed (sterile) container in the refrigerator. Add this speise to your finished dunkelweizen at priming time.

The "Weizen" Part

At which point does a dark ale with wheat in the grain bill become a dunkelweizen? Perhaps the easiest demarcation line between comes from the German beer tax law. It defines a weizenbier as any brew made with at least 50 percent wheat. In practice, most Bavarian weizenbiers are mashed with between 60 and 70 percent wheat. Typical North American pub wheats with, say 30 to 40 percent wheat, therefore, do not qualify as weizenbiers. Because wheat has a relatively high glucan and protein content and very little husk material, at least compared to barley, brewers who push their wheat portion above 60% sometimes "fluff up" their mash with flavorless rice husks (up to one unit of husks for 10 units of grain, by weight) to reduce lautering times and keep extract efficiency values tolerable.

The "Dunkel" Part

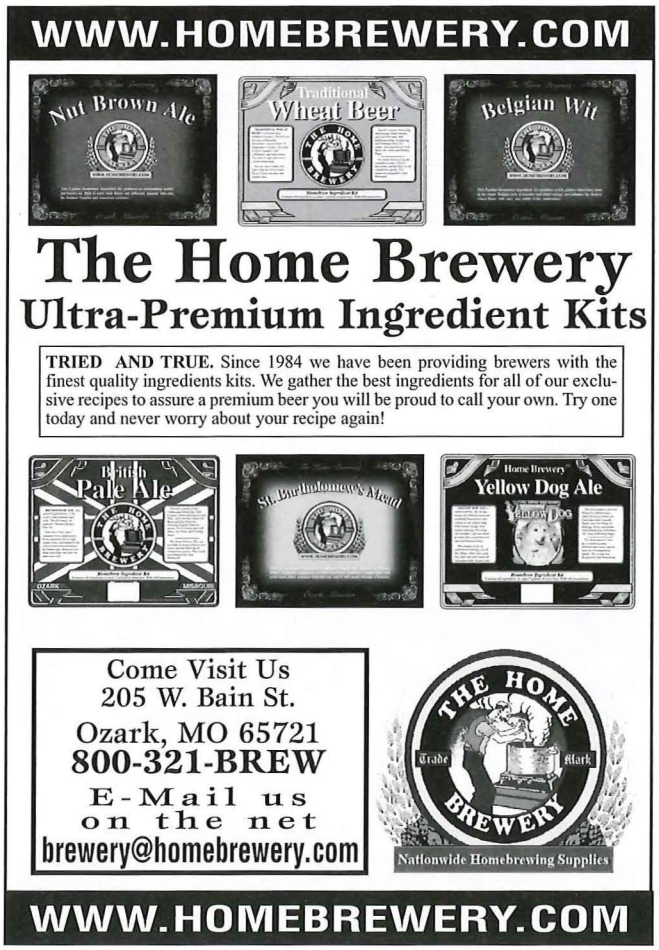
There are several ways to get the "dunkel" color into weizenbier. Most German dunkelweizen makers take color from three sources: the barley, the wheat, and a small amount of color malt extract. This allows the brewer to obtain the widest possible flavor palate from all the ingredients.

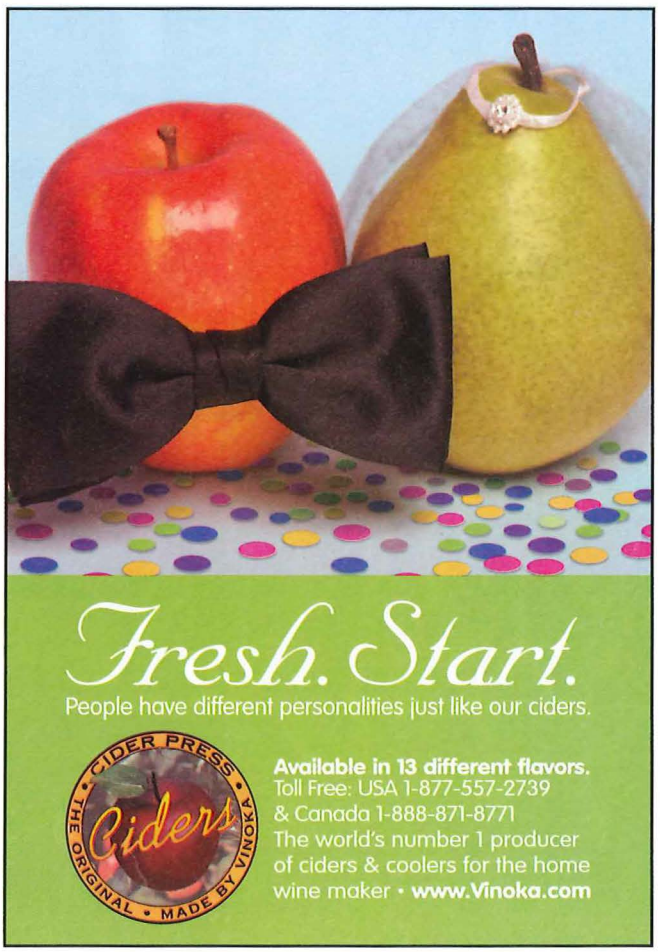
I actually use six different malts in the mash tun, plus some color malt extract in the kettle. These proportions work well: At least 60% pale wheat malt for the characteristic wheat flavor and texture, 20–25% plain Pils malt for enzymatic strength, approximately 5% Vienna malt for some mild sweetness, approximately 5% Munich malt for nutty sweetness and mouthfeel, 3–4% caramel wheat malt for color and chocolate wheat flavor, about 1% dehusked roasted barley malt for deep color and richness (without bitterness), and a small amount (perhaps a quarter ounce per five gallons) of SINAMAR malt extract for color correction.

Because dunkelweizen is a Bavarian style, made initially with only local Bavarian ingredients, our recipes rely strictly on Bavarian malt varieties from the Weyermann Malting Company. In my experience, the North American malts with the closest equivalence, come from the Briess Malting Company in Wisconsin. Here are the Weyermann malts that I used, with their Lovibond ranges in parentheses: pale wheat malt (1.7–2.4 °L), Pilsner malt (1.5–2.1 °L), Vienna malt (2.8–3.9 °L), Munich malt Type II (8.1–9.9 °L), Carawheat (42–53 °L), dehusked Carafa Special Type II (375–450 °L) and SINAMAR color malt extract (3,040–3,200 °L).

The "Beer" Part

Hops notes must be gentle in a dunkelweizen, because this brew is already rich in flavor from the different grains. For best results, use a low-alpha, noble hop (in the 4-percent





continued from page 20

more Dunkelweizen recipes

wort to 68 °F (20 °C). Pitch the yeast into a clean carboy, siphon the cooled wort over the yeast and aerate the beer.

Lower the temperature of the fermenter over 2–3 days to about 45 °F (7 °C). One week after pitching, rack the brew into a clean carboy and let the temperature rise to room temperature. Keep it there for another two or three days. Finally, pour the sterile wort (here called speise) into a carboy and rack the brew into it. To bottle-condition the dunkelweizen, package it immediately. To keg-condition it, simply seal the Cornelius keg. Keep the beer at room temperature for a week, then cold-condition for two weeks around 45 °F (7 °C). And no, do not serve this beer with a lemon slice!

Partial mash option:

Replace the wheat malt and Pilsner malt in the all-grain formulation with 6.5 lbs. (2.9 kg) Weyermann Bavarian Hefeweizen liquid malt extract.The rest of the ingredients remain the same.

Step by step

Place the milled grains into a muslin bag. Immerse the bag in roughly 0.5 gallons (2 L) of cold water and slowly heat to 170–190 °F (77–88 °C). This step should take about 30 minutes. Remove grain bag from brewing water and rinse grains with roughly 0.5 gallons (2 L) of water at 165 °F (74 °C). Heat the resulting "grain tea" to boiling, then stir in the malt extracts. Bring the wort to a boil and add the bittering hops immediately. Boil for 60 minutes. Half an hour into the boil, add the flavor hops. After another half hour, turn off the heat to the kettle and follow all subsequent instructions for the all-grain version.

Dunkelweizen Symphony

(5 gallons/19 L, extract only)

OG = 1.054 FG = 1.014

IBU = 17 SRM = 16–17 ABV = 5.2%

Ingredients

5.8 lbs. (2.6 kg) Weyermann Bavarian Hefeweizen liquid malt extract

1.5 lbs. (0.7 kg) Weyermann Munich Oktoberfest liquid malt extract

0.5 oz. (14 g) SINAMAR color extract

5 AAU Hallertauer Mittelfrüh hops (bittering)
(1.25 oz./35 g of 4% alpha acid)

1 oz. (28 g) Hallertauer Mittelfrüh hops (flavor/aroma)

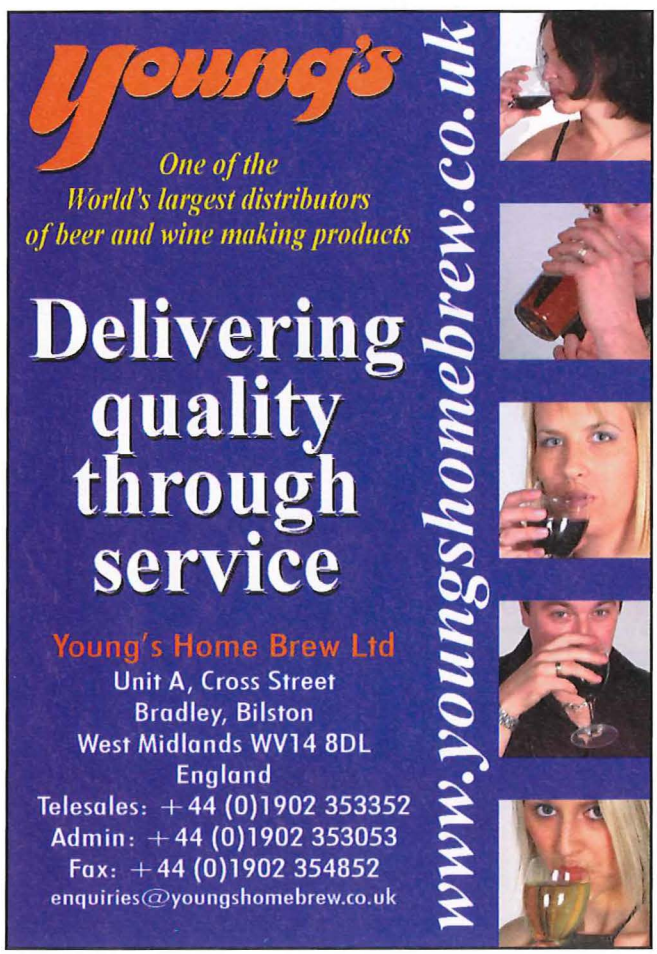
1 teaspoon Irish moss

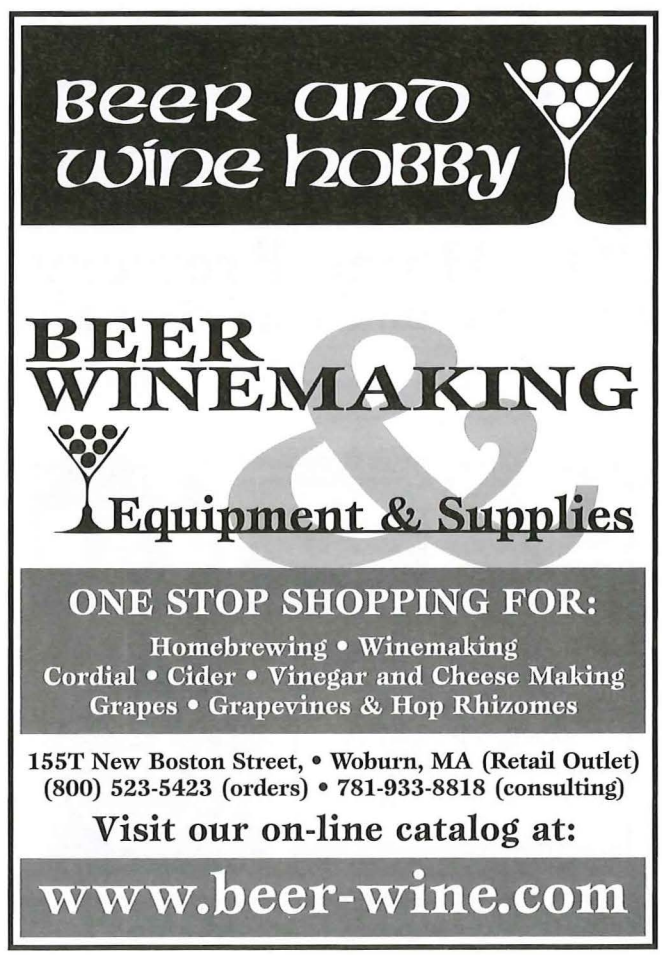
Wyeast 3068 (Weihenstephan Weizen) or White Labs WLP380 (Hefeweizen IV) yeast

1 quart (~1 L) sterile wort (for priming)

Step by step

Bring 4 gallons (15 L) of water to a boil. Remove from heat and stir in malt extracts. Bring the wort to a boil and add the bittering hops immediately. Boil wort for 60 minutes. Half an hour into the boil, add the flavor hops. After another half hour, turn off the heat to the kettle and follow all subsequent instructions for the all-grain version.





alpha acid range), such as a Hallertauer Mittelfrüh for both bittering and flavor. Two hop additions are plenty for a Dunkelweizen. Add the bittering hops about an hour into the two-hour boil and the flavor hops about 30 minutes before shutdown.

Select a yeast strain that is advertised as having low flocculation. These strains leave more yeast in suspension in the finished beer — hence they are more effective at bottle or keg-conditioning. Wyeast 2068 (Weihenstephan Weizen) and White Labs WLP380 (Hefeweizen IV) work well.

It's an Ale . . . by Law!

The reason weizenbiers, including dunkel versions, are considered members of the ale family is strictly historical — it has nothing to do with brew-technical specifications. Between 1553 and 1850, brewers in Bavaria were only allowed to make wheat beer during the warm season, defined by the law as the time between April 23 and September 29. During the chilly months, brewers were allowed to make both wheat and barley beers.

As a result of seasonal variations in temperature in fermentation cellars, (before refrigeration arrived in 1872) Bavarian summer beers always turned out to be ales, while winter beers turned out to be lagers. To this day, we associate Bavarian wheat beers with ale and Bavarian barley beers with lager. It is interesting and perhaps a little known fact that many commercial Weizenbier breweries reinnoculate their wheat beers at the kräusen and conditioning stage with . . . yes, lager yeast! They claim it gives their weizenbier a smoother taste and longer shelf life. Traditionalist breweries, however, eschew such tactics.

Our dunkelweizen specifications are calculated for a hypothetical brew system with a nominal extract efficiency rating of 65%. For such a system, the total amount of grain is about 11.4 pounds (5.2 kg) to reach our target OG of 1.054.

Horst Dornbusch is the Style Profile columnist for BYO and author of many books on German beers. ■

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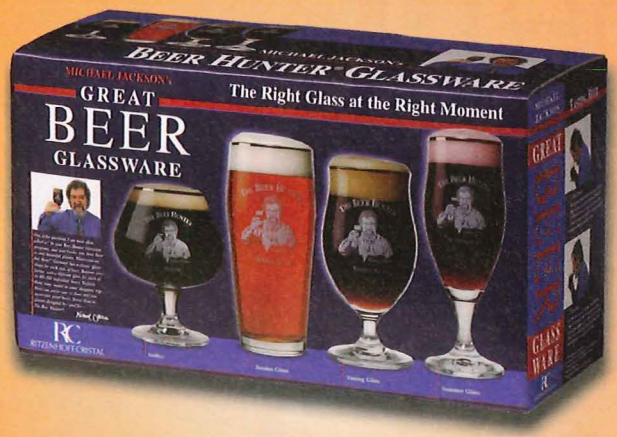

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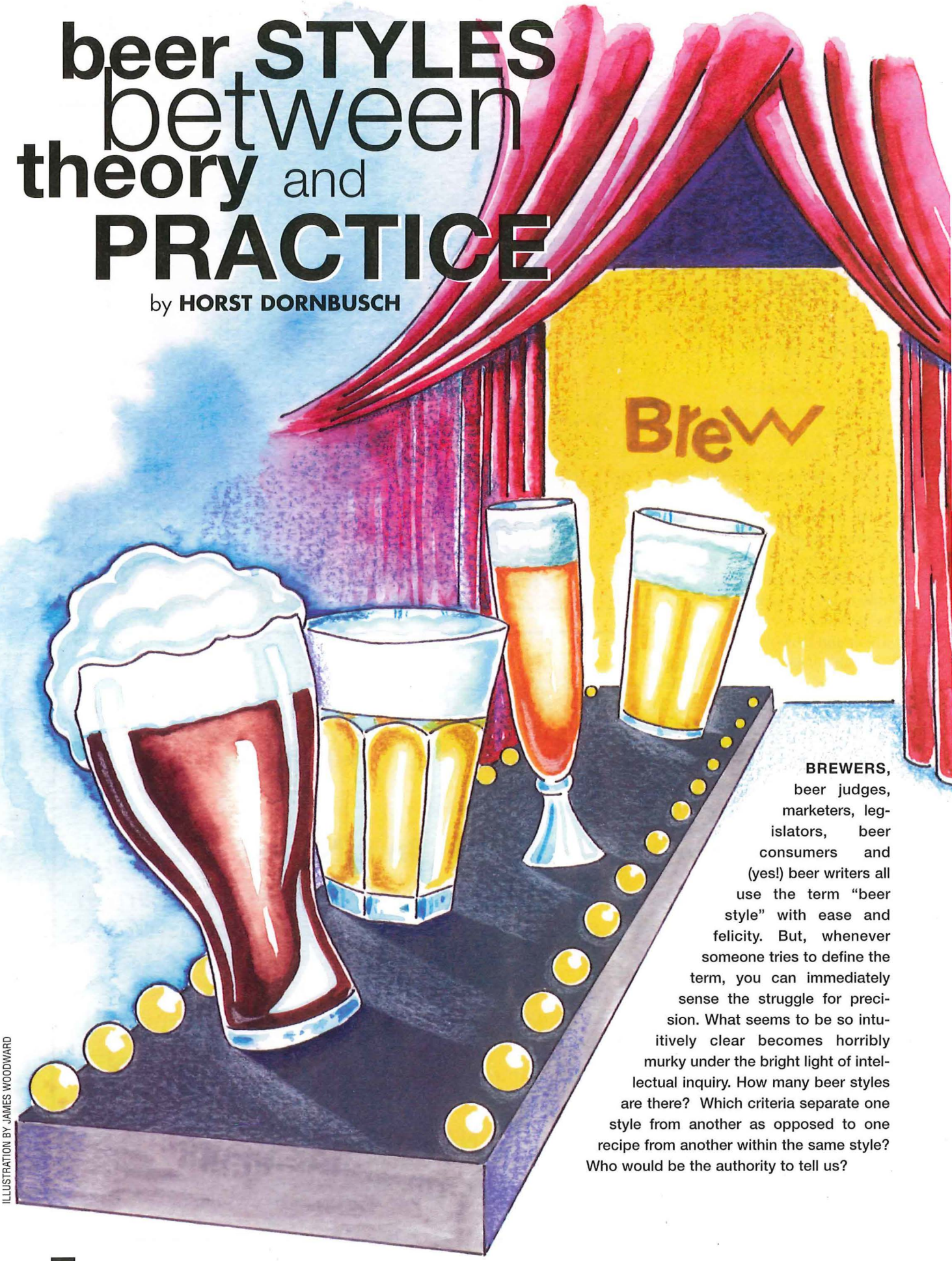

ILLUSTRATION BY JAMES WOODWARD

BREWERS, beer judges, marketers, legislators, beer consumers and (yes!) beer writers all use the term "beer style" with ease and felicity. But, whenever someone tries to define the term, you can immediately sense the struggle for precision. What seems to be so intuitively clear becomes horribly murky under the bright light of intellectual inquiry. How many beer styles are there? Which criteria separate one style from another as opposed to one recipe from another within the same style? Who would be the authority to tell us?

I once listened to a lecture by a Belgian brewer about Belgian beers, during which he confidently declared: "I love beer, I hate styles. In Belgium, we make 650 different beers, so we make 650 different styles." This view obviously represents an extreme approach, one which makes the concept of beer styles completely irrelevant. It seems to imply that, as soon as you vary one ingredient or procedure in your brewing, you can legitimately claim that you have created not just a different beer, but a different style.

In Germany, a country next door to Belgium, on the other hand, beer style designations are necessary and relevant. In fact, there they are part of a beer drinker's everyday vocabulary. In a German pub or restaurant, you would never ask for a beer by its brand name as is the custom in North America. Instead, you would order it by its style. You might order "ein Helles bitte" or "ein Pils bitte," but not "ein Warsteiner bitte." Likewise, in Britain, where many pubs are tied houses, you are more likely to ask for a pint of bitter than for a pint of Courage.

STYLES: Straightjacket or Framework?

Many art critics hold that it is style and form that impose the greatest challenge on the artist and separates the great ones from the average. They hold that the greatest works have been produced under the most stringent style guidelines: The sonnet forces the poet to pay attention to the measure. The fugue forces the composer to be extremely disciplined. Pointillism forces the painter to convert what he sees into meticulous and deliberate brush strokes. The opposites would be random words, random notes and random blotches of color.

In wine, the issue of style is fairly simple. The key determining factor of a wine's style is its grape. Combine the grape variety with the *terroir* (the locale) and you've got a clear designation — varied only by the vintner, harvesting and processing techniques and the year. This information is usually revealed on the label. In wine, therefore, any cognoscenti can understand style designations clearly and unequivocally. There is, for instance, a Bernkasteler Riesling (a Riesling wine from the Mosel village of Bernkastel), Spätlese (late harvest), Dr. Thanisch (the grower), of 1993. No further questions!

Not so in beer, where the raw material is usually barley or barley and wheat. Unlike the grape variety in wine, the composition of the grain bill in beer rarely comes up on the label. The *terroir* usually does not tell us much about the beer either. A brewpub can make a Munich-style or London-style brew without being located there. Unfortunately, even such simple distinctions as ale and lager (though clear to most beer aficionados) can be misnomers on a beer label. This is mostly because in several of the United States any beer (no matter if ale or lager) must be labeled as "ale," "bock," or "malt liquor" if its alcohol is above a certain legislated level. Finally, the differences between brands within a beer style, such as brown ale or porter, can be greater than the differences between such adjacent beer styles as an American-style lager and an American-style premium lager. Obviously, beer styles are slippery creatures, seemingly defying to be snared up and cubby-holed. Then, what ties a beer style together? What do we really mean by "beer style?"

BEER STYLES in Theory

A good starting point for any definition of beer styles is the Association of Brewers (AoB) Beer Style Guide. The AoB has been honing its guide since 1979, and it has grown to more than 100 beer styles in its latest revision. (It can be found on the web at www.beertown.org/education/pdf/beer_styles_2003.pdf.) In the introduction, it says: "The Association of Brewers' beer style guidelines reflect, as much as possible, historical significance, authenticity or a high profile in the current commercial beer market. The more a beer style has withstood the test of time, marketplace, and consumer acceptance, the more likely it is to be included in the Association of Brewers' style guidelines."

This approach seems admirable in theory, but often difficult to carry through in practice. Nobody would quibble with the notion that a beer style's inclusion in the list should be based in part on whether or not the style has "withstood the test of time." One might wonder, however, how a style that the AoB authors call a Chocolate/Cocoa Flavored Beer belongs on the same stage as porter or hefewiezens. If historicity is a factor, you might also wonder, why the juniper-berry flavored Finnish sahti, which is one of the oldest ale styles in the world, is not on that list.

If neither theory nor practice gives us clear guidance as to what a beer style is, where should we turn? My suggestion: Turn to history.

STYLE: It's More than Beer

Perhaps a consideration of the history of a style's processes, beyond the question of what it tastes like, is one useful way to clarify what a style is.

We should look at how styles started. How did generic beers evolve over time to become ever more differentiated? A study of history suggests that the key variables in the emergence of styles were (1) the extent to which brewers became more adept in understanding and controlling the ingredients and processes by which they made their brews, and (2) the extent to which the public embraced the brewers' new offerings as distinct gustatory experiences.

From antiquity to the Middle Ages, brewers used the ingredients that were available in their location. They used processes that experience taught them produced drinkable beverages more often than not. Styles in that sense were products of happenstance.

Usually the ancient brewers turned their grains into flat loaves of bread, which they then gently baked. The ancients then crumbled their beer-bread into crocks of water and let airborne yeasts ferment the broth. Brewers probably learned to skip the bread-baking step and instead to mash their grain some time in the early part of the first millennium.

It was around the beginning of the second millennium that generic beer came to be separated in terms of the grains from which they were brewed as well as in terms of their alcoholic strength. The first clearly documented distinction between different mash

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beer STYLES
WHAT GOOD ARE THEY?

When I was young, I had no idea that beer came in styles. There were different brands of beer, of course — my dad usually drank Olympia or Schlitz, my grandfather's fridge usually held Hamms or Grain Belt and the supermarket even had plain white cans of generic beer — but these were all just different interpretations of the same thing. Nowadays, almost everybody knows there are different varieties of beer. Few outside brewing circles, however, know that there are "official" beer styles.

Most people group beers into categories for their own personal utility. A high school buddy of mine divides beer into two categories. He calls American-style Pilsners "beers" while virtually all other brews — from Sam Adams to Guinness — are labeled "dark beers." His classification system exists because he doesn't like "dark beers." Other people group beers according to which are the cheapest, which get them drunkest the fastest or which won't scare girls away from their parties.

Most non-brewing beer drinkers can probably name several beer styles. Knowing descriptors like "pale ale," "porter" and "stout" helps them decide what to order at the brewpub or grab from the cooler in the beer aisle. However, the average beer drinkers style vocabulary probably includes designations — such as "Mexican beer" or "Asian rice beer" — that homebrewers don't view as legitimate beer styles.

While an average person's list of beer styles may not correspond much to a homebrewer's ideas, leave it to the government to really screw things up. Governments categorize beers, usually ranked by strength, in order to levy taxes on them. The reasonability of the beer laws seem to vary according to a region's beer culture. In Germany, the law stipulates that doppelbocks must be over 18 °Plato. Thus, if I travel to Munich and buy a Salvator Doppelbock, I know from the word "doppelbock" that I'm getting a strong lager. In Texas, words such as "ale" and "stout" are designations of alcoholic strength, not indicators of beer styles. Thus, when I buy Salvator Double Bock in Austin, I am assured by the labeling that it is an "ale." Yee ha!

As homebrewers, we have an "official" set of style guidelines, the Beer Judge Certification Program (BJCP) style guidelines. The BJCP style guidelines seek to define the characteristics of beer styles that are accepted in homebrew competitions. The guidelines describe 69 kinds of beer grouped into 24 categories, with 2 categories for mead and cider. Each beer is described in terms of aroma, appearance, flavor, mouthfeel and other characteristics. A set of statistics, including OG, FG, IBU, SRM and ABV is also given. You can find these guidelines at www.bjcp.org. The guidelines are an impressive compilation, but it's still fair to ask — do they do us homebrewers any good?

the GOOD

The BJCP guidelines were compiled for use in homebrewing contests. And in this capacity, they work well. The guidelines ensure that both the judge and brewer are on the same page when it comes to the attributes of a certain style. You can read the guidelines and see what is expected of, say, a Munich dunkel at competition. Likewise, at the contest, the beer judge will assess the beer against these guidelines rather than against his own definition of dunkel.

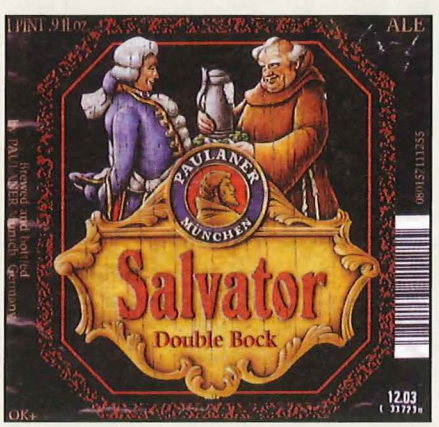
Homebrewers can, and do, quibble about the parameters of various styles and whether judges stick closely enough to them. But, most homebrewers recognize the need for style guidelines at homebrew contests.

The benefits of the guidelines extend beyond competitions, however. Most of the beer styles listed in the BJCP guidelines are historically successful combinations of ingredients and brewing techniques. German doppelbocks are listed because this style has been tried, refined and people enjoy it. The information in the guidelines can help you formulate recipes. If you just tasted your first doppelbock and wanted to know how to brew one, the style guidelines provide some information that would be useful in recipe formulation. You'd probably want to do some more research to catch all the nuances of a style, but the BJCP guidelines are a good starting point.

The BJCP beer style guidelines also encourage brewers to seek out and sample new beer styles. I'm sure I'm not the only one who has used the guidelines as a checklist in his beer-sampling endeavors. When a homebrewer learns of a new beer style, he (or she) may also become aware of new ingredients or brewing techniques. Becoming acquainted with smoked beers, lambics and eisbocks has surely helped many homebrewers comprehend how big the world of beer and brewing really is.

the BAD

The problem with the style guidelines come when people use them in a way they were never intended to be used. For example, some homebrewers seem convinced that beers enshrined in the BJCP guidelines are the only beers worth brewing. For some brewers, even the BJCP guidelines are not stringent enough. Some brewers feel adjuncts, which are allowed in many BJCP styles, should — in the moral sense — be avoided. Likewise, others feel homebrewers "should" abide by the



Reinheitsgebot. Now, some brewers may avoid adjuncts or only brew Reinheitsgebot-compliant beers because they only like all-malt beers. That's fine. The problem comes when they confuse "I prefer brewing" with "everyone should be limited to brewing." For the life of me, I don't understand this attitude. I guess some people need to seek forms of authority to knuckle under.

If our goal as homebrewers is to brew the best beer possible, there are several reasons why it makes perfect sense to ignore existing style guidelines. Many beer styles are clear compromises between flavor and economic necessity (from either ingredient cost or taxation). Tax laws in many countries are such that beers are brewed at lower gravities than consumers would otherwise gravitate to. Likewise, in countries where specific beer styles must meet some minimum criterion, those beers cluster right above that minimum.

In homebrewing, we have no tax considerations when choosing our grain bill and we can brew using an ingredient list that would bankrupt any commercial brewer. Many homebrewers use these freedoms to brew "Imperial" (high gravity) versions of traditional styles or to hop the bejesus out of their beer. As far as I'm concerned, good for them.

In addition, although beer is relatively simple — with most styles being made from only four ingredients — not every possible combination of malt, sweetness, melanoidins, roast, hop bitterness, hop flavor, hop aroma and yeast characteristics has been tried. Originally, many malt/hop combinations arose of necessity. English pale ales typically use English hops because the original pale ale brewers were located in England and English hops were the available ingredients. Today, almost any decent homebrew shop will have ingredients from the US, England, Germany and Belgium. There are almost certainly some awesome flavor combinations in this mix of ingredients that have yet to be discovered. Brewers have pioneered new beer styles for centuries — does anyone really think we're all through now?

Misapplication of style guidelines also has potentially negative consequences to our hobby. If we allow the beer style guidelines steer how we think about and discuss homebrews, we may inadvertently be driving new brewers from the hobby. Imagine meeting a young homebrewer who pours you a beer of his own making. It's reddish and clear with almost no head and he calls it a hefeweizen. What's your reaction going to be?

Most homebrewers, I'm sure, would taste his beer and attempt to give him some constructive criticism — praising anything that turns out to be praiseworthy, but including the fact that a hefe should be pale, cloudy and have a big head. However, I'm sure we all know homebrewers who would trip all over themselves to start explaining what's wrong with his beer before even taking a sip of it. One thing we could ask ourselves is — is either of these approaches the right thing to do? Just because guidelines exist for judging beer according to style, does that mean every beer must be judged in this manner? In the good old days, we were encouraged by Charlie Papazian to "Relax, don't worry, and enjoy a homebrew." These days, the message many new homebrewers get is, "Don't relax yet, your beer doesn't meet our stringent numerical guidelines."

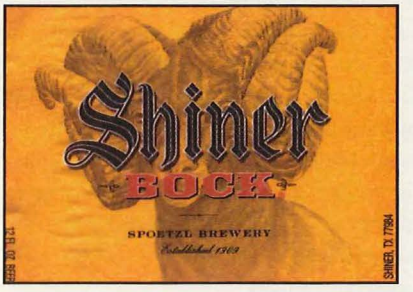
By focusing on the beer only as it relates to the hefeweizen style, we close our minds to the possibility that it might be great beer, either in a different style or as it's own unique style. Beer can be great, even if it mislabeled by homebrewing standards. When I moved to Texas, I became acquainted with Shiner Bock. I like it. Most homebrewers don't. When asked why, I have never heard any homebrewer remark on the flavor, aroma or even appearance of the beer. It's always the same thing — "It's not a real bock." When this happens, I usually ask what they'd think of it if it was labeled Shiner German-American Dunkel or something. The response is usually, "Oh yeah, then it would OK." My (usually unspoken) response to this is, "does a beer really change from bad to good just because the label has changed?" (And speaking of real German bocks, should I spit out my Texas-labeled Salvator in disgust because it's not a good example of an ale? Clearly not.) Shouldn't the first thing we worry about be the flavor of the beer and the last thing be the beer's label? I mean really, are you a homebrewer because you like the flavor of good beer or because of the interesting clerical diversions of pigeonholing beers in their official categories?

the UGLY

Finally, by letting the beer style guidelines steer how we think about homebrewing, we may lose the ability (or desire) to formulate a truly unique beer, a beer whose only merits are that it tastes great. Notice that there's no acceptable BJCP category for a completely unique beer. Even in the experimental category, you are required to specify the base beer style of your experimental beer! For my 100th batch of beer, I'm considering making a high-gravity ale with a considerable amount of adjunct to boost the alcohol content, but not the body. I want to add a small amount of very dark grain to get a nice brownish (not red) color and I want it to have a nice, noble hop finish. If this beer turns out well, there is no possible category I could enter it in because it's not within a beer style.

If I could make one suggestion to the BJCP committee, it would be to have an "open" category in the guidelines for beers like the one above — and for the zillions of beers made by homebrewers who focus on flavor, not styles. Would this category collect a hodgepodge of beers? Sure. Would the judging be influenced by the personal preferences of the judges? Sure, but the same thing applies at any best of show panel.

None of this should be taken as a slam on the BJCP. My only point is that any set of style guidelines should exist to serve our brewing, not the other way around. *— Chris Colby*



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beer types can be found in the eleventh-century annals of the monastery brewery of Saint Gall, in present-day Switzerland. The monks of Saint Gall produced a strong wheat and barley beer called celia, an herb-flavored oat beer called cervisa, an oat and honey beer called cervisa mellita, and a thin beer called conventus, which was made from the weak, final runnings of celia mixed with some regular cervisa.

We also know that the thirteenth century brewers of Bohemia made two distinct varieties of top-fermenting beers: barley beers and wheat beers, the latter being the forerunner of the modern Bavarian weissbiers.

Flemish immigrants probably brought hops as a beer flavoring to the British Isles in the early 1400s, after which time the term "ale" came to denote a brew made without hops while the term "beer" denoted a brew flavored with hops. But the acceptance of hops spread so rapidly that the term "ale" was soon used for all types of beers made in Britain.

Meanwhile, on the Continent, in the sixteenth century, the rulers of Bavaria proclaimed two beer-related laws that helped improve the quality of Bavarian beers. The first decree was the now-famous Beer Purity Law (Reinheitsgebot) of 1516, which stipulated that only barley, hops and water may be used in brewing. (The existence of yeast had not yet been discovered.) The second decree was the 1553 summer brewing prohibition, which forbade all brewing between April 23 and September 29.

From that point forward, beer could be brewed only during the cold winter months, when ale yeasts become dormant and lager yeasts are still active. All Bavarian beers henceforth would be lagers, as an uninteded side effect of the medieval regulators. Also, the early lagers would be barley, not wheat, beers. And because of the malting techniques in use at that time, these beers would be dark (dunkel), not pale. The style that emerged, therefore, as the standard daily beer of Bavaria was what we now call Bavarian dunkel.

Because of the summer brewing prohibition, Munich brewers dramatically increased production in late winter. In March (März in German), they brewed a beer with a higher alcohol level for improved keeping qualities. They would store the beer in caves filled with ice for the summer months when they were not allowed to brew. This practice in fact led to the emergence of another lager style — the strong March beer, or Märzen. When the well-aged Märzen became a staple at the annual Oktoberfest in the nineteenth century, the Bavarians renamed it Oktoberfestbier.

As time went on, more styles followed. In Munich, bockbier emerged in the early seventeenth century and its stronger relative, doppelbock, in the late eighteenth century, roughly at the same time as porter took off in London.

The early nineteenth century brought us the gift of pale malt and with it the emergence of the pale ale and IPA in England as well as the helles in Munich, the Vienna lager in Vienna, the Pilsner in Bohemia and the Kölsch in Cologne.

After the German engineer Carl von Linde had build the first refrigeration unit for the Spaten Brewery, in Munich, in 1873 — and after the Danish botanist Emil Christian Hansen had figured out, in 1881, how to breed pure strains of ale and lager yeasts — the brewer's ability to brew different types, or styles, of beer deliberately was assured.

Control of the brewing process was given a further boost by the British chemist Cornelius O'Sullivan, when he discovered the workings of mash enzymes in 1890. It was only in the nineteenth century, therefore, that the terms "ale" and "lager" came to be applied to top- and bottom-fermenting beers, respectively.

The Social Roots of Beer STYLES

To borrow a metaphor from physics, a beer style is a concept by which people bundle different beers into a single concept the same way people bundle different wavelengths of light into a single color. This makes a beer style, like a color, very much a social convention and less of a measurable entity.

Note that, in nature, there really is no such thing as "color." There is just a continuous spectrum of light from infrared to ultraviolet. Who is to say at which wavelength, exactly, one color ends and another begins? The color orange, for instance, is situated on the spectrum between yellow to its left and red to its right. But where exactly does yellow transition to orange and orange to red? There are no clear dividing lines that separate these three colors. Yet, we all seem to have a concept of the core characteristics of yellow, red, and orange. The division of the spectrum of light into colors, therefore, seems to be less a matter of precise science and mathematics than a matter of fuzzy convention and aesthetics.

And so it is with the division of the universe of beers into beer styles. In the world of beer, we do not know exactly when a pale ale, for instance, is dark enough to be called a brown ale. Nor can we define with any certainty when an altbier becomes so blond that it would better be called a Kölsch. But still, we have a clear notion of the distinction between all these beers.

History and brewing techniques help us sort out styles when our taste buds give out or are ambivalent. Our concepts of beer styles, like our concepts of color, have emerged historically and culturally, and they have proven useful, though imprecise. This means that style specifications and style descriptions must always be given in ranges, never in discrete terms or numbers. These ranges may overlap with those of adjacent styles. Consequently, there is never a need to be dogmatic about a style definition as there is plenty of room for arguments.

How Many STYLES?

Beer styles are meaningful to the extent that they allow us to group individual beers in terms of significant characteristics. Based on the historical evolution of beer making, there are certain characteristics that tie certain brands of beer together into styles. But the number of styles is probably

neither unbounded — as the Belgian brewer seemed to suggest — nor several hundred. I would argue that, historically and culturally, there are about two dozen major beer styles. In addition, there are perhaps another dozen or so lesser ones. And of course, there are countless truly obscure styles such as kvass.

Some people may take issue with this approach and would prefer to divide the spectrum of beer into ever finer shades of brew. I do not see the merit of such distinctions. In fact, I have a hard time distinguishing, both theoretically (in my head) and practically (in my mouth), among lagers designated, for instance, as American-Style Light, American-Style Premium, American-Style Pilsner, Dry Lager, or American Ice.

Likewise, I would have a hard time distinguishing between a bockbier at the high end of its alcohol range (about 6.5% ABV) and a doppelbock at the low end of its alcohol range (about 6.8% ABV). At the same time my taste buds tell me that, for instance, the Samuel Smith Taddy Porter is a very different beer from the Fuller's London Porter, even though both are members of the porter family.

Towards a New Flexibility

In defining styles, therefore, we must be able to point to the core characteristics that the different beers grouped in this style have in common. These variables may be a cluster of brew-technical, socio-historical and artistic-aesthetic characteristics.

The brew-technical definitions manifest themselves in such specifications as color ranges; bitterness ratings; original and final gravity ranges; attenuation values; mash temperature and pH values; boiling times for the wort; grain, hops and yeast selections; and fermentation times and temperatures.

But styles are more than just their set of technical specifications. Styles emerged at a particular point in time within a particular culture. Just ask yourselves whether a Belgian Trappist ale is really a Trappist ale if it were not brewed by monks. There is always that intangible element of style. Though in beer, unlike in wine, *terroir* does not matter, perhaps origin does. An Irish stout just tastes so much better in an Irish pub than it does in a generic diner with a liquor license. Or, if you ever get the chance, try a Berliner weisse with woodruff syrup sipped out of a wide bowl, outside, in a promenade café, on the Kurfürstendamm in Berlin.

So, now we have come full circle. A beer style is an intangible, sociological, cultural and historical thing — a concept that defies precise technical definition, yet it is useful and meaningful for brewing and enjoying beer. The lesson: When it comes to beer styles, do not split hairs and do not be dogmatic. ■

Horst Dornbusch is the Style Profile columnist for Brew Your Own.

PaleALE

by **Terry Foster**

LEGACY of an Empire, now the Monarch of ALES!

Yesterday, at Brü Rm at BAR — a brewpub in New Haven, Connecticut — I helped to brew a pale ale that an English barman probably wouldn't recognize. Why? Because it is just full of hop character! This comes from late hopping with the spicy, fragrant American hop Mount Hood followed by generous dry hopping in the fermenter with English Kent Goldings. This hop adds a delicate lemony, grassy character to the beer. Couple these late addition hops with American Centennial hops for bittering and you have a pale ale that is a symphony in hops. This makes for a interestingly complex beer that is also refreshing and very drinkable.

Earlier in the year, BAR's head brewer (Jeff Browning), a couple of friends and I visited an English beer festival. It was held in Burton-on-Trent, a city often regarded as the home of pale ale. The first striking feature of the city is the Coors signs that dominates it, the American company now being the biggest brewer in Burton. Second it was clear from the variety of beers that we sampled that British brewers have only a hazy concept of beer styles in general and of pale ale in particular.

Do we really need to classify the beer we drink? The concept of beer styles is not important in the sense that what really matters is whether it is a good beer or not. If you do like it, you don't need to understand what class it belongs to, do you? Well, that's not entirely true. After all, you wouldn't be happy if you really fancied a refreshing glass of Pilsner and the barman served you a dry stout instead. And more importantly, if you want to brew beer that fits a particular style, you need to know what defines that style. This is especially important in the case of pale ale, which is often confusingly used to describe both a whole range of ales — from bitter to IPA — and to one particular style that fits in that range!

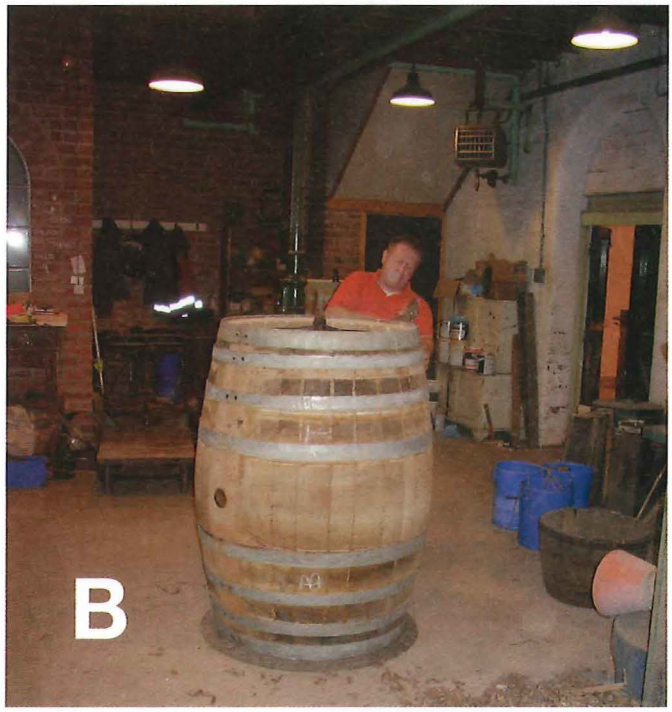
In the beginning . . .

Pale ale is obscure in origin. Beers with that designation were produced in England as far back as the 17th century, possibly even earlier. But these beers were rare, the common beers of

that time were generally brown in color. Those pale ales that were produced were expensive because of the high cost of pale malt. Precise figures are difficult to find, but it seems that pale malt could cost up to twice as much as "ordinary" malts. However, malts were sold by volume and there was about 30% more pale malt than brown malt in a bushel. It was difficult to produce pale malt with the relatively primitive malting techniques then available. The main problem was that most malt was kiln-dried over an open wooden fire, which often resulted in scorching of the malt.

Hodgson ships his beer to India

Throughout the 18th century, pale ales remained what we would today call niche products. Brown beers suited popular taste and the most important of these, porter, was first produced in the 1720s. Many brewers grew rapidly on the backs of porter. A few of them, such as Whitbread and Courage, being still in business even in the 20th century. Even the Burton brewers were producing dark brown beers in the 1700s. The most important brewer of pale ales at that time was actually a London brewer, Charles Hodgson. In 1790, he hit on a potentially lucrative market in India and started shipping pale ale to the sub-continent. Hodgson was a pioneer and, like most pioneers, he never really got the credit he deserved. Perhaps he himself did not realize he had made the first steps in a brewing revolution by brewing a pale, highly-hopped beer that would be stable when shipped over long distances.



A.
Wooden clad mash tun at Marston's Brewing in Burton. This is the only brewery still using the famous Burton Union system.

B.
This is the cooper at Marston's making one of the unions, or wooden casks used in the Burton Union System.

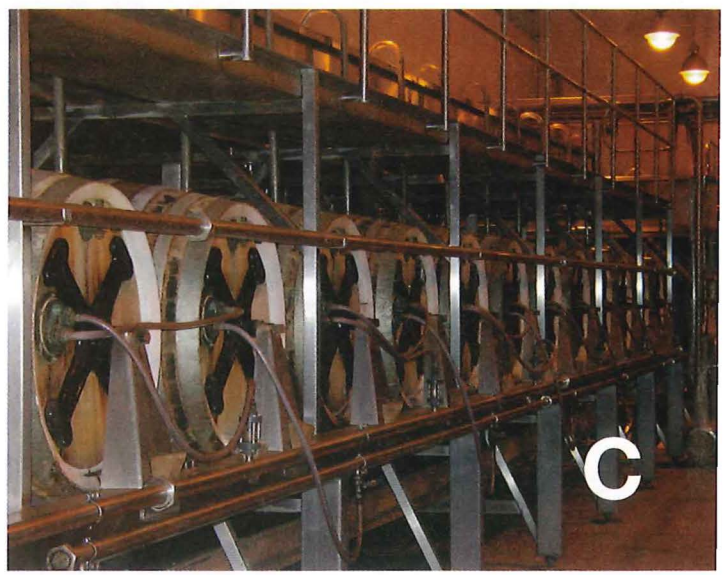
C.
This shows a whole row of Burton Unions in place at Marston's Brewery.

The 18th century was an exciting time in Britain. By mid-century the Industrial Revolution was well under way. It was clearly gathering steam before that, following the scientific lead of Isaac Newton and others. As scientific knowledge advanced, the technologies of manufacturing advanced rapidly. Iron and coal production increased and early mass-production techniques were developed, notably by such as Wedgwood in his pottery. Businesses and factories grew at astonishing rates. The growth of breweries is a good example of the progress made during this period. At the start of the century, a large London brewery might manage 10,000 barrels. By 1800, several brewers were turning out close to 200,000 barrels a year.

The cost of pale malt drops

The malting industry also developed its technology, working out ways to produce more and better malt. Techniques of kilning were improved as maltsters learned how to control the heat applied and to use coke instead of wood. In this way, pale malt of good quality could be made relatively cheaply. Towards the end of the century, it still remained more expensive than brown malt in terms of price per bushel.

However, by this time, brewers were beginning to use the hydrometer and coming to the understanding that pale malt was actually cheaper per unit of fermentable extract than the brown malt. However, porter was still the most popular beer and



Hodgson seems to have been the only brewer to see the potential for pale beers.

All this was to change in the 19th century. As the Industrial Revolution got under way, manufacturers sought better means of transporting their products to outlets than carrying them by horse-drawn carts over inadequate roads. A partial solution to this was the building of an extensive network of canals. This enabled the Burton brewers to ship their strong dark ales to the East Coast of England and then to the Baltic States and Russia. Although the Burton brewers were still much smaller than their London counterparts, this was a lucrative trade for them.

Competition for Hodgson

Unfortunately, as a result of the Napoleonic wars, France engineered shipping embargoes on all English trade with Northern Europe. This ended the Burton brewers business with the Baltic States and Russia. Hunting for another market for their products, brewers in Burton were approached by the East India Company who wanted to break Hodgson's monopoly. In 1822, Allsopp's made their own India Pale Ale and started shipping the product to India in 1823. It wasn't long before other brewers in Burton — such as Bass, Worthington and Salt — were doing the same. These brewers were helped by the fact that their brewing liquor was high in both calcium and sulfate, making it ideal for heavily-hopped pale ales. They were helped as well by the unique flavor obtained through the use of the famous Burton Union fermentation system. In the Burton Union system, overflow from fermentation casks flowed into troughs that ran beside the casks. The yeast was skimmed from this overflow and the beer was returned to the casks. The trade of the nine Burton brewers expanded rapidly. In 1831, they produced 50,000 barrels annually; by 1881 Bass alone was turning out a million barrels each year!

Clear glass and snobbery

But that was IPA, not pale ale — so how did that come about? Why there was a move towards pale beers is not clear, for it happened in Europe and the Americas as well. One reason may have been a change in the nature of drinking vessels. There had been a long-standing high duty on glass in Britain, so drinkers used pewter, earthenware and china vessels rather than glass. This duty was removed in 1845, just about the time mass-production methods were developing in Europe (notably in Bohemia). And as soon as drinkers in the pub were using glasses and they could see what they were drinking, the trend towards pale beers gathered speed.

Also, by the mid-1800s, a sizable middle class had emerged in Britain, which had now become the world's major industrial nation. This middle class had what we now call disposable income and they wanted — and were prepared to pay for — quality beers. There was also an element of snobbery in that they did not want the dark beers favored by the working class. It didn't help that there had been massive problems with adulteration of porter in the early part of the century, thus lowering its image in the eyes of many people. The middle class wanted something more elegant, special and certainly less vulgar.

Plenty of pale ales . . . and bitter, too

Naturally, other British brewers jumped on the IPA bandwagon and started to produce their own version of the style. IPA was a relatively strong beer at around 7% alcohol by volume (ABV). This made it somewhat expensive to produce and brewers were beginning to learn something about marketing. So many of them began to widen their range of beers — instead of offering just one or two, they now offered as many as five to ten. Pale beers of lesser strength than IPA would be called just pale ale. It was still not a clearly different style since there were many other similar beers, but rejoicing in names like "dinner ale," and "family ale." In addition, the term "bitter" was beginning to creep in.

During the second half of the 19th century, the practice of bottling beer became more common. At first, bottle-conditioned beer was the main product. However, a whole raft of technologies followed rapidly on one another and soon changed that. Filtration techniques, refrigeration, pasteurization and artificial carbonation enabled the brewer to produce clear, stable beers in bottles. By the early 20th century, bottled beer made up some 10–15% of total beer production in Britain. If that does not sound like a lot, remember that the English have always drunk mostly draught beer.

It became common to apply the term "pale ale" to bottled, rather than draught beer. Many brewers — including the biggest IPA producer of all, Bass — dropped the IPA designation. The term does still linger today, but hardly any of the beers called IPA are worthy of that title. Most of them lack the appropriate strength and hop bitterness. In addition, the Burton Union System for fermentation, which lent a distinct flavor to beers produced with it, fell into disuse. Today, only one beer, Marston's Pedigree Bitter, is still fermented in a Union system.

The tax man

In 1880, the British Government changed the taxation system applied to brewing. Instead of taxing malt, as had previously been the case, taxation was now assessed according to the original gravity of the wort as it went into the fermenter. This had two important results, the first being that brewers could now use sugar or cereals in place of malt. The second is that the original gravities of British beers started to decline and continued to do so until today. Average gravity in 1900 was 1.055, while now it is 1.037! As strength fell, bitter became the preferred term for draught pale beers and pale ale for the bottled version. Caramel and roasted malts in bitters became popular from about 1900 onwards, as a way of adding more flavors to improve the taste of weaker beers.

A bitter argument

It could be argued that all bitters are pale ales, or even that pale ale is simply bottled bitter. However, bitter

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PALE ALE ADAPTATIONS
Expanding Pale Ale's Niche

Pale ale is a versatile beer style. Although pale ale technically only refers to moderate alcohol, light-colored ales, the basic idea of pale ale — a combination of ingredients and brewing techniques — has stretched out to cover a range from low-alcohol bitters to big, boozy IPAs. (And, when you think about it, what's an English-style barley wine but a very, very big pale ale?) Craft brewers in the United States have expanded on the pale ale "body plan" and come up with hoppy West Coast pale ales and malty, hoppy American amber ales. Homebrewers have further sought to expand pale ale's niche with some interesting adaptations. Here are three recipes that are still recognizably related to pale ale, but incorporate new flavors and aromas.

Wright's Shifting Balance Bitter

(5 gallons/19 L, all-grain)
OG = 1.053 FG = 1.014
IBU = 30 SRM = 15–17 ABV = 5.0%

The Munich and crystal malts, paired with the yeast strain, give this beer a malty flavor with a caramel-sweet edge, shifting this pale ale's malt/hop balance slightly to the malt side.

Ingredients

7.75 lbs. (3.5 kg) pale ale malt (3 °L)
2.0 lbs. (0.9 kg) Munich malt (10 °L)
0.25 lbs. (0.11 kg) crystal malt (20 °L)
0.66 lbs. (0.3 kg) crystal malt (30–40 °L)
0.33 lbs. (0.15 kg) crystal malt (60 °L)
7.5 AAU East Kent Goldings (EKG) hops (bittering)
(1.5 oz./43 g of 5% alpha acids)
2.5 AAU EKG hops (flavor)
(0.5 oz./14 g of 5% alpha acids)
0.5 oz. (14 g) EKG leaf hops (dry hop)
Wyeast 1968 (London ESB Ale) or White Labs WLP002 (English Ale)
0.66 cups corn sugar (for priming)

Extract with grains option:
Replace pale ale malt with 4.2 lbs. (1.9 kg) dried malt extract.

Haldane's Select IPA

(5 gallons/19 L, all-grain)
OG = 1.062 FG = 1.014
IBU = 49 SRM = 11 ABV = 6.2%

This strong ale gets its malt complexity from biscuit malt and a pinch of chocolate malt. The adjunct, hops and yeast lend a dry, "woody" finish.

Ingredients

8.25 lbs. (3.7 kg) pale ale malt (3 °L)
2 lbs. (0.9 kg) cane sugar
0.33 lbs. (0.15 kg) crystal malt (30 °L)
0.25 lbs. (0.11 kg) biscuit malt (25 °L)
0.33 oz. (9.3 g) chocolate malt (325 °L)
12.5 AAU East Kent Goldings hops (bittering)
(2.5 oz./71 g of 5% alpha acids)
3.75 AAU Fuggles hops (flavor)
(0.75 oz./21 g of 5% alpha acids)
1.5 oz. (43 g) Fuggles hops (dry hop)
Wyeast 1028 (London Ale) or White Labs WLP026 (Premium Bitter) yeast
0.75 cups corn sugar (for priming)

Extract with grains option:
Replace pale ale malt with 4.4 lbs. (2.0 kg) dried malt extract.

Fisher's Fundamental ESB

(5 gallons/19 L, all-grain)
OG = 1.049 FG = 1.012
IBU = 44 SRM = 7 ABV = 4.7%

US-grown Amarillo hops have a bold, "grapefruity" flavor and aroma. This Amercian-style pale ale is bursting with hop flavor.

Ingredients

9.5 lbs. (4.3 kg) 2-row pale malt (2 °L)
0.66 lbs. (0.3 kg) crystal malt (20 °L)
9 AAU Chinook hops (bittering)
(0.75 oz./21 g of 12% alpha acids)
9 AAU Amarillo hops (flavor)
(1 oz./28 g of 9% alpha acids)
2 oz. (56 g) Amarillo hops (dry hop)
Wyeast 1056 (American Ale) or White Labs WLP001 (California Ale) yeast
⅞ cups corn sugar (for priming)

Extract with grains option:
Replace 2-row pale malt with 5.1 lbs (2.3 kg) dried malt extract.

Step by step (all-grain recipes)

Mash grains at 152–154 °F (67–68 °C) for 1 hour using 1.25 quarts (1.2 L) of water per pound (0.45 kg) of grain. Add boiling water to raise temperature to 168 °F (76 °C) and hold for 5 minutes. Recirculate for 20 minutes. Wort collection should take 90 minutes. Sparge water should be 168 °F (76 °C). Collect roughly 1 gallon (3.7 L) of wort for every two pounds (0.91 kg) of grain. Add water to make 6 gallons (23 L) of wort total. Boil wort for 90 minutes, adding bittering hops at 60 minutes left and flavor hops with 15 minutes left. After boil, cool wort to 70 °F (21 °C) and transfer to fermenter. Aerate and pitch yeast. Ferment at 70 °F (21 °C) for one week then transfer to secondary fermenter. Bottle or keg after 1 week in secondary. Dry hop in secondary or (preferably) in keg.

Step by step (extract recipes)

Place crushed specialty grains in a nylon bag. Add roughly 1.5 quarts (1.4 L) of water to your brewpot for every pound (0.45 kg) of grain in the bag. Heat water to 158 °F (70 °C) and immerse grain bag in the water. Hold for 45 minutes, keeping the temperature over 148 °F (64 °C). Remove grain bag with a large kitchen strainer and rinse with 165 °F (74 °C) water. The volume of rinse water should be equal to amount of water you originally added to your brewpot. Add water to "grain tea" to make 4 gallons (15 L). Bring this liquid to a boil. Turn off heat and stir in malt extract. Resume heating and bring wort to a boil. Boil for 60 minutes, adding bittering hops at the beginning of the boil. Follow remaining all-grain instructions. — *Chris Colby*

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covers such a range of strengths (3.2–5.5% ABV), colors and hop bitterness as to make this approach inappropriate, though there are some that fit the pale ale profile. On the other hand, some draught bitters are called pale ale by their brewers, but do not fit the style. Pale ale derives directly from IPA and should be of a reasonable strength. It should be pale — in English terms — and, most importantly, it should have a significant level of hop bitterness. It is generally taken that English pale ale should be brewed only with English hops. It is worthy of note though that during the late 19th century, Bass imported a good deal of American hops. Since we cannot taste those beers, we don't know whether they actually had any typical American hop character. It is more likely that they were blended with other hops so as not to drastically change the beer.

The New World

Of course, the history of pale ale does not end with British beers, since it was a style that readily lent itself to microbrewing in America. When microbreweries began to emerge in this country in the 1980s, most of them brewed ales. This was partly because ales require simpler, cheaper equipment than lager brewing and have a faster turn-around time. Many of the new brewers got their start in homebrewing and were already in love with pale ales and IPAs. They were also in love with hops . . . and American hops in particular.

Some English commercial brewers think that many American micros have gone overboard in their use of hops. Perhaps that is true in some of the wilder Californian IPAs, but it certainly suits the pale ale style to overdo, rather than underdo, hop bitterness and flavor. There is no question that American microbrewing deserves a lot of credit for reviving the almost defunct style of IPA. Also, to my mind, some of the best modern examples of pale ale are brewed in this country; Sierra Nevada Pale Ale is a classic of the style. So too, though less well known is the pale ale we brew at BAR. And of course, one of the defining qualities of American pale ale is the use of American hops with their distinctive flavors. Which means that we really have to classify American pale ales as a style distinct from the British version.

Definitions

1. English Pale Ale

This beer should be of medium strength (SG 1.045–1.055, 11.2–13.6 °P), golden to copper in color, with moderate to high hop bitterness (30–45 IBU). This is really a one-dimensional beer so that there should be little or no malt or caramel flavor, though some estery fruitiness is permissible. In other words, it is brewed mainly from pale malt; only the lighter types of crystal malt may be used, and sparingly, if at all. Hop flavor and aroma should be present, but should not be pronounced as it should come from English hops.

2. American Pale Ale

The broad definition is the same as that for the English style in terms of strength, color, malt and caramel flavor. It can have an estery fruitiness even though the classic of the style, Sierra Nevada Pale Ale, most certainly does not! Hop bitterness should be high (30–50 IBU) and hop aroma and flavor should be pronounced, coming mainly from American hops.

PALE ALE BY THE NUMBERS:

OG	**1.045–1.055 (11.2–13.6 °P)**
FG	**1.010–1.014 (2.6–3.6 °P)**
SRM	**8–14**
IBU	**30–50**
ABV	**4.5–5.5%**

Brewing Pale Ale.

Base Malt: Obviously, pale ale malt is the foundation of this beer. Classically this should be English 2-row pale ale malt. Many brewers regard floor-malted Maris Otter as being the highest quality pale malt obtainable. However, the quality of U.S. 2-row pale malts is also high and is used by many American micros for their pale ales. Most pale ale malts have a color rating around 3 °L, higher than the 1.8–2 °L of Pilsner and other pale malts. As far as malt extract is concerned, the approach is very simple — use a pale extract or one designated specifically as a pale ale extract. The malt extract may be used alone or in conjunction with steeped specialty malts.

Specialty Malts: Hop bitterness and flavor, rather than malty notes, dominate the taste of pale ale, so the only specialty malt used is crystal malt. Even this should only be the lightly-roasted version, with a color of 10–40 °L. Crystal malts add some reddish colors to the beer and a sweetness usually described as "caramel-like." Crystal malts usually comprise up to 10% of the grist, leading to the final beer color of 8–14 SRM and a just a hint of caramel flavor.

Extract brewers can steep their crystal malt at 150 °F (66 °C) for 30 minutes before bringing their brewing water to a boil and adding extracts. Just place the crushed malt in a nylon steeping bag and let it soak in hot brewing water. Some pale ale extracts will already have color from crystal malt in their formulation. All-grain brewers will mash the crystal malt along with their base grains.

Adjuncts: Many English brewers use sugar or corn as an adjunct. The adjunct adds fermentables to the wort but doesn't add any flavor, color or body. An English brew might contain up to 15% sucrose — which is cane sugar, not corn sugar. This is added to the kettle, so it can be used by extract or all-grain brewers. All-grain brewers can also use flaked maize in their mash, up to 20% of the grist as some English brewers do.

Adjuncts also dilute the protein content of the wort. At the levels described here, this should present no problems in terms of yeast nutrition. However, just to be safe, adding ¼–½ tsp. yeast nutrients per 5-gallons (19 L) may help your fermentation when using sugar or flaked maize. It may also help if your malt extract contains adjuncts.

Hops: For a classic English-style pale ale, English hops are required, naturally. The first choice for both bittering

PALE ALE recipes

ALL-GRAIN RECIPES

Classic English Pale Ale
(5 gallons/19 L, all-grain)
OG = 1.053 FG = 1.013
IBU = 43 SRM = 9 ABV = 5.1%

Ingredients
10.25 lbs. (4.6 kg) 2-row Maris Otter pale ale malt
0.5 lbs. (0.22 kg) crystal malt (40 °L)
10 AAU East Kent Goldings hops (bittering)
(2 oz./56 g at 5% alpha-acids)
5 AAU East Kent Goldings hops (flavor)
(1 oz./28 g at 5% alpha-acids)
Wyeast 1028 (London Ale) or White Labs WLP023 (Burton Ale) yeast
1 cup corn sugar (for priming)

Classic American Pale Ale
(5 gallons/19 L, all-grain)
OG = 1.055 FG = 1.014
IBU = 53 SRM = 8 ABV = 5.3%

Ingredients
11 lbs. (5.0 kg.) 2-row pale malt
0.5 lbs. (0.22 kg) crystal malt (40 °L)
11 AAU Cascades hops (bittering)
(2 oz./56 g at 5.5% alpha acid)
11 AAU Cascades hops (flavor)
(2 oz./56 g at 5.5% alpha acids)
Wyeast 1056 (American Ale) or White Labs WLP001 (California Ale) yeast
1 cup corn sugar (for priming)

BAR Pale Ale
(5 gallons/19 L, all-grain)
OG = 1.050 FG = 1.013
IBU = 52 SRM = 9 ABV = 4.9%

Ingredients
9.75 lbs. (4.4 kg.) Briess 2-row pale malt
0.8 lbs. (0.37 kg) crystal malt (40 °L)
11.5 AAU Centennial hops (bittering)
(1 oz./28 g at 11.5% alpha acids)
8 AAU Mt. Hood hops (flavor)
(2 oz./56 g at 4% alpha acids)
1 oz. Willamette hops (dry hop)
1 oz. East Kent Goldings (dry hop)
Wyeast 1098 (British Ale) or White Labs WLP006 (Bedford Ale) yeast
1 cup corn sugar (for priming)

Step by step

Use a single-step infusion mash at 153-155 °F (67–68 °C) for 1–1.5 hours. Sparge one hour, with water no hotter than 175 °F (79 °C), until run-off reaches SG 1.010–1.012. Boil 90 minutes, with bittering hops added after the first foamy head subsides. Add flavor hops 10 minutes before the end of the boil. Adjust wort volume with cold water, and cool to about 70 °F (21 °C). Pitch with yeast starter, and allow to ferment. By 5–7 days, final gravity should have been reached; if so, rack into a glass fermenter. One to two weeks later, rack again, prime with corn sugar and package in keg or bottles. The beer should be ready to drink after conditioning for a week or so. Add the dry hops (if any), preferably to the primary fermenter or else to the keg. In either case, the hops should be placed in a sterilized muslin bag, with a sterilized weight attached.

EXTRACT RECIPES

Classic English Pale Ale
(5 gallons/19 L, extract only)
OG = 1.052 FG = 1.014
IBU = 40 ABV = 4.9%

Ingredients
6.6 lbs. (3 kg) pale ale liquid malt extract
0.33 lbs. (0.14 kg) pale dried malt extract
10 AAU East Kent Goldings (EKG) hops bittering)
(2 oz./56 g at 5% alpha-acids)
5 AAU EKG hops (flavor)
(1 oz./28 g at 5% alpha-acids)
Wyeast 1028 (London Ale) or White Labs WLP023 (Burton Ale) yeast
1 cup corn sugar (for priming)

Classic American Pale Ale
(5 gallons/19 L, extract only)
OG = 1.055 FG = 1.015
IBU = 50 ABV = 5.2%

Ingredients
6.6 lbs. (3 kg) pale ale liquid malt extract
0.75 lbs. (0.34 kg) pale dried malt extract
11 AAU Cascades hops (bittering)
(2 oz./56 g at 5.5% alpha acid)
11 AAU Cascades hops (flavor)
(2 oz./56 g at 5.5% alpha acids)
Wyeast 1056 (American Ale) or White Labs WLP001 (California Ale) yeast
1 cup corn sugar (for priming)

BAR Pale Ale
(5 gallons/19 L, extract only)
OG = 1.050 FG = 1.014
IBU = 50 ABV = 4.7%

Ingredients
6.6 lbs. (3 kg) pale ale liquid malt extract
0.2 lbs. (90 g) pale dried malt extract
11.5 AAU Centennial hops (bittering)
(1 oz./ 28 g at 11.5% alpha acids)
8 AAU Mt. Hood hops (flavor)
(2 oz./ 56 g at 4% alpha acids)
1 oz. Willamette hops (dry hop)
1 oz. East Kent Goldings (dry hop)
Wyeast 1098 (British Ale) or White Labs WLP006 (Bedford Ale) yeast
1 cup corn sugar (for priming)

Step by step

Bring 3–4 gallons (11–15 L) of water to a boil. Turn off the heat, add malt extracts and stir well to ensure that the extracts dissolve properly. Bring to a boil, add the bittering hops and boil one hour. Add flavor hops in final 10 minutes of boil. Siphon off wort from the hops and trub, then add cold water sufficient to yield just over 5 gallons (19 L) of wort. Cool to around 70 °F (21 °C) and follow instructions for all-grain beers for fermentation and conditioning.

Extract with grains option:

Replace pale ale liquid malt extract with a plain light or extra light malt extract. Steep 0.5–1.0 lbs. (0.22–0.45 kg) of crystal malt at 150 °F (65 °C) for 30 minutes prior to adding extract.

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and finishing would be East Kent Goldings, with Fuggles coming a close second. East Kent Goldings usually contain 4–6% alpha acids are are often described as a "clean" hops. Fuggles are also usually rated in the 4–6% alpha acid range and are described as "earthy" or "woody." Challenger or Progress hops are also suitable, although some English brewers do use Saaz for hop flavor (through late kettle hopping). I recommend only Goldings or Fuggles for dry hopping if you want to go that way.

For a classic American-style pale ale, Cascade — with its typically floral-citrus flavors — is the most commonly used hop, especially for late and dry hopping. But the choice is wide and such hops as Centennial, Willamette and Northern Brewer can also be used. Other American hops — such as Liberty and Mount Hood — make excellent pale ales, but these would no longer fit the classic American style.

Water: Ever since the Burton brewers got in on the act, "permanently hard" water has been the choice for brewing pale ale. Water from artesian wells in Burton contains very high amounts of calcium (275–300 ppm) and sulfate (450–700 ppm). This ensures that mash acidity is in the optimum pH range of 5.2–5.5 for starch conversion. It can be argued that modern pale malts are of such quality that it is no longer necessary to use very hard water in pale ale brewing. Indeed, Hodgson's original IPA was brewed with London water, which is very high in "temporary hardness" — calcium and carbonate ions — rather than in "permanent hardness" of Burton.

However, this is first and foremost a hoppy style and "permanent hardness" does accentuate and sharpen hop bitterness. In contrast, "temporary hardness" tends to make for a harsher bitter flavor. Therefore, I recommend that any carbonate should be removed by boiling the water before mashing, and that you add some gypsum (calcium sulfate) before the mash. Exact amounts are difficult to recommend, as much depends on the nature of the water you are using. For medium-hard water (about 50–100 ppm calcium) add 1tsp. (about 5g) gypsum (calcium sulfate); for a very soft water (less than 50 ppm calcium), you might want to add as much as 2 tsp. gypsum.

If you are brewing with a pale ale malt extract, you should not need to treat the water as this should have been done in the preparation of the extract.

Yeast: As ales, all these beers should be brewed with top-fermenting yeast strains. The choice is wide, and those recommended below in the recipe section — Wyeast 1028 (London Ale), 1098 (British Ale) and 1056 (American Ale) — are strains I have found satisfactory for these beers.

Pale ales typically have a fruity aroma. This fruity characteristic comes from esters, which are fermentation by-products produced by ale yeasts. At low levels, the fruity smells are pleasing. At higher levels, the aromas often take on a banana character and become disagreeable. The amount of esters produced increases with temperature. For most ale strains, 72 °F (22 °C) is the maximum temperature that produces a beer with suitable ester levels. Personal preferences vary, however, and some homebrewers ferment at higher temperatures than this. Inadequate pitching rates or aeration levels can also elevate the ester level.

Some pale ales also have buttery or butterscotch notes. These flavors come from diacetyl, a molecule that forms during early fermentation but is later reabsorbed by the yeast cells. Diacetyl is acceptable in small amounts in pale ale. If you've ever had a Redhook ESB, you've tasted a beer with a small amount of residual diacetyl (this is intentional). In most beer styles, however, diacetyl is considered a beer fault. As such, most brewers try to minimize this flavor in their beers. Most ale yeast strains will reduce diacetyl below its flavor threshold if you follow standard homebrewing procedures. A few, in particular the Ringwood Ale yeast (Wyeast 1187), will leave some diacetyl in the finished beer.

Wyeast 1056 (American Ale) yeast is used for the classic American pale ale from Sierra Nevada and really is a must for that style. 1056 ferments "cleanly" — i.e. producing few esters — and is a good diacetyl reducer. White Labs WLP001 (California Ale) is a comparable strain to Wyeast 1056. White Labs WLP023 (Burton Ale), not surprisingly, works well for English pale ale! Other ale yeast strains may do just as well, so long as they are not high ester producers.

Brewing Approach: Mashing is simple, use a single-step infusion at 152–155 °F (67–68 °C). Lower mash temperatures can result in a thin beer tasting only of hops and quite out of balance. Boil the wort for 90 minutes, with the bittering hops added at the start and finishing hops 5–10 minutes from the end of the boil. Cool to fermentation temperature (65–70 °F/18–21 °C) and pitch the yeast, preferably as a 0.5-gallon (1.9-L) starter. Hold at 65–70 °F (18–21 °C) during fermentation, which should only take five to seven days.

Traditionally, many English brewers performed open fermentations. However, most homebrewers use closed fermentations to avoid wort contamination.

Classically, pale ales are dry hopped in the keg, but this can also be done in the fermenter. (It would have to be if you are bottling.) In either case, use 0.5–1.0 oz. of the hops in a hop bag held down with a sterilized weight. When bottling, prime with 1 cup of corn sugar; for my taste, ¾ cup of corn sugar would be even better as this beer should not be highly carbonated.

Conclusion

Pale ale is sometimes dismissed by experienced brewers as being straightforward and not much of a challenge to brew. I don't think that is true, it always takes skill and care to brew a good beer! And what can be wrong with brewing a beer that is relatively simple, yet classic, drinkable style? ■

Terry Foster is the author of "Pale Ale," number 16 in the Classic Beer Styles series (1999, Brewers Publications).

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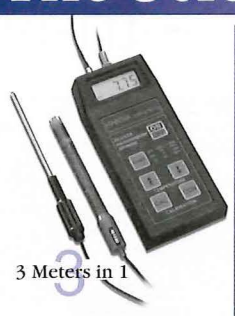

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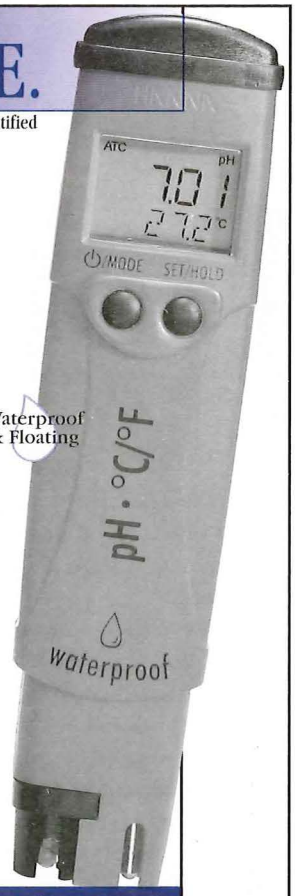

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by Don Million
photos by Chris Colby

BEAUTY and the YEAST

You make the wort – they make the beer

Many brewers believe yeast is the single biggest factor affecting the final taste of their beer. The effort we put into mashing, boiling and the rest simply prepares an environment where the yeast can do their work.

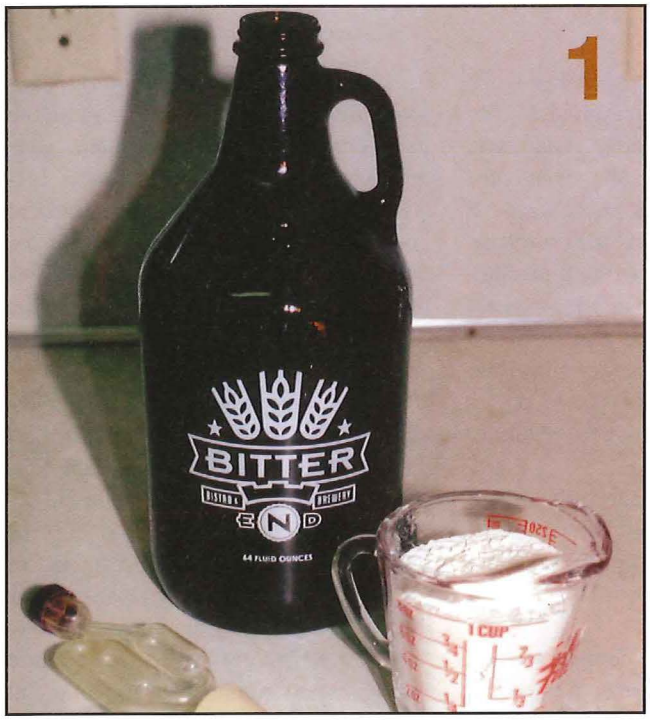
Some of the flavor and aroma compounds that are affected by yeast are esters ("fruity," often banana, aroma), diacetyl (buttery or butterscotch flavor), fusel alcohols (solvent-like flavor), and aldehydes (green apple aroma and flavor). Most lager yeasts also produce noticeable amounts of sulfur. These characteristics are acceptable, sometimes even desirable, in low concentrations, but are considered flaws in higher concentrations. And for beer styles such as German hefeweizen or some Belgian beers, key flavor and aroma characteristics of the beer are a product of the special yeast strains used in their brewing. That's why choosing the right yeast strain and handling the yeast correctly is so important.

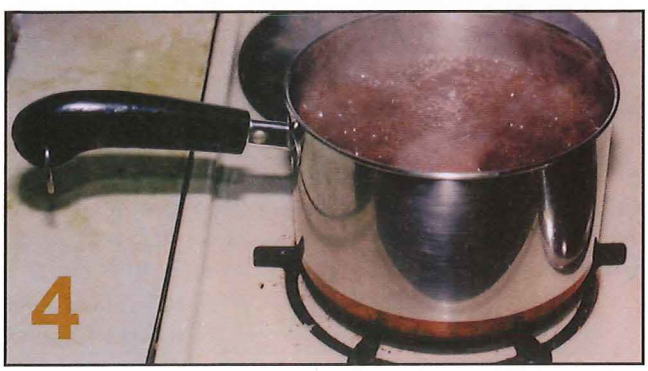
choosing the right yeast strain and handling your yeast correctly is important

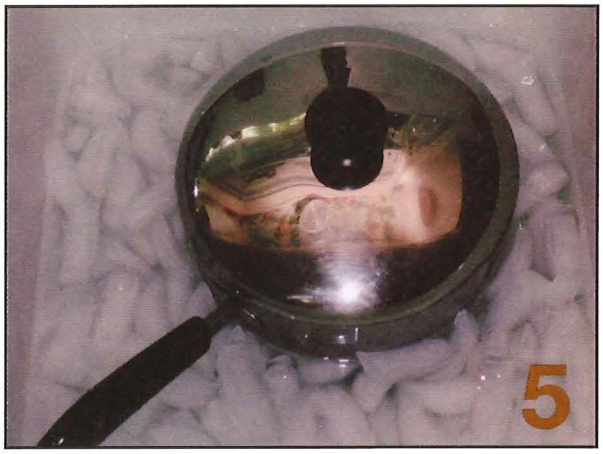
Selecting the Right Yeast

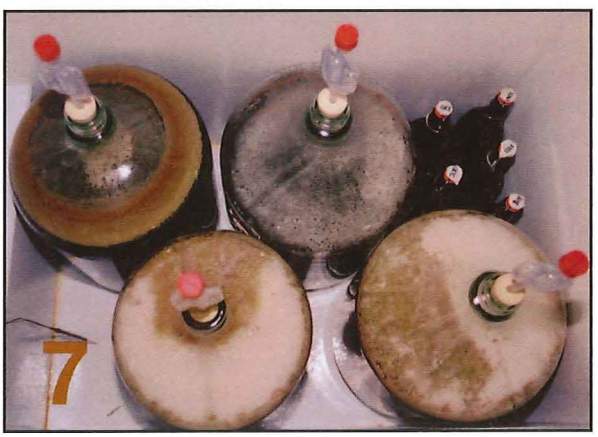
Should you use dry yeast or liquid? In the past, dry yeast got a bad reputation for a number of reasons. One of the main ones was the generic package stuck under the lid of all-in-one can kits of an earlier era. This yeast was sometimes old and could have overheated during shipping.

Name brand dry yeast suppliers, like Lallemand and Safale, have made dramatic improvements in the last few years. If you haven't tried dry yeast









To ensure a healthy fermentation, (1) measure out 1-1.5 cups of dried malt extract, (2) boil 64 oz. (~2 L) of water, (3) turn off heat and add malt extract to hot water, (4) boil for 15 minutes, (5) cool starter wort to a maximum of 90 °F (32 °C), (6) transfer to a sanitized container and pitch yeast to the starter wort and (7) pitch starter wort to main wort on brewing day. Making a starter allows for faster starts, cleaner fermentations and lower finishing gravities.

recently, you haven't tried dry yeast. The only drawback these days is that it is not available in as many varieties as liquid. If you are making a basic pale, brown or amber ale, there are dry yeasts available that are as good as the best liquid yeast you can buy. If you are making lagers, many Belgian ales or a German-style wheat beer, you will need one of the appropriate liquid yeast strains.

An important step in selecting a yeast strain is checking the suppliers' information. Most yeast suppliers provide information about attenuation, flocculation and appropriate temperatures for each of their yeast strains. In addition, they will describe the style of beer the strain is best suited for and whether or not it can tolerate high gravity wort.

Attenuation: Attenuation refers to how completely the yeast can ferment wort. If your wort's starting gravity is 1.048 and its final gravity is 1.012, then the attenuation is calculated as (48-12)/48 = 0.75, or 75%. This value is about average. Some yeast attenuate less — in the 70-73% range — resulting in a sweeter, fuller-bodied beer. Wyeast 1968, White Labs WLP002 and Danstar Windsor are examples of low to moderate attenuating yeast. Other yeasts attenuate more — as much as 80-85% — resulting in a drier, lighter-bodied beer. Wyeast 1010, Danstar Nottingham and White Labs WLP007 are examples of highly-attenuating yeast strains.

Flocculation: Flocculation refers to the tendency of the yeast to clump together and settle out when fermentation is complete. All yeast does this to some extent, but there is considerable variation between strains. For example, White Labs WLP300 and Wyeast 1007 are both known as low flocculating yeasts while WLP002 and Wyeast 2112 are both highly flocculent. The important difference to homebrewers is that with a highly flocculent yeast, the beer will clear more quickly and completely than with a low flocculating strain.

Temperature: Most ale yeasts work best between 65–75 °F (18–24 °C) and will slow down or stop working completely if the temperature drops much below 60 °F (15.6 °C). Lager yeast work at much lower temperatures, in the range of 45–60 °F (7–16 °C). As always, there are exceptions; ale yeasts are available that work as cold as 55° F (13° C) and lager yeasts that work as warm as 68° F (20° C) without producing off flavors. Both ale and lager yeast will ferment at temperatures above their recommended range, but then produce excessive amounts of esters and other flavor compounds, resulting in off tastes.

Once you have chosen a strain and gotten it home, it should be refrigerated until you are ready to use it.

Pitching Enough Yeast

Yeast want lots of company when they are making beer. Once in the wort, yeast will reproduce until there are 6-10 million cells per milliliter, per degree Plato — for a total of as many as two trillion cells in a typical 5-gallon (19 L) batch!

Commercial breweries have established the ideal amount of yeast to pitch at about 1 million cells per milliliter per degree Plato. The yeast then accomplish a six to ten-fold increase in population between pitching and the time when the majority of alcohol production occurs. If the yeast must reproduce more than that, there will be a correspondingly longer lag time.

A long lag time leaves the wort susceptible to contamination by bacteria and wild yeast. The increase in yeast growth that goes along with low pitching rates is also associated with increases in diacetyl, esters and fusel alcohols. Finally, under-pitching can result in under-attenuation — causing high final gravities — or an extremely slow fermentation.

If you do the math, you would find that you should be pitching 228 billion yeast cells for an average strength ale. A larger batch or higher gravity calls for more yeast.

How do you get that many yeast cells? First of all, you don't need exactly that many yeast cells. This is an "ideal" amount, but good beer has been made with far less. If you get into the neighborhood, your beer will be fine.

On the other hand, if you're experiencing long lag times, or any of the problems associated with them, your pitching rate should be increased. It is also a good idea to err on the side of too much yeast rather than too little for lagers and high gravity ales. This is because the fermenting conditions for these kinds of beer put more demands on the yeast.

According to their respective manufacturers, large smack packs and "pitchable" tubes of liquid yeast contain up to 60 billion cells while an 11-gram packet of dry yeast may have as much as 160 billion cells. A packet of dry yeast gets you fairly close to your target pitching rate and two is plenty even for a high gravity beer. The liquid yeast should really be stepped up at least once.

Making a Starter

To step up the quantity of yeast, we make a yeast starter. This is a simple process, but you need to be careful about sanitation. You want to grow brewers yeast, not bacteria or wild yeast. Remember, too, that you are growing yeast. While the process is similar to making a mini batch of beer, the objective is different.

The correct specific gravity for starter wort is a matter of some disagreement. Wyeast says it should be between 1.020 and 1.030. White Labs recommends about 1.040. Many commercial breweries make starters with gravities of 1.048. What everyone seems to agree on is that yeast grow more rapidly in lower gravity wort. The disagreement revolves around whether lower gravity wort properly prepares the yeast for pitching into the actual batch.

My recommendation is to begin with relatively low gravity wort; 60% of the projected gravity of the actual batch is a good rule of thumb. For instance, if your batch is going to have a gravity of 1.050, you would make a starter with a gravity of (50*0.60 = 30) 1.030. For a high gravity beer, I would step the yeast up a second time into a starter that was closer in gravity to the batch, perhaps 75–80%. How big of a starter do you need? Since you

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NATURE OF THE YEAST

by Paul Manzo

Oh waiter, there's a unicellular Ascomycete in my wort

Classification of Yeast

Yeast are living organisms. Yeast, truffles, mushrooms and many agricultural pests are all members of the kingdom Fungi. Originally considered to be plants, it is now clear that fungi are distinct from both plants and animals. Both fungi and animals need to feed on organic material derived from other organisms, yet unlike animals, fungi are decidedly immobile. In the wild, fungi perform an important ecological role by decomposing dead organic matter. And, while the feral crop of mushrooms growing on your front lawn may appear timid and fragile, fungi are some of the toughest and most durable organisms on the planet.

The largest and oldest living organism on earth is a massive fungus known as *Armillarie ostoyae*. This fungus has, unbeknownst to most of us, consumed large parts of the Pacific Northwest. One genetically identical fungus from the Blue Mountains of eastern Oregon covers an area equivalent to 1,665 football fields. The presence of the occasional above-ground cluster of honey colored mushrooms belies vast acres of underground white mycelial mats and rhizomorphs (connecting tubes, essentially).

Although many fungi (including mushrooms, morels and truffles) are cultivated or harvested as food, the predominant commercial use of fungi is in the production of beer, wine, bread, various cheeses and soy sauce.

The most commonly used species of yeast is *Saccharomyces cerevisiae*, whose name roughly translates to the "sugar fungus of beer." While brewers commonly distinguish between *S. cerevisiae* and *S. uvarum* (also called *S. carlsbergensis*), most taxonomists consider all brewing yeasts to be different strains of *S. cerevisiae*. *Brettanomyces bruxellensis* and *B. lambicus* are two distantly related yeast species used in the production of Belgian beers. These yeasts are usually used in combination with *S. cerevisiae* and some species of lactic acid bacteria to make Belgian lambics.

Structure of Yeast

While many fungi form large, multicellular structures, yeast exist as small (5-10 microns in diameter), round, solitary cells. Yeast cells growing in culture will join together to form colonies, but each cell remains independent from its neighbors.

Yeast — as well as humans, pine trees, paramecium and many other organisms — are known as eukaryotes. This large group includes those organisms containing cells with discrete, membrane-bound structures called organelles. Essentially, organelles are little "bags" inside of a eukaryotic cell that perform a specific function. Named after the Greek term for "instrument" or "tool," organelles perform many of the vital tasks important for life. Examples of eukaryotic organelles include the nucleus (which houses the cell's genetic material) and mitochondria (the so-called "powerhouses" the cell).

Yeast cells are bounded by both an inner cell membrane and an outer cell wall made of a complex carbohydrate called chitin. The cell wall selectively allows passage of material between the cell and the environment, and forms a protective barrier in times of environmental stress.

Yeast Life Cycle

Growth and proliferation of yeast cells can follow a few different paths. In humans and many other organisms, sperm and egg cells with half the typical amount of genetic material combine to reform a cell (zygote) that contains the full complement of chromosomes — one set from Mom, one set from Dad. A similar process occurs in yeast cells, but the predominant form of cell proliferation in brewer's yeast involves "budding." In budding, a cell with the full complement of chromosome splits and forms a pair of daughter cells. Each daughter cell contains the full complement of chromosomes.

As with many organisms, the presence (or absence) of food and sexual reproduction are intimately related. When sugar and other nutrients are plentiful, *S. cerevisiae* will grow and multiply exclusively budding. When conditions become unfavorable — during times of desiccation or starvation — yeast cells form resting spores.

Spores are analagous to egg and sperm in animals and, like these cells, have only a half set of chromosomes. Yeast spores differ from sperm and egg in that the spores are nearly the same size as a "regular" yeast cell. And, unlike sperm and eggs, spores can also undergo several rounds of replication before fusing with another spore of a different mating type.

Fermentation and Respiration

Yeast also have more than one option when it comes to breaking down their "food," namely sugars. The process of breaking down sugars in the presence of oxygen is know as aerobic respiration. This process takes place in a cell's mitochondria. A related process, known as fermentation, occurs in the cytoplasm (the liquid) of yeast cells when oxygen is absent.

Brewer's yeast are only exposed to oxygen for a short time during the brewing cycle. Most brewing scientists believe that even when oxygen is present, brewer's yeast ferment rather than aerobically respire. A few experts disagree, but most think that the high sugar levels in fresh wort suppress aerobic respiration — a phenomenon called the Crabtree effect. Even though brewer's yeast don't aerobically respire, they still need oxygen in order to produce fats and sterols — compounds necessary for yeast health and growth.

When brewing, pay attention to your yeast's health and they will reward you with better tasting beer.

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probably don't have the equipment to count yeast cells, you have to base it on the volume of the starter. A standard rule of thumb is to step up the volume of yeast to 6–10 times the amount of wort that you start with. That means, if you are going to make a 5-gallon (19 L) batch, you would ideally pitch from a 2-quart (~ 2 L) starter. Any of the "pitchable" yeast tubes or large smack packs can be pitched directly into a 2-quart (~2 L) starter.

A Starter, Step by Step

Here is how to make a 2-qt. (~2L) starter with a gravity of about 1.030.

1. Heat 2 qts. (~2 L) of water to boiling.
2. Add 6 ozs. (170 g), or about 1½ cups, of dry malt extract.
3. Add ¼ tsp. of yeast nutrient. (This is optional, but recommended).
4. Boil for 15-20 minutes. (Watch out for boilovers!)
5. Remove from heat and cool to below 90° F (32° C).
6. Transfer starter wort to a sanitized container that provides at least a couple of inches of headspace. A one-gallon (3.8 L) apple cider bottle works well, as does a brewpub growler or 3-liter soda bottle.
7. Aerate well.
8. Add yeast.
9. Close the container with a stopper and airlock or simply cover with aluminum foil.

Keep the starter warm, at the upper end of — or even slightly above — the supplier's recommended temperature range. Don't be surprised if you don't see a lot of foaming or airlock activity. Starters often ferment quickly, but quietly. If, after a day or two, you see yeast sediment in the container, your starter has been active.

Using the Starter

Once the yeast goes through the growth phase, the starter is ready. At this point, a layer of gray, putty-like yeast will have settled to the bottom of the container. You can decant the liquid and only pitch this yeast sediment, or you can pitch the entire starter. If you decant the liquid, you will lose some yeast still in suspension, but will not dilute your batch as much. If your starter was similar in gravity and color to your batch, however, diluting is not an issue and I recommend pitching the entire starter. In either case, you need to swirl the container to loosen the sediment on the bottom.

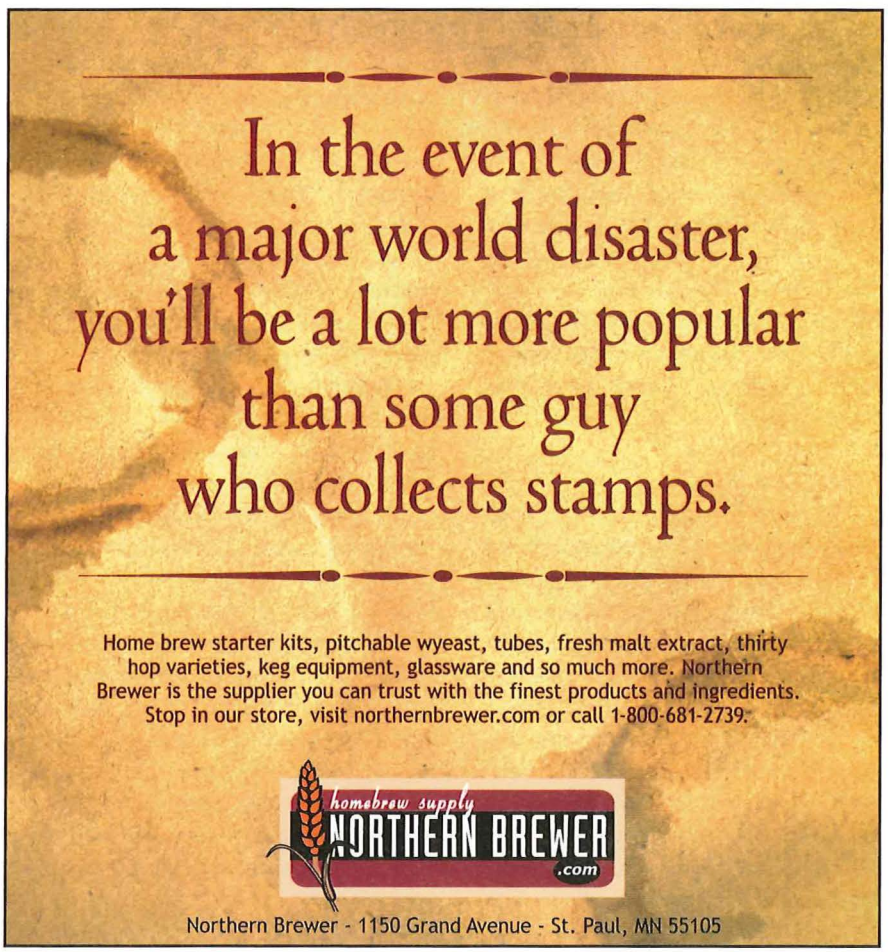
Other Sources of Yeast

An alternative to a starter is using the yeast sediment from a previous batch. Time your batches so that you are ready to pitch a new one just as you are bottling the previous one, or moving the previous one from primary to secondary, and you have a ready-made starter.

Some homebrewers pour the new batch in on top of the yeast sediment from the previous batch after moving the previous batch out of the primary fermenter. An alternative, which separates the new batch from the cold-break and hop residue of the previous batch, is to measure out about a cup (about 250 mL) of the previous batch's yeast sediment from either the primary or secondary fermenter and pitch that into the new batch. As usual, pitch more for a lager or high gravity ale.

Be aware that over several generations the yeast can mutate. For that reason, any changes for the worse in your beer should signal that it is time to stop reusing that yeast. Also, if a batch exhibits any signs of contamination, it's time for fresh yeast.

Should you use the yeast from the primary or secondary fermenter? Yeast from the secondary has gone through a longer fermentation period and spent more time in an alcohol-rich environment. For that reason, some brewers believe they are "tired" and less suitable than yeast from the primary. On the other hand, the yeast from the primary will have more trub mixed in with them, so some brewers feel the yeast from the secondary are "cleaner." I'd prefer fresh, "dirty" to "tired," clean yeast, but good beer has been made using both methods.



A final option with some strains is to skim the floating yeast from the top of the primary. This is my favorite way to harvest yeast, because you get the freshness of yeast from the primary, but avoid the trub. White Labs WLP022 and Wyeast 1007 are examples of strains that usually leave enough yeast floating on top for this to work. Use a carefully sanitized spoon to skim the yeast and save it in a sanitized jar under distilled water.

Pitching Temperature

Wherever you get your yeast from, avoid shocking it with a large temperature change when you pitch. Most brewers yeast strains can survive temperatures well over optimal fermentation temperatures. However, yeast do not like rapid temperature changes, for instance from pitching cold yeast into a batch of beer that has not been cooled adequately. Try to ensure that the temperature difference between your yeast and beer is 10 °F (5 °C) or less. Remove the yeast from the fridge, if that's where you're storing it, at least three hours before you use it to let it warm up.

Nutrients and Oxygen

Pitching enough yeast isn't all there is to it, though. You also have to provide the right environment for them. This means the right nutrients and enough oxygen for them to go through a healthy reproductive phase and move vigorously into fermenting your wort.

Yeast nutrients are available at most homebrew stores. The contents of these mixtures vary, but most contain zinc and diammonium phosphate (DAP). Some also contain common minerals like thiamin, niacin and folic acid, and many contain yeast hulls (the empty cells of dead yeast).

With all-grain recipes, the wort should contain all the nutrients the yeast will need. If the recipe includes a lot of adjuncts, there may be deficiencies. Extract or partial mash recipes may also benefit from the addition of yeast nutrients. Extremely high gravity wort, where the yeast is going to be stressed just converting all of the sugar to alcohol, can also benefit from additional nutrients. Usually a teaspoon or two, added to the boil, is all that is needed.

You need to get as much oxygen as possible into the wort immediately after it cools. This can be done by shaking the fermenter, splashing the wort, allowing air to be sucked in and mixed with the wort while siphoning, or by direct injection of air or oxygen using an aquarium pump or oxygen cylinder. Yeast require oxygen during their growth phase, when they are rapidly reproducing. Without it, they can't reproduce adequately and will come out of the growth phase weakened and unable to fully ferment the wort. The affect on the beer is the same as not pitching enough yeast.

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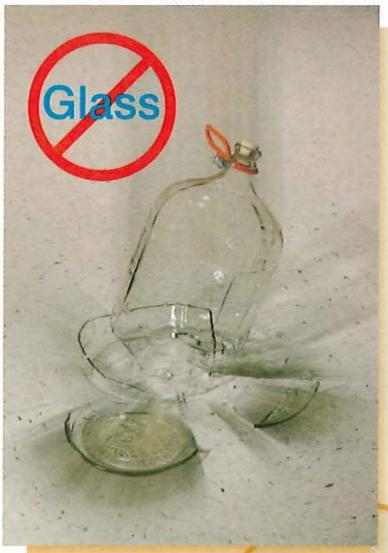

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Fermentation

Fermentation is where it all comes together, as far as homebrewing is concerned. Each strain of yeast has different characteristics it will impart to the beer and different conditions in which it will ferment most effectively. If you're making an imperial stout, for instance, you want yeast that can tolerate high gravity and the high alcohol content towards the end of fermentation. Examples would be White Labs WLP007 and Wyeast 1728. If your fermentation area is on the warm or cool side, pick a strain that will do well at that temperature. White Labs WLP001, for instance, ferments well at warmer temperatures while Wyeast 1007 does well at cooler temperatures.

Some extremely flocculent yeast strains may need to be roused during fermentation. You will need to shake the fermenter or stir the wort to get the yeast off the bottom and back into suspension. Wyeast 1968 is an example of this type of yeast.

The attenuation your yeast achieves is dependent on all the things we've discussed up to now, as well as on the fermentability of the wort. If you under-pitch, fail to aerate, keep the fermenter too cool or use a yeast intended for low gravity beers in a high gravity wort, then under-attenuation is a likely result.

During fermentation, about all you have to do as a homebrewer is ensure that the temperature remains in the recommended range and (at least roughly) constant. Also, keep your carboy away from bright lights, especially bright sunlight. A dark t-shirt over the carboy is all you'll need for light protection if your fermenting area is brightly lit. If you have taken care of yeast nutrition and aeration, sit back and let the yeast do their work.

Yeast for Bottle-Conditioning

After the wort ferments, the yeast will eventually settle out and the beer will appear clear. Even after beer has fallen clear, it still has yeast in it — enough yeast for bottling in almost all cases. Some homebrewers, however, still prefer to add some bottling yeast for quicker conditioning. If you add fresh yeast, it is not necessary to pitch as much as for a completely new batch. The Sierra Nevada brewery, for instance, adds only enough yeast to their bottle conditioned beers to get about 250,000 cells/mL, or the equivalent of 1 teaspoon (5 mL) of yeast slurry in a 5-gallon (19 L) batch. ■

Don Million wrote "Keg Your Beer" in the March-April 2003 issue of BYO.

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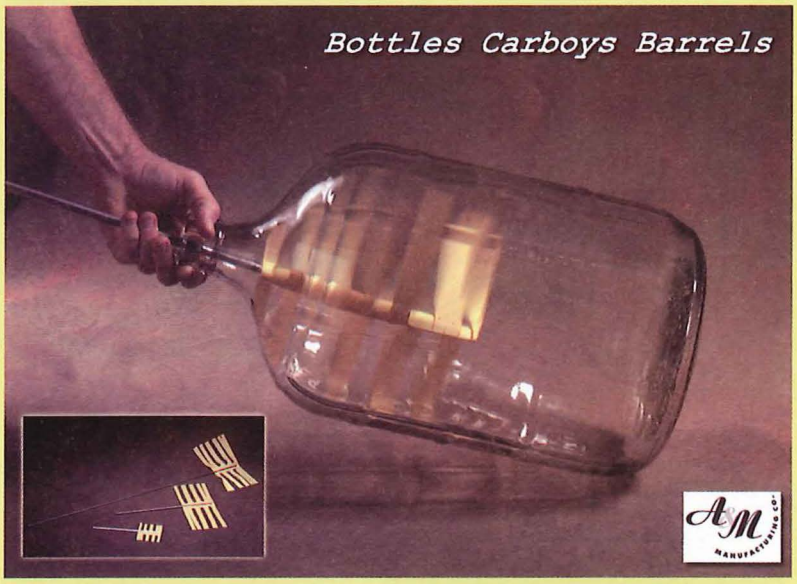

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Dry hopping

For maximum hop flavor and aroma

Story by Donald Million

Hops play a number of roles in the brewing process. Depending on when they are added, they contribute bitterness, flavor, aroma or something of all three. The bitterness comes from alpha acids contained in hops, while flavor and aroma come mostly from volatile oils. The term volatile refers to the fact that the oils boil out of the wort relatively quickly — most within 15-20 minutes. This is why brewers normally add flavor and aroma hops closer to the end of the boil. For maximum flavor and aroma, and to preserve as much of the volatile oils as possible, some brewers practice dry hopping.

What Is dry hopping?

The term dry hopping originated centuries ago with British brewers and was used to refer to adding hops to the cask shortly before it was shipped off to the customer. In fact, ½-ounce hop plugs were specifically developed by British hop producers to be a convenient way to add whole hops to a keg or cask. Nowadays, dry hopping refers to any hop addition after the wort has been cooled. These additions can be done in the primary fermenter, in the secondary or by adding hops directly to a keg. I have even heard of one homebrewer attempting to add one or two hop petals to each bottle of a bottle-conditioned batch! (It didn't work though.)

Pros and cons

Due to the fact that no volatile oils are boiled off, the benefit to dry hopping is that the brewer can get as much flavor and aroma possible into the final beer. This can give your beer a floral hop essence and an intense flavor that is desirable in hoppy beer styles like pale ales and IPAs. Some commercial beers that are dry-hopped include Sierra Nevada's Celebration Ale, Young's Special Ale, Anchor Liberty, and Sam Adams Pale Ale.

What dry hopping does not add to the beer is bitterness. Boiling is necessary to convert the alpha acids in the hops to iso-alpha acids to create bitterness. To maintain your desired bitterness, you still need to add the bittering hops to the boil.

The lack of boiling, however, is also a potential drawback of dry hopping. That is, since they are not boiled, the hops are not sanitized. This seems to worry a lot of brewers, especially those who haven't tried dry hopping before. The truth is that hops do not provide a supportive environment for most types of bacteria. On top of that, if the hops are added to the primary fermenter after the start of fermentation, any bacteria on them will have a difficult time competing with the vigorously active yeast in the wort. If the hops are added to the secondary fermenter then the alcohol content and the low pH of the beer will suppress bacterial growth. Keeping this in mind, it's safe to say that bacterial contaminations caused by dry hopping are extremely rare and not worth worrying over.

The only other drawback to dry hopping is that some beer drinkers just don't like the effect. They think it makes the beer taste "grassy" or "oily." This method definitely gives a different kind of flavor and aroma than the traditional method of adding hops to the boil, but if you like any of the commercially dry-hopped beers mentioned, you will probably like it in your homebrew as well. Personally, I love it!

Which hops to use?

The first step in dry hopping is to select the hop variety to use. You normally want to use a hop variety that is considered a "flavor" or "aroma" hop. It is common for these hops to have relatively low alpha acid ratings, often around 6% or less. Some hop varieties commonly used for dry hopping include Cascade, Crystal, Willamette, East Kent Golding, Fuggle, Saaz, Hallertau and Tettnanger.

Of course, one of the beauties of homebrewing is that you do not have to

RECIPE

Dad's Day Pale Ale

(5 gallons/19 L, all-grain)
OG = 1.052 FG = 1.013
IBU = 35 SRM = 14 ABV = 5.1%

I first brewed this beer on Father's Day several years ago. It is an easy-to-make American-style pale ale.

Ingredients

10 lbs. (4.5 kg) 2-row pale malt (2 °L)
1 lbs. (0.45 kg) crystal malt (80 °L)
9.5 AAU Cascades or Willamette hops (bittering)
(1.9 oz. /54 g of 5% alpha acid)
2.0 oz. (57 g) Cascades or Willamette hops (dry hop)
Danstar Windsor, Wyeast 1056 (American Ale) or White Labs WLP001 (California Ale) yeast

Step by step

Crush malt and mash with 3.5 gallons (13 L) of water at 165 °F (74 °C). Mash should settle in at about 152 °F (67 °C). Rest for 40 mins. Raise mash temperature to 168 °F (76 °C) for mash-out for 10 mins. Sparge with about 4 gallons (15 L) of water at 168 °F (76 °C). Collect 6 gallons (23 L) of wort. Bring to boil and add bittering hops. Boil for at least 60 mins. Chill wort and aerate well. Pitch 10 g of dried yeast or a quart (~ 1 L) starter of liquid yeast. Allow to ferment for about one week. If bottling, put dry hops in secondary fermenter and rack beer on top of hops. Leave in secondary for 1-2 weeks. If kegging, place dry hops in a sanitized bag and rack beer on top of bag. Force carbonate. After carbonating, let the beer sit for at least a week to absorb hop essence.

Extract option:

Extract brewers can substitute 7 lbs. (3.2 kg) of light DME for the 2-row and steep the crystal grains at 160 °F (71 °C) for 20 minutes.

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follow anyone's suggestions; you can try whatever you want. This being said, some homebrewers dry-hop with high alpha acid varieties like Centennial and Chinook. Personal preferences vary, and you should experiment to see what you like. In general, if you like the results of using a particular hop variety in the last 5–10 minutes of the boil then you will probably like the results of dry hopping with the same variety.

When to dry hop

Once you've decided what hops you're going to use, you need to decide when to add them. The choices are in the primary fermenter, in the secondary fermenter, or in the keg.

dry hopping in the primary fermenter will work, and is favored by some brewers, but conventional wisdom teaches that the primary might not be optimal. The problem lies in the bubbling of the CO_2 and the agitation of the wort during primary fermentation. This bubbling and agitation takes some of the hop aroma out of the beer just like boiling would. This, of course, may defeat the purpose of dry hopping, although some of the hop essence will subsist. If you choose to dry-hop in the primary fermenter, you may want to add more hops than you would for dry hopping in the secondary or keg.

The secondary fermenter is generally considered the best place for dry hopping for a couple of reasons. First, the beer has already mostly fermented so, as mentioned above, the alcohol and low pH helps to ward off any bacteria on the un-sanitized hops. Second, the vigorous CO_2 activity of the primary is finished, so the aroma of the hops won't be scrubbed out of the beer.

There is, however, one potential difficulty with dry hopping in the secondary. Many brewers use glass carboys with narrow necks as their secondary fermenters. Getting the hops into, and then back out of, the slender opening can be an exercise in frustration. This is especially true if you like to keep the hops in a bag, making it easy to separate them from the beer. My recommendation is to use a bucket with a large opening rather than a carboy, or to forget about putting the hops

in a bag and just dump them in. You can then separate the hops from the beer when racking to your bottling bucket or keg.

The final option for dry hopping is in the keg. Here, it is advisable to use a muslin or cheesecloth bag to contain the hops. Otherwise you run the risk of sucking hops into the system, clogging it up, or getting hops into your glass. One concern with dry hopping in the keg is the extended duration that the hops are in contact with the beer.

Some brewers feel that if the hops are in the beer for more than a few weeks, the beer develops a "grassy" flavor. Personally, I've never experienced it, despite leaving hops in my kegs for as long as six weeks.

Pellets, plugs or loose?

Okay, you've decided on the variety of hops to use and when to add them. The next question is, what form of hops to use? The choices are the same as the hops that you add to the kettle: pellets, plugs, or loose. The pros and cons are a bit different though.

As I said before, plugs were originally designed specifically for dry hopping and they work quite well for that purpose. They're easy to measure (since each plug is a ½-ounce), easy to put into a bag if you choose, and are easy to fit through the neck of a carboy — even more easy if you cut them in half.

Loose hops have to be weighed, but are also easy to stuff through a carboy neck — not so easy if put in a bag though.

Pellet hops also have to be weighed, but are probably the easiest type of hops to pour through a carboy neck. They are also easy to put into a bag, but only a very fine bag will contain the powder when they dissolve.

On the other hand, pellets can cause a sudden eruption of foam that will have you scrambling for a towel and wondering what sort of alien being has taken over your beer. This is because as the pellets break apart (almost immediately) they provide thousands of nucleation sites for the CO_2 in the beer to attach itself and come out of solution. Be careful and go

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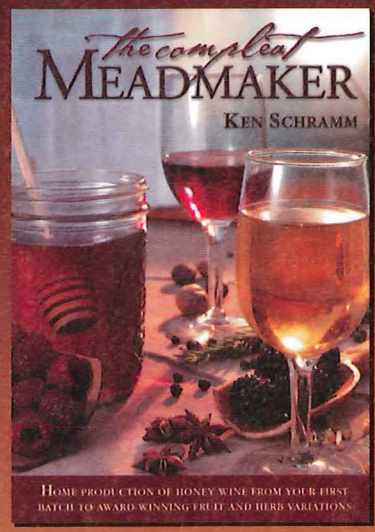

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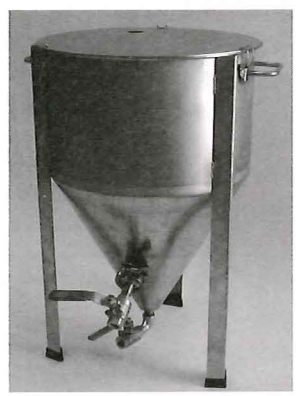

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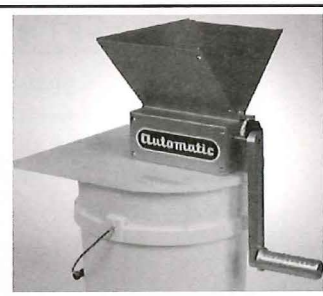

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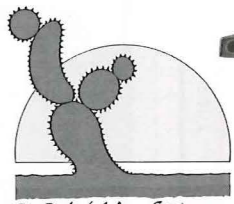

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slowly when adding pellet hops to any nearly full container.

Pellet hops will sink when well soaked. Plug and loose hops usually float. Either way it's not too hard to rack the beer away from any form of hops if you are careful. Since pellet hops are more highly processed than plugs or loose hops, there is some concern that volatile oils are lost. When using pellets for dry hopping, you may want to add a little more than usual.

How much?

This brings us to the question of quantity. A "normal" measurement for dry hopping is between 1–2 oz. (28–56 g) of hops for a five gallon (19 L) batch. But the real answer to the question of how much is simply, "as much as you want." If you want just a hint of hop aroma you might go as low as a ½ oz. (14 g). If you want a beer that will knock you over with a pungent hop flavor and aroma, you might decide to go nuts and throw in 4 oz. (112 grams). I've heard of brewers using even more than this, but even a serious hophead like myself will tell you that more than four ounces of dry hops may be pushing it.

You should also take into account the variety of hop. If you're using a hop with a high essential oil content, you probably don't want to use as much as you might if you were using something less oily.

My advice for your first experiments with dry hopping would be to pick a traditional aroma hop and use no more than 1 ounce (28 g). This will give you a good idea of what dry hopping does for a beer. From there you are only limited by your own sense of adventure in deciding what hops to try and how much to use.

To bag or not to bag?

The final question in dry hopping is whether or not to put your hops in a bag. Bagging your hops can make them easier to retrieve when either you or your beer decides it's time. On the other hand, hops tend to expand when wet, so a bag that you were able to stuff through the neck of a carboy dry may be difficult or impossible to get out when fully saturated.

Another issue with bagging is that it tends to reduce the hops exposure to the beer. To account for this, you may want to use 10–15% more when bagging. Also, while the hops are naturally resistant to bacteria, the bag is not. Because of this, you should always boil the bag to sanitize it before putting hops in it.

If you're a fan of hop flavor and aroma, you really have to try dry hopping your homebrew. I'm enough of a hophead that, unless it is completely inappropriate for the style, I am dry hopping nearly all of my beers these days and enjoying every one of them. ■

Don Million also wrote "Beauty and the Yeast" on page 38 of this issue.

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pH pHacts

The role of pH in brewing

Homebrew Science

by Steve Parkes

IN A PREVIOUS ARTICLE on water chemistry, I raised the subject of pH and its effect on mashing biochemistry. I intend to revisit this subject here and also to give an overview of the way pH influences beer properties and the brewing process.

First the basics — pH is a measure of hydrogen ions (H^+) in solution. Water (H_2O) exists as a mixture of H_2O molecules and its component ions H^+ and OH^-. In solution, hydrogen ions (H^+) are always associated with one or more water molecules and are nowadays usually written as H_3O^+ to reflect this fact. An H_3O^+ ion is called a hydronium ion. In pure water at 25 °C, there are roughly two H_3O^+ and OH^- ions for every billion water molecules. This corresponds to a concentration of 10^{-7} mol/L.

In 1909, a Danish scientist named Soren Sorenson devised the pH scale while working at the Carlsberg Brewery in Copenhagen. He devised a logarithmic scale that runs from 0–14 and represents the negative log of the hydronium ion concentration. For example, if the concentration of H_3O^+ ions in a solution was 10^{-5} mol/L, the pH of that solution would be 5. A pH value of 7 is considered neutral because, at 25 °C, the concentration of H_3O^+ ions in solution equals the concentration of OH^- ions. Values lower than 7 are acidic and higher are basic (or alkaline). Each single number change on the pH scale represents a 10-fold change in hydronium ion concentration. The addition of acids, which donate H_3O^+ ions to a solution, lower the pH of a solution. Bases (or alkalis), which donate OH^- ions, raise the pH of solutions.

The pH of a solution can be measured using pH papers in which a paper strip is impregnated with a dye whose color is determined by the H_3O^+ ion concentration. Or it can be measured more accurately using a meter that measures the flow of electrons across a glass membrane. The flow is caused by the difference in electron concentration in the test solution and a standard solution inside the electrode.

Homebrewers have access to reasonably priced pH meters and they make a useful addition to your homebrewing tools, provided you plan to take steps to influence your beer's pH.

A pH meter should be calibrated each brewing session by presenting the electrode with at least two different standard buffer solutions. In most cases, we use standards of pH 4 and 7 (well, 4.01 and 7.01, really) to calibrate the pH meter. This is great for brewers, since we're really interested in the pH range of 4 to 8. This range encompasses typical pH values for mash, wort, all water used in brewing and the final product. Once the meter is 'trained" to recognize the pH of the standards, it can then identify the pH of an unknown solution. Due to the logarithmic nature of the scale, small differences in recorded values in the brewery represent huge differences in the actual hydronium ion content to the point where a change of 0.1 pH unit represents a doubling of the actual hydronium ion content.

Why is all this important? Well, almost every reaction occurring in our breweries is carried out by enzymes; the mash conversion, the reactions in fermentation and the maturation all require enzymes to work. Every enzyme has an ideal pH at which it operates most rapidly. Even those reactions dependent on chemistry rather than biochemistry (i.e. non-enzymatic reactions) such as hop resin isomerization, haze formation, color development or beer staling are influenced by pH. Finally our perception of a beer's flavor, after-taste and mouth-feel are influenced by the beer's pH.

Mash

A mash carried out with distilled water will end up with a mash pH in the 5.8–6.0 range due to the buffering capacity of weak organic acids and amino acids from the malt. Buffering capacity refers to the ability of some chemicals to resist a change in pH of a solution when acids or bases are added to the solution.

Calcium ions in the brewing water, however, react with phosphate ions in the malt to release H_3O^+ ions and acidify the mash. Hence the presence of calcium ions can lower the mash pH to the 5.4–5.6 range. This drives the pH in the mash toward the optimal conditions for each of the two main mashing enzymes, alpha amylase (pH between 5.6–5.8) and beta amylase (pH between 5.4–5.6). Thus, the presence of calcium in the mash increases extract recovery from the malt. Most water contains calcium and so in a lot of cases there is enough present in the water for mashing. If not, calcium can be added to the mash in the form of calcium sulfate ($CaSO_4$, gypsum) or calcium chloride ($CaCl_2$), either by adding the salt directly to the mashing water or by mixing the solid material in with the milled malt prior to mashing.

typical pH values in brewing

mash	5.2–5.6
final runoff	up to 6.0
boil	up to 5.8 (start) 5.3 (end)
fermentation	5.3 (start) 4.3 (end)
conditioned beer	3.9–4.4

Some brewers, particularly German brewers, feel that protein solubilization, breakdown and particularly amino acid production is an important factor in mashing and so indulge in a whole range of temperature rests. Some of the enzymes responsible for this action have optimal pH's far lower than simple calcium treatment will allow (provided they survive kilning,

which in the case of British malt is unlikely). These brewers treat their mashes with acids in order to drive the pH lower still. Lactic, phosphoric, citric and even sulfuric acids may be used to drive the mash pH down to the 5.2–5.4 range.

Sparge water is another area where brewers need be concerned about pH. Sparge water is the hot (150–170 °F/66–77 °C) water sprayed onto the surface of the grain bed in the mash tun to replace the strong wort as it is drained from the bottom of the mash. It is strained through the grain bed and collected as it contains diluted wort. As the run off of wort from the mash tun nears its completion, the liquid being collected is quite close in composition to the water added to the grain bed above. It is very weak and contains little in the way of dissolved sugars, amino acids and buffering ability. Thus the pH can rise. If it rises above 6.0, it can extract some of the more undesirable compounds that would otherwise remain in the spent grain, namely polyphenols. Polyphenol (tannins) compounds are a part of beer haze and can provide harsh astringent beer flavors.

Dimethyl sulfide — the compound responsible for the corn, tomato, or stewed vegetable flavor in beer — is also influenced by pH.

Kettle

In the kettle, pH plays a vital role in the various chemical reactions. The pH drops during wort boiling, again due to the reaction between calcium and phosphates. This is why some brewers wait to add gypsum in the kettle where the solid calcium salts are more soluble, relying on there being enough calcium already dissolved in the water to take care of the needs of the mash. Protein coagulation and hence hot break (or trub) formation is improved at lower pH's. This improves the beer's clarity and reduces its susceptibility to chill haze. However, lower pH's reduce the efficiency of hop alpha acid isomerization and solubility, which optimally occurs at pH values that are higher than those found in most kettles. The same applies to the reactions that darken color. Lower pH's result in less color pickup than higher ones.

Dimethyl sulfide (DMS) — the compound responsible for the corn, tomato, or stewed vegetable flavor in beer — is also influenced by pH. The conversion of the pre-cursor during boiling is slower at lower pH's.

Another factor influenced by pH during boiling is the action of kettle finings or Irish moss. They too have an optimal pH at which they are most effective. Luckily it's around 5.3, where

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we expect our boiled wort pH to end up anyway. If you drop the wort pH in the kettle to 5.0, you need to use 50% more kettle finings for the same result. Below 4.4 they do not work at all. There are many German brewers who feel it is also necessary to reduce the pH of the wort in the kettle to influence the final beer pH, something that simply acidifying the mash cannot adequately achieve. This will involve direct addition of acid to the kettle to drive the pH down to 5.1-5.2. Of course, this reduces hop extraction efficiency but does provide additional benefits associated with having a low final beer pH, one of which is a "cleaner" perception of the bitterness.

Fermentation

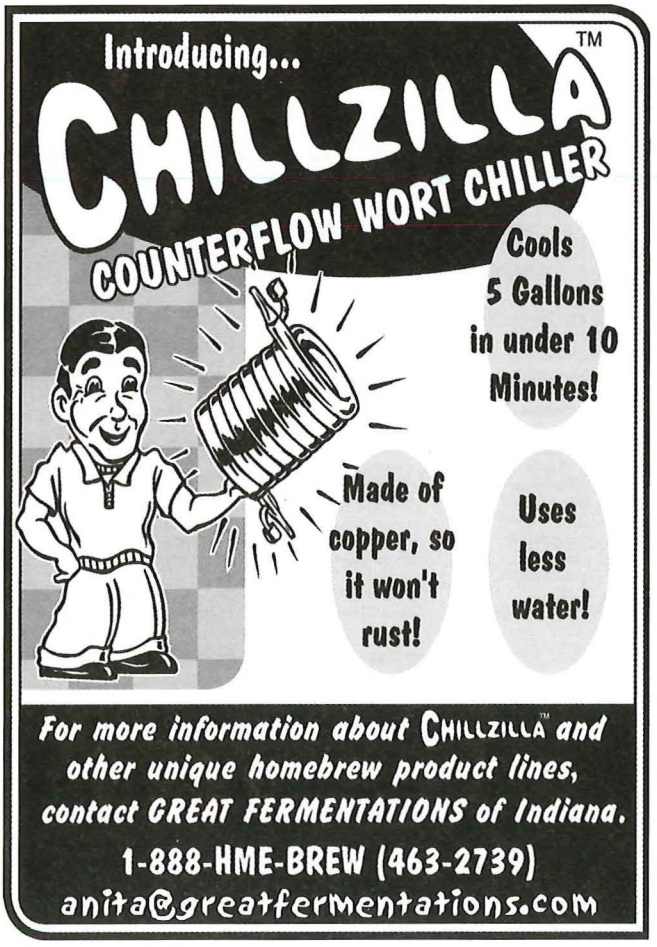
During fermentation, the pH of the wort drops rapidly. In the first 24 hours, the pH should fall from 5.3 down to 4.3. This is due to the rapid consumption by yeast of buffering capacity (i.e. amino acids) and the related production of acidic material such as organic acids. A slow fermentation or a long lag phase from your yeast will delay, or slow this drop and could result in beer flavor problems. The main issue would be in the ability of contamination in the form of spoilage organisms to gain a foothold while the pH is higher than 4.4.

During fermentation, the pH of the wort drops rapidly. In the first 24 hours, the pH should fall from 5.3 down to 4.3.

As you can imagine, the multitude of biochemical reactions occurring in a fermentation vessel with the multiple billions of enzyme reactions occurring every second the pH is likely to have a profound influence on the rates. Remember also that quoted values for enzyme pH's refer to optimal rates and that enzymes are still active on either side of their optimal pH figure.

One simple example is the production, conversion and ultimate reduction of diacetyl, the buttery or butterscotch flavored by-product of a fermentation. Lower pHs (between 4.2 and 4.4) tend to favor the removal of diacetyl. For most beers made from American malt, or German-style lager beers, the final beer pH will be in the region of 4.2–4.4. For English-style beers, and cask conditioned beer in particular, the final beer pH will invariably be in the 3.9–4.1 range.

A combination of factors probably account for this, including additional buffering from higher protein malts in lager brewing, more rapid fermentations in ales, water salts in ale brewing and the tendency to use kettle sugars in ale brewing which offer no buffering. As beer matures, the pH will begin to rise slightly as yeast cells autolyse



and release their contents into the beer. In fact, one test for yeast health involves measuring the pH difference between a slurry of yeast and the liquid around it. It can also be shown that reduced beer pH improves head retention in finished beer. Brewers who utilize isinglass finings should be aware that the action of finings is pH dependent. The action relies on electrical attractions between oppositely charged components and the degree to which a charge is expressed is dependent on pH. In general, high beer pH adversely affects fining action.

In general, the following benefits are known to be achieved by having the pH fall in the correct range throughout the process. The extraction of material into solution in the mash tun will be enhanced, the separation of the wort from the spent grain will be better. Hot break will be better and so later beer clarification will be easier. The beer will be less prone to contamination from spoilage organisms and maturation will be more successful.

Finally, a whole range of research has been done on the way pH influences a beer's sensory qualities. Lower beer pH (4.2–4.3) in lager brewing is said to provide a rounder, fuller, softer flavor. When brewing British-style ales, a pH on the lower end of the appropriate range (3.9–4.1) produces beer with a sharper, crisper, and fresher flavor. As pH drops below 4.0 (as it may in British-style bitters brewed with British malt) the beer tastes sharper and more acidic and the perception of astringency is enhanced. Hop bitterness is said to be more pleasant and less harsh and lingering, although it may be perceived at a higher level than measured. The beer's foam is more stable and finer. The excess of hydrogen ions in the mash and throughout the process is also likely to influence the beer's balance between its reducing power and its oxidizing potential, especially given that it is the OH- ion that is heavily implicated in these redox reactions. The OH- ion is a highly reactive ion that readily accepts a hydrogen ion. Lipid material in the mash readily gives up hydrogen causing it to begin the pathway that leads to staling aldehydes. Thus a lower mash pH will theoretically improve a beer's flavor stability in regard to oxidation. However, Japanese research shows that natural antioxidant protection from sulfite and polyphenols is reduced at lower pH's, so once again the debate rages on.

As a homebrewer what does all this mean and how can you influence any of this? You Should be aware of the flavor effects yeast autolysis has on your homebrew. Essentially though, brewing with all malt, good water, healthy yeast and clean equipment will take care of most of this on its own. ■

Steve Parkes is the owner and lead instructor of the American Brewers Guild and head brewer at Otter Creek Brewing in Middlebury, Vermont.

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Bottle Washer Deluxe

The original bottle sprayer gets a face lift

story and photos by Thom Cannell

I've been making homebrewing gadgets for years — my first project being completed before my first batch of beer. Some work better than others. A recent example is the "Clean-In-Place" bottle sprayer. It's a nice innovation, but after putting a year's worth of mileage on the original bottle washer, I've discovered its shortcomings. Specifically, the original was wasteful of sanitizer and sized to fit over a bucket. The original also relied on pinching a tube to provide on/off capability.

I'm thrifty and hate to spill gallons of useful sanitizer. I wanted a better bottle cleaner, one that would be small, portable, inexpensive to build and inexpensive to operate. I also had a Cornelius keg with pinhole leaks that I couldn't weld into usefulness.

A keg, I thought, would hold gallons (3.7 L) of sanitizer solution or other cleaner. Inside its circular cavity should be an upwards pointing spray wand, and something to support a bottle of any size. The keg would be easy to plumb, with one hose to gather used liquid and another to connect to the sprayer. I would need a pump to power the sprayer, then I'd have a great little bottle washer.

Why use a "corny" keg? Kegs are ubiquitous and inexpensive; and those are the functional ones. There are plenty of severely dented or leaking Cornelius kegs out there headed for the scrap heap. Surely, you can think of a way to rescue one or two? And if you can't locate one, any sturdy metal or heavy plastic cylindrical container — perhaps a flour canister — could work.

Construction Step by step

First, cut your keg and clean up the edges. Begin by marking your keg at the halfway point. This will give you a potential volume of at least one gallon (3.7 L) of solution. Lay the keg on its side and rotate it against a fixed marker. This will be your cutting guide, so be sure it is accurate.

Cut the keg. I used a small grinder equipped with a cutoff wheel, but a hacksaw or jig saw with a fine (24 tpi) bimetal blade or grit-coated blade would work as well. If you're using power tools, wear ear and eye protection. Once the keg is cut, grind and file the edges until level and smooth. This is thin steel, and it can retain sharp edges, and burrs — be sure to smooth them out. Files, sandpaper and grinders can all be used.

To prevent cutting yourself, you may wish to coat the finished edge with silicone sealant. You could also cut a length of otherwise useless racking tube lengthwise and fit it over the edge. This also provides a convenient anti-skid rest for the carboys.

Holes — the In and Out

There are several ways to make bulkhead fittings for the container.

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Conelius keg $10 or less
⅜-inch (10 mm) copper tube $1.00 (scrap)
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⅜-inch x ⅜-inch Compression Connector $1.60
¾" x ⅜-inch brass Female garden hose barbed adapter
⅜-inch polyethylene tubing 10' (3 m) $3.00
Little Giant drill powered pump $8
Or RIMS pump - $120
plus quick disconnects, $22.00 (approximate) ⅜

(Bulkhead fittings are the leak proof connectors that penetrate the container wall.) One kind involves welding a stainless steel nipple or union into the container's wall. Another, which I recommend, is building inexpensive bulkhead fittings for the intake and output. These can be made from a brass compression fitting with male NPT threads and ⅜-inch tubing. This tubing leads to a ⅜-inch pipe (10 mm) and through a hole (that you'll drill) to the outside.

Outside, and securing the assembly, is a ⅜-inch (10 mm) female NPT barbed fitting. That's the nut. To seal these together and prevent leakage, you'll need an interior "O" ring of proper size. Ordinary garden hose

The original bottle sprayer functioned well, but had certain shortcommings.

The new bottle washer addresses size and waste concerns of the old system.

The project calls for a Cornelius keg to be measured, cut, and smoothed.

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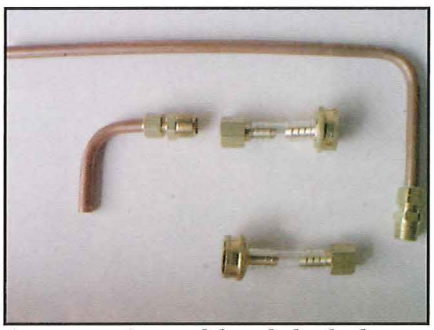

A compression and female barbed connector comprise each bulkhead fitting .

washers also work well for ⅜-inch fittings. It's your choice. You may need a thick washer. This is because NPT fittings are not meant to fit snugly together. I made a washer out of scrap Plexiglas for the spray side and used two hose washers for the intake — one inside and the other out. Drill a ⅝-inch (16 mm) hole for our chosen fittings and you're done.

These holes belong above the chine and cylinder. (The chine is the welded joint between the keg's bottom "cup" and the cylindrical body, just above the rubber bumper.) I measured one inch (25 mm) above the chine, used a prick punch to mark the location and drilled a ⅛-inch (3 mm) pilot hole before drilling the larger hole.

Intake and Output Construction

Liquid is stored in the bottom of the container, then pumped into a spray wand. Both the intake and spray wand were bent out of scrap tubing (⅜-inch or 10 mm) using a tubing bender. You can also use the stainless steel keg spear, but copper is easier to bend.

Bend a right angle that is about 1.5 inches (40 mm) by 3 inches (75 mm). Later we will trim this pickup tube to size. Then bend a right angle with one leg equal to your keg's radius and the other about 12 inches (300 mm) long for the spray wand.

The pickup tube should extend downward from the side of the container to within a ½-inch (13 mm) of the bottom. The spray wand should be centered in the keg.

Supporting your Favorite Bottle

I had difficulty figuring out how I would hold the wide variety of bottles I use. I needed a method that would not require me to hold every bottle while washing. I found that a scrap of 2-inch (50-mm) PVC pipe would support the shoulders of every bottle I use. Long necks, squatties, champagne punts and bail-tops all happily sat atop the tube. Three-inch PVC pipe may work better

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if you use gallon wine jugs with handles. With a hacksaw, I slit a 7-inch (175-mm) tube 3 inches (75 mm) deep and widened the cut with more cuts and rough files. I produced a ½-inch (13-mm) gap that allows the PVC tube to slide over the spray wand and allows all the liquid cleaner to spill away freely — Easy, cheap, and elegant.

Making a Spray Tip

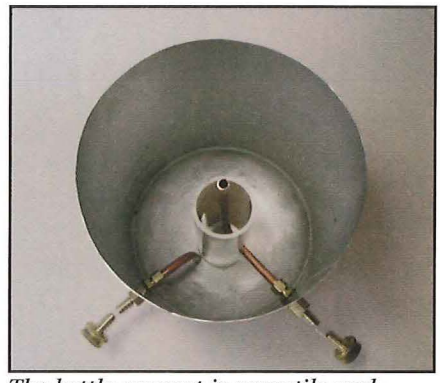
The final construction involves making a spray tip. There are a variety of methods for this. If you have access to a Tractor Supply Company store you might purchase a genuine replacement spray tip for about $10. You can mash the tube almost flat with a hammer to produce a fan-shaped spray. You might round the tube over nicely and drill 1-5 holes. You can also make a variety of spray tips, and see which works best with different bottles and pumps.

I cut the spray wand approximately 3 inches (75 mm) below the bottom of my shortest bottle, then made a variety of spray tips to test. They had smashed ends and different amounts and angles of drilled holes. To join each 1-inch (25-mm) spray tip to the open spray wand only requires an inch of ordinary poly racking tubing. You'll want to use Oetiker or low pressure clamps — the pump will blow the spray tip out of its racking tube sleeve.

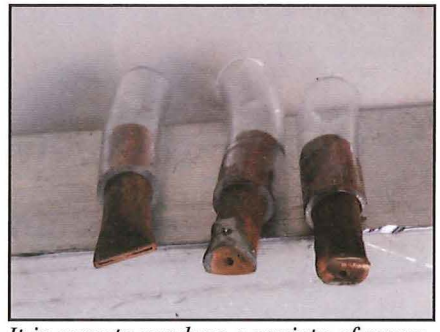
Pump Hookup

To complete the project, join each barbed fitting on the keg to the correct inlet or output fitting of your pump with clear tubing and clamp. Drill powered pumps cost less than $10 use garden hose fittings, and require no on/off valve. Barbed adaptors and ⅜-inch (10-mm) hose of suitable length complete this pump type. If you want to use your RIMS or transfer pump, I'd recommend quick disconnects as a time saver. ■

In next month's installment of Projects, Thom Cannell motorizes a malt mill.



The bottle support is versatile and holds nearly all types of bottles.



It is easy to produce a variety of spray tips, each with its specific purpose.

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BETTER-BOTTLE

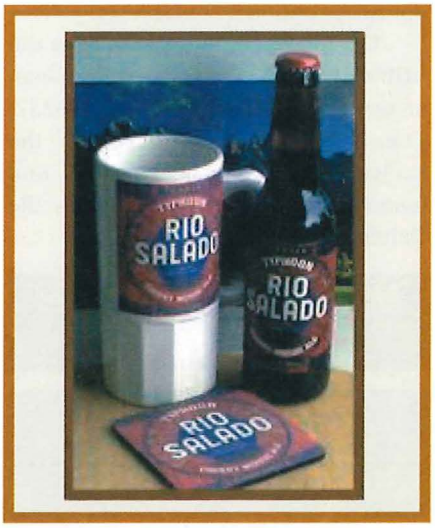
The Better-Bottle is a five-gallon carboy made from a new kind of PET (polyethylene terepthalate copolymer). PET is an unbreakable, colorless plastic. While most glass carboys weigh 12 pounds (5.4 kg) empty, the Better-Bottle weighs just 1.5 pounds (0.7 kg), making it easier to handle, especially during cleaning. The PET rinses as quickly as glass, making the carboy easy to sanitize. The new product is food-grade and FDA/NSF approved.

This high-tech form of PET does not impart a "plastic" flavor to beer. Tests show that even root-beer flavor, a particularly potent contaminant, rinses easily out of the Better-Bottle. In addition, the new plastic is almost entirely impermeable to oxygen.

A high-tech PET closure provides a tight seal at the neck. This stopper can accommodate attachments such as an airlock and a number of hose-barb adapter plugs. The rotating collecting-tube allows you to take a beer sample anywhere from 0.1–5 inches from the bottom of the carboy. A carrying handle snaps over the neck. For information, go to www.better-bottle.com.

CUSTOM BEER MUGS

The Coffee Mug Factory has expanded its product line to include



custom-made beer steins. The business transfers digital imaging and text from homebrew labels onto 16-ounce ceramic beer mugs. The mugs are dishwasher safe and highly durable. The Coffee Mug Factory's Website (www.thecoffeemugfactory.com) allows the homebrewer to upload his logo, images and text to be placed on the stein, and begin the design process. To compliment the mugs, The Coffee Mug Factory prints logos on washable rubber coasters; these have a striking resemblance to miniature mouse pads! Business owners Jim and Diane Kurtz came up with the idea after completing a ceramic tile project for the Rio Salado Brewing Company in Tempe, Arizona.

The project involved heat-transferring the brewing company's beer logo onto ceramic tiles for use in the bathrooms. The idea of putting logos onto ceramic mugs came naturally to the couple in the coffee (and now beer) mug business.

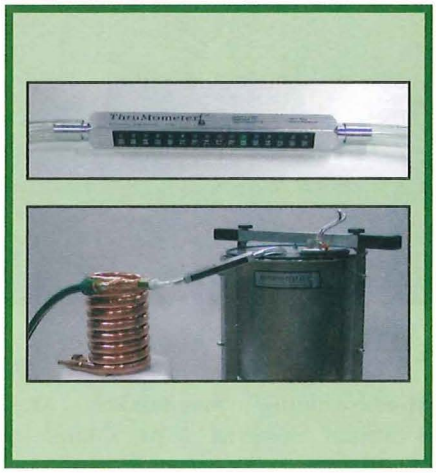
FIRST CERTIFIED ORGANIC HOMEBREW SUPPLIER

Seven Bridges Cooperative in Santa Cruz crossed another bridge for the world of homebrewers, becoming the first hombrew supplier to gain full certification under the USDA National Organic Program (NOP) by the California Certified Organic Farmers. Every product offered by Seven Bridges, including barley malt, hops, extract, brewing herbs, and adjunct grains are certified organic. Even the cotton straining bags fall within the organic certification guidelines.

The co-op also sells its own line of organic beer ingredient kits. The October 21, 2002 USDA Federal organic rule guarantees the consumer that organic products are grown without toxic pesticides, herbicides, or fertilizers.

Products labeled organic also cannot contain genetically modified organisms and are free from irradiation. The complete Seven Bridges catalog of products can be found online at www.breworganic.com, or a printed version of the catalog can be ordered by calling 1 (800) 768-4409.

THRUMOMETER

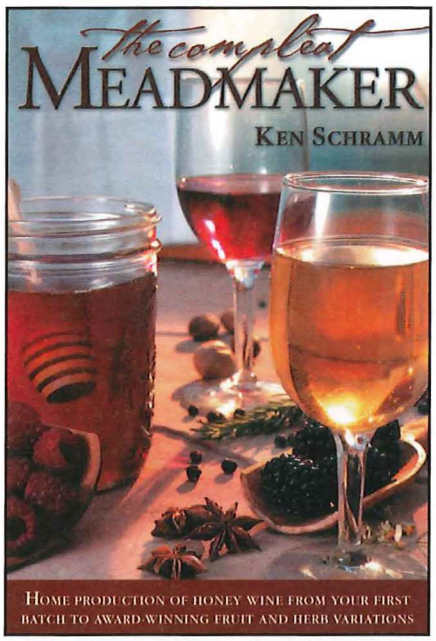


Blichmann Engineering has released a new in-line thermometer for measuring wort temperature. The "Thrumometer" allows the homebrewer to adjust the wort and water flow rates in his counterflow heat exchanger. This enables the brewer to dial in the exact wort temperatures that specific yeast cultures require. It differs from traditional in-line thermometers

in that it is constructed of a highly conductive aluminum, rather than pipe fitting — which is susceptible to bacteria. The inner passage of the Thrumometer is mirror smooth, permitting zero tolerance for bacteria to hide and contaminate your wort.

The liquid crystal thermometer responds quickly (up to 1 °F per second), and measures to 0.5 °F. Unlike digital and bi-metal thermometers, the Thrumometer will never need calibrating and is built to last a lifetime with a heat-treated, corrosion-resistant aluminum.

THE COMPLEAT MEADMAKER

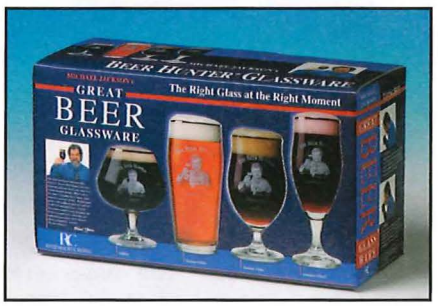


The Association of Brewers and award-winning meadmaker Ken Schramm released "The Compleat Meadmaker." Appropriate for the novice and experienced brewer alike, this book offers modern home production techniques for the world's oldest alcoholic beverage — mead or "honey-wine."

The 212-page book contains easy-to-follow procedures, simple recipes, and in later chapters, flavorful variations of mead that incorporate spices, fruits, grapes, and malt. Schramm is the founding competition director of the Mazer Cup, the oldest American mead competition and has twice prepared the commemorative mead for the AHA's national conference.

The book can be purchased at the AOB's Website at www.beertown.com or over the phone at (888) 822-6237. The book is also available on the shelves of many bookstores, and homebrew specialty shops across the United States.

MICHAEL JACKSON GLASSWARE



In conjunction with German glassware manufacturer Ritzenhoff Cristal, renowned beer writer Michael Jackson has designed a set of four purpose-specific beer glasses. In theory, Jackson believes good beer ought to be treated as well, or better than, fine wine.

The set of four glasses is packaged in an informative carton that will help guide beer enthusiasts in choosing the right glass for each style of beer. It is Jackson's longtime belief that serving beer in the right glass at the right time maximizes its flavor, appearance and enjoyment.

The set contains four high quality platinum rimmed glasses. Each set includes the following:

One snifter — perfect for stronger beers such as barley wines, imperial stouts, and strong Belgian ales.

One session glass — a stylized pint glass with thin edges meant to enhance the flavor of any ale or lager.

One tasting glass — a tulip-shaped glass that enhances the aroma and appearance of any beer.

One summer glass — ideal for fruit beers, wheat beers, and kolsch.

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in a bag and just dump them in. You can then separate the hops from the beer when racking to your bottling bucket or keg.

The final option for dry hopping is in the keg. Here, it is advisable to use a muslin or cheesecloth bag to contain the hops. Otherwise you run the risk of sucking hops into the system, clogging it up, or getting hops into your glass. One concern with dry hopping in the keg is the extended duration that the hops are in contact with the beer.

Some brewers feel that if the hops are in the beer for more than a few weeks, the beer develops a "grassy" flavor. Personally, I've never experienced it, despite leaving hops in my kegs for as long as six weeks.

Pellets, plugs or loose?

Okay, you've decided on the variety of hops to use and when to add them. The next question is, what form of hops to use? The choices are the same as the hops that you add to the kettle: pellets, plugs, or loose. The pros and cons are a bit different though.

As I said before, plugs were originally designed specifically for dry hopping and they work quite well for that purpose. They're easy to measure (since each plug is a ½-ounce), easy to put into a bag if you choose, and are easy to fit through the neck of a carboy — even more easy if you cut them in half.

Loose hops have to be weighed, but are also easy to stuff through a carboy neck — not so easy if put in a bag though.

Pellet hops also have to be weighed, but are probably the easiest type of hops to pour through a carboy neck. They are also easy to put into a bag, but only a very fine bag will contain the powder when they dissolve.

On the other hand, pellets can cause a sudden eruption of foam that will have you scrambling for a towel and wondering what sort of alien being has taken over your beer. This is because as the pellets break apart (almost immediately) they provide thousands of nucleation sites for the CO_2 in the beer to attach itself and come out of solution. Be careful and go

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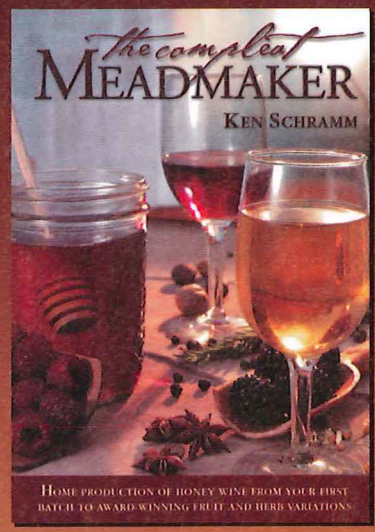

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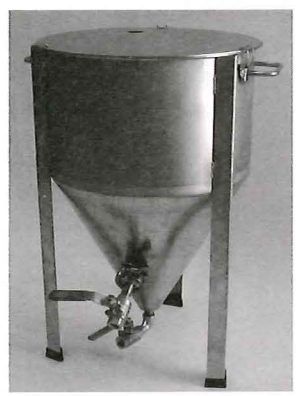

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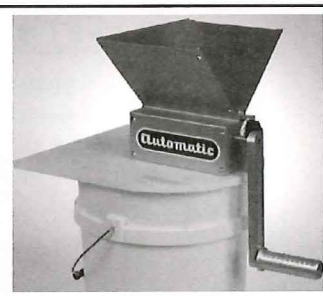

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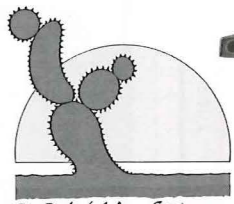

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slowly when adding pellet hops to any nearly full container.

Pellet hops will sink when well soaked. Plug and loose hops usually float. Either way it's not too hard to rack the beer away from any form of hops if you are careful. Since pellet hops are more highly processed than plugs or loose hops, there is some concern that volatile oils are lost. When using pellets for dry hopping, you may want to add a little more than usual.

How much?

This brings us to the question of quantity. A "normal" measurement for dry hopping is between 1–2 oz. (28–56 g) of hops for a five gallon (19 L) batch. But the real answer to the question of how much is simply, "as much as you want." If you want just a hint of hop aroma you might go as low as a ½ oz. (14 g). If you want a beer that will knock you over with a pungent hop flavor and aroma, you might decide to go nuts and throw in 4 oz. (112 grams). I've heard of brewers using even more than this, but even a serious hophead like myself will tell you that more than four ounces of dry hops may be pushing it.

You should also take into account the variety of hop. If you're using a hop with a high essential oil content, you probably don't want to use as much as you might if you were using something less oily.

My advice for your first experiments with dry hopping would be to pick a traditional aroma hop and use no more than 1 ounce (28 g). This will give you a good idea of what dry hopping does for a beer. From there you are only limited by your own sense of adventure in deciding what hops to try and how much to use.

To bag or not to bag?

The final question in dry hopping is whether or not to put your hops in a bag. Bagging your hops can make them easier to retrieve when either you or your beer decides it's time. On the other hand, hops tend to expand when wet, so a bag that you were able to stuff through the neck of a carboy dry may be difficult or impossible to get out when fully saturated.

Another issue with bagging is that it tends to reduce the hops exposure to the beer. To account for this, you may want to use 10–15% more when bagging. Also, while the hops are naturally resistant to bacteria, the bag is not. Because of this, you should always boil the bag to sanitize it before putting hops in it.

If you're a fan of hop flavor and aroma, you really have to try dry hopping your homebrew. I'm enough of a hophead that, unless it is completely inappropriate for the style, I am dry hopping nearly all of my beers these days and enjoying every one of them. ■

Don Million also wrote "Beauty and the Yeast" on page 38 of this issue.

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pH pHacts

The role of pH in brewing

Homebrew Science

by Steve Parkes

IN A PREVIOUS ARTICLE on water chemistry, I raised the subject of pH and its effect on mashing biochemistry. I intend to revisit this subject here and also to give an overview of the way pH influences beer properties and the brewing process.

First the basics — pH is a measure of hydrogen ions (H^+) in solution. Water (H_2O) exists as a mixture of H_2O molecules and its component ions H^+ and OH^-. In solution, hydrogen ions (H^+) are always associated with one or more water molecules and are nowadays usually written as H_3O^+ to reflect this fact. An H_3O^+ ion is called a hydronium ion. In pure water at 25 °C, there are roughly two H_3O^+ and OH^- ions for every billion water molecules. This corresponds to a concentration of 10^{-7} mol/L.

In 1909, a Danish scientist named Soren Sorenson devised the pH scale while working at the Carlsberg Brewery in Copenhagen. He devised a logarithmic scale that runs from 0–14 and represents the negative log of the hydronium ion concentration. For example, if the concentration of H_3O^+ ions in a solution was 10^{-5} mol/L, the pH of that solution would be 5. A pH value of 7 is considered neutral because, at 25 °C, the concentration of H_3O^+ ions in solution equals the concentration of OH^- ions. Values lower than 7 are acidic and higher are basic (or alkaline). Each single number change on the pH scale represents a 10-fold change in hydronium ion concentration. The addition of acids, which donate H_3O^+ ions to a solution, lower the pH of a solution. Bases (or alkalis), which donate OH^- ions, raise the pH of solutions.

The pH of a solution can be measured using pH papers in which a paper strip is impregnated with a dye whose color is determined by the H_3O^+ ion concentration. Or it can be measured more accurately using a meter that measures the flow of electrons across a glass membrane. The flow is caused by the difference in electron concentration in the test solution and a standard solution inside the electrode.

Homebrewers have access to reasonably priced pH meters and they make a useful addition to your homebrewing tools, provided you plan to take steps to influence your beer's pH.

A pH meter should be calibrated each brewing session by presenting the electrode with at least two different standard buffer solutions. In most cases, we use standards of pH 4 and 7 (well, 4.01 and 7.01, really) to calibrate the pH meter. This is great for brewers, since we're really interested in the pH range of 4 to 8. This range encompasses typical pH values for mash, wort, all water used in brewing and the final product. Once the meter is 'trained" to recognize the pH of the standards, it can then identify the pH of an unknown solution. Due to the logarithmic nature of the scale, small differences in recorded values in the brewery represent huge differences in the actual hydronium ion content to the point where a change of 0.1 pH unit represents a doubling of the actual hydronium ion content.

Why is all this important? Well, almost every reaction occurring in our breweries is carried out by enzymes; the mash conversion, the reactions in fermentation and the maturation all require enzymes to work. Every enzyme has an ideal pH at which it operates most rapidly. Even those reactions dependent on chemistry rather than biochemistry (i.e. non-enzymatic reactions) such as hop resin isomerization, haze formation, color development or beer staling are influenced by pH. Finally our perception of a beer's flavor, after-taste and mouth-feel are influenced by the beer's pH.

Mash

A mash carried out with distilled water will end up with a mash pH in the 5.8–6.0 range due to the buffering capacity of weak organic acids and amino acids from the malt. Buffering capacity refers to the ability of some chemicals to resist a change in pH of a solution when acids or bases are added to the solution.

Calcium ions in the brewing water, however, react with phosphate ions in the malt to release H_3O^+ ions and acidify the mash. Hence the presence of calcium ions can lower the mash pH to the 5.4–5.6 range. This drives the pH in the mash toward the optimal conditions for each of the two main mashing enzymes, alpha amylase (pH between 5.6–5.8) and beta amylase (pH between 5.4–5.6). Thus, the presence of calcium in the mash increases extract recovery from the malt. Most water contains calcium and so in a lot of cases there is enough present in the water for mashing. If not, calcium can be added to the mash in the form of calcium sulfate ($CaSO_4$, gypsum) or calcium chloride ($CaCl_2$), either by adding the salt directly to the mashing water or by mixing the solid material in with the milled malt prior to mashing.

typical pH values in brewing

mash	5.2–5.6
final runoff	up to 6.0
boil	up to 5.8 (start) 5.3 (end)
fermentation	5.3 (start) 4.3 (end)
conditioned beer	3.9–4.4

Some brewers, particularly German brewers, feel that protein solubilization, breakdown and particularly amino acid production is an important factor in mashing and so indulge in a whole range of temperature rests. Some of the enzymes responsible for this action have optimal pH's far lower than simple calcium treatment will allow (provided they survive kilning,

which in the case of British malt is unlikely). These brewers treat their mashes with acids in order to drive the pH lower still. Lactic, phosphoric, citric and even sulfuric acids may be used to drive the mash pH down to the 5.2–5.4 range.

Sparge water is another area where brewers need be concerned about pH. Sparge water is the hot (150–170 °F/66–77 °C) water sprayed onto the surface of the grain bed in the mash tun to replace the strong wort as it is drained from the bottom of the mash. It is strained through the grain bed and collected as it contains diluted wort. As the run off of wort from the mash tun nears its completion, the liquid being collected is quite close in composition to the water added to the grain bed above. It is very weak and contains little in the way of dissolved sugars, amino acids and buffering ability. Thus the pH can rise. If it rises above 6.0, it can extract some of the more undesirable compounds that would otherwise remain in the spent grain, namely polyphenols. Polyphenol (tannins) compounds are a part of beer haze and can provide harsh astringent beer flavors.

Dimethyl sulfide — the compound responsible for the corn, tomato, or stewed vegetable flavor in beer — is also influenced by pH.

Kettle

In the kettle, pH plays a vital role in the various chemical reactions. The pH drops during wort boiling, again due to the reaction between calcium and phosphates. This is why some brewers wait to add gypsum in the kettle where the solid calcium salts are more soluble, relying on there being enough calcium already dissolved in the water to take care of the needs of the mash. Protein coagulation and hence hot break (or trub) formation is improved at lower pH's. This improves the beer's clarity and reduces its susceptibility to chill haze. However, lower pH's reduce the efficiency of hop alpha acid isomerization and solubility, which optimally occurs at pH values that are higher than those found in most kettles. The same applies to the reactions that darken color. Lower pH's result in less color pickup than higher ones.

Dimethyl sulfide (DMS) — the compound responsible for the corn, tomato, or stewed vegetable flavor in beer — is also influenced by pH. The conversion of the pre-cursor during boiling is slower at lower pH's.

Another factor influenced by pH during boiling is the action of kettle finings or Irish moss. They too have an optimal pH at which they are most effective. Luckily it's around 5.3, where

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we expect our boiled wort pH to end up anyway. If you drop the wort pH in the kettle to 5.0, you need to use 50% more kettle finings for the same result. Below 4.4 they do not work at all. There are many German brewers who feel it is also necessary to reduce the pH of the wort in the kettle to influence the final beer pH, something that simply acidifying the mash cannot adequately achieve. This will involve direct addition of acid to the kettle to drive the pH down to 5.1-5.2. Of course, this reduces hop extraction efficiency but does provide additional benefits associated with having a low final beer pH, one of which is a "cleaner" perception of the bitterness.

Fermentation

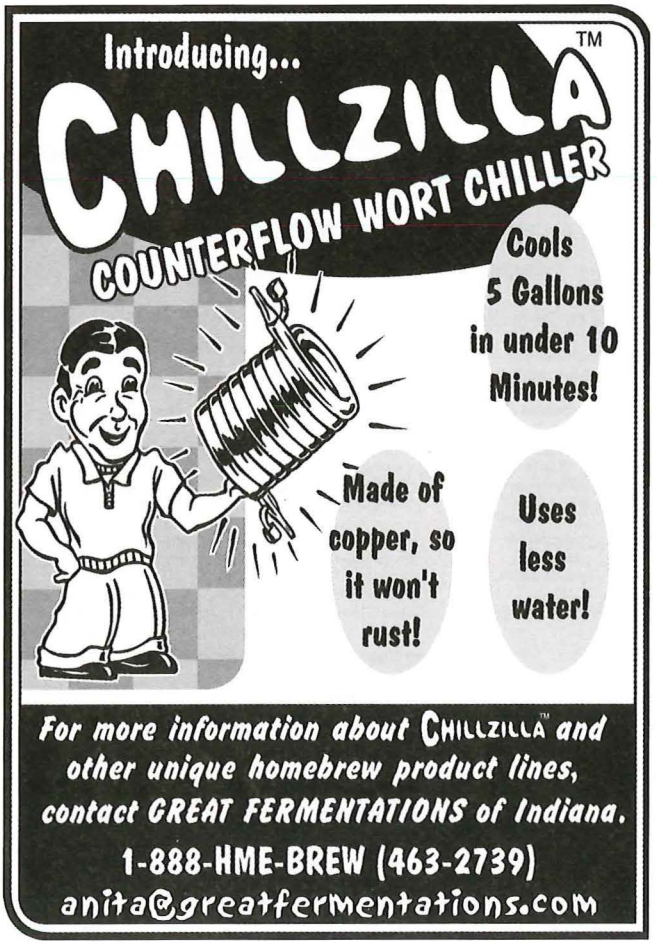
During fermentation, the pH of the wort drops rapidly. In the first 24 hours, the pH should fall from 5.3 down to 4.3. This is due to the rapid consumption by yeast of buffering capacity (i.e. amino acids) and the related production of acidic material such as organic acids. A slow fermentation or a long lag phase from your yeast will delay, or slow this drop and could result in beer flavor problems. The main issue would be in the ability of contamination in the form of spoilage organisms to gain a foothold while the pH is higher than 4.4.

During fermentation, the pH of the wort drops rapidly. In the first 24 hours, the pH should fall from 5.3 down to 4.3.

As you can imagine, the multitude of biochemical reactions occurring in a fermentation vessel with the multiple billions of enzyme reactions occurring every second the pH is likely to have a profound influence on the rates. Remember also that quoted values for enzyme pH's refer to optimal rates and that enzymes are still active on either side of their optimal pH figure.

One simple example is the production, conversion and ultimate reduction of diacetyl, the buttery or butterscotch flavored by-product of a fermentation. Lower pHs (between 4.2 and 4.4) tend to favor the removal of diacetyl. For most beers made from American malt, or German-style lager beers, the final beer pH will be in the region of 4.2–4.4. For English-style beers, and cask conditioned beer in particular, the final beer pH will invariably be in the 3.9–4.1 range.

A combination of factors probably account for this, including additional buffering from higher protein malts in lager brewing, more rapid fermentations in ales, water salts in ale brewing and the tendency to use kettle sugars in ale brewing which offer no buffering. As beer matures, the pH will begin to rise slightly as yeast cells autolyse



and release their contents into the beer. In fact, one test for yeast health involves measuring the pH difference between a slurry of yeast and the liquid around it. It can also be shown that reduced beer pH improves head retention in finished beer. Brewers who utilize isinglass finings should be aware that the action of finings is pH dependent. The action relies on electrical attractions between oppositely charged components and the degree to which a charge is expressed is dependent on pH. In general, high beer pH adversely affects fining action.

In general, the following benefits are known to be achieved by having the pH fall in the correct range throughout the process. The extraction of material into solution in the mash tun will be enhanced, the separation of the wort from the spent grain will be better. Hot break will be better and so later beer clarification will be easier. The beer will be less prone to contamination from spoilage organisms and maturation will be more successful.

Finally, a whole range of research has been done on the way pH influences a beer's sensory qualities. Lower beer pH (4.2–4.3) in lager brewing is said to provide a rounder, fuller, softer flavor. When brewing British-style ales, a pH on the lower end of the appropriate range (3.9–4.1) produces beer with a sharper, crisper, and fresher flavor. As pH drops below 4.0 (as it may in British-style bitters brewed with British malt) the beer tastes sharper and more acidic and the perception of astringency is enhanced. Hop bitterness is said to be more pleasant and less harsh and lingering, although it may be perceived at a higher level than measured. The beer's foam is more stable and finer. The excess of hydrogen ions in the mash and throughout the process is also likely to influence the beer's balance between its reducing power and its oxidizing potential, especially given that it is the OH- ion that is heavily implicated in these redox reactions. The OH- ion is a highly reactive ion that readily accepts a hydrogen ion. Lipid material in the mash readily gives up hydrogen causing it to begin the pathway that leads to staling aldehydes. Thus a lower mash pH will theoretically improve a beer's flavor stability in regard to oxidation. However, Japanese research shows that natural antioxidant protection from sulfite and polyphenols is reduced at lower pH's, so once again the debate rages on.

As a homebrewer what does all this mean and how can you influence any of this? You Should be aware of the flavor effects yeast autolysis has on your homebrew. Essentially though, brewing with all malt, good water, healthy yeast and clean equipment will take care of most of this on its own. ■

Steve Parkes is the owner and lead instructor of the American Brewers Guild and head brewer at Otter Creek Brewing in Middlebury, Vermont.

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Bottle Washer Deluxe

The original bottle sprayer gets a face lift

story and photos by Thom Cannell

I've been making homebrewing gadgets for years — my first project being completed before my first batch of beer. Some work better than others. A recent example is the "Clean-In-Place" bottle sprayer. It's a nice innovation, but after putting a year's worth of mileage on the original bottle washer, I've discovered its shortcomings. Specifically, the original was wasteful of sanitizer and sized to fit over a bucket. The original also relied on pinching a tube to provide on/off capability.

I'm thrifty and hate to spill gallons of useful sanitizer. I wanted a better bottle cleaner, one that would be small, portable, inexpensive to build and inexpensive to operate. I also had a Cornelius keg with pinhole leaks that I couldn't weld into usefulness.

A keg, I thought, would hold gallons (3.7 L) of sanitizer solution or other cleaner. Inside its circular cavity should be an upwards pointing spray wand, and something to support a bottle of any size. The keg would be easy to plumb, with one hose to gather used liquid and another to connect to the sprayer. I would need a pump to power the sprayer, then I'd have a great little bottle washer.

Why use a "corny" keg? Kegs are ubiquitous and inexpensive; and those are the functional ones. There are plenty of severely dented or leaking Cornelius kegs out there headed for the scrap heap. Surely, you can think of a way to rescue one or two? And if you can't locate one, any sturdy metal or heavy plastic cylindrical container — perhaps a flour canister — could work.

Construction Step by step

First, cut your keg and clean up the edges. Begin by marking your keg at the halfway point. This will give you a potential volume of at least one gallon (3.7 L) of solution. Lay the keg on its side and rotate it against a fixed marker. This will be your cutting guide, so be sure it is accurate.

Cut the keg. I used a small grinder equipped with a cutoff wheel, but a hacksaw or jig saw with a fine (24 tpi) bimetal blade or grit-coated blade would work as well. If you're using power tools, wear ear and eye protection. Once the keg is cut, grind and file the edges until level and smooth. This is thin steel, and it can retain sharp edges, and burrs — be sure to smooth them out. Files, sandpaper and grinders can all be used.

To prevent cutting yourself, you may wish to coat the finished edge with silicone sealant. You could also cut a length of otherwise useless racking tube lengthwise and fit it over the edge. This also provides a convenient anti-skid rest for the carboys.

Holes — the In and Out

There are several ways to make bulkhead fittings for the container.

PARTS LIST

Conelius keg $10 or less
⅜-inch (10 mm) copper tube $1.00 (scrap)
2-inch PVC (50 mm) pipe $2.00 (scrap)
⅜-inch ID Barb x ⅜-inch FIP Female Adapter
⅜-inch x ⅜-inch Compression Connector $1.60
¾" x ⅜-inch brass Female garden hose barbed adapter
⅜-inch polyethylene tubing 10' (3 m) $3.00
Little Giant drill powered pump $8
Or RIMS pump - $120
plus quick disconnects, $22.00 (approximate) ⅜

(Bulkhead fittings are the leak proof connectors that penetrate the container wall.) One kind involves welding a stainless steel nipple or union into the container's wall. Another, which I recommend, is building inexpensive bulkhead fittings for the intake and output. These can be made from a brass compression fitting with male NPT threads and ⅜-inch tubing. This tubing leads to a ⅜-inch pipe (10 mm) and through a hole (that you'll drill) to the outside.

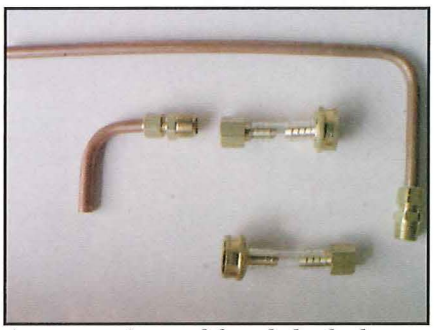
Outside, and securing the assembly, is a ⅜-inch (10 mm) female NPT barbed fitting. That's the nut. To seal these together and prevent leakage, you'll need an interior "O" ring of proper size. Ordinary garden hose

The original bottle sprayer functioned well, but had certain shortcommings.

The new bottle washer addresses size and waste concerns of the old system.

The project calls for a Cornelius keg to be measured, cut, and smoothed.

Commercially available connectors and a tubing bender make the job easier.



A compression and female barbed connector comprise each bulkhead fitting .

washers also work well for ⅜-inch fittings. It's your choice. You may need a thick washer. This is because NPT fittings are not meant to fit snugly together. I made a washer out of scrap Plexiglas for the spray side and used two hose washers for the intake — one inside and the other out. Drill a ⅝-inch (16 mm) hole for our chosen fittings and you're done.

These holes belong above the chine and cylinder. (The chine is the welded joint between the keg's bottom "cup" and the cylindrical body, just above the rubber bumper.) I measured one inch (25 mm) above the chine, used a prick punch to mark the location and drilled a ⅛-inch (3 mm) pilot hole before drilling the larger hole.

Intake and Output Construction

Liquid is stored in the bottom of the container, then pumped into a spray wand. Both the intake and spray wand were bent out of scrap tubing (⅜-inch or 10 mm) using a tubing bender. You can also use the stainless steel keg spear, but copper is easier to bend.

Bend a right angle that is about 1.5 inches (40 mm) by 3 inches (75 mm). Later we will trim this pickup tube to size. Then bend a right angle with one leg equal to your keg's radius and the other about 12 inches (300 mm) long for the spray wand.

The pickup tube should extend downward from the side of the container to within a ½-inch (13 mm) of the bottom. The spray wand should be centered in the keg.

Supporting your Favorite Bottle

I had difficulty figuring out how I would hold the wide variety of bottles I use. I needed a method that would not require me to hold every bottle while washing. I found that a scrap of 2-inch (50-mm) PVC pipe would support the shoulders of every bottle I use. Long necks, squatties, champagne punts and bail-tops all happily sat atop the tube. Three-inch PVC pipe may work better

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if you use gallon wine jugs with handles. With a hacksaw, I slit a 7-inch (175-mm) tube 3 inches (75 mm) deep and widened the cut with more cuts and rough files. I produced a ½-inch (13-mm) gap that allows the PVC tube to slide over the spray wand and allows all the liquid cleaner to spill away freely — Easy, cheap, and elegant.

Making a Spray Tip

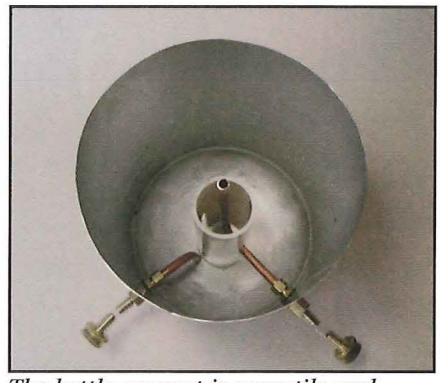
The final construction involves making a spray tip. There are a variety of methods for this. If you have access to a Tractor Supply Company store you might purchase a genuine replacement spray tip for about $10. You can mash the tube almost flat with a hammer to produce a fan-shaped spray. You might round the tube over nicely and drill 1-5 holes. You can also make a variety of spray tips, and see which works best with different bottles and pumps.

I cut the spray wand approximately 3 inches (75 mm) below the bottom of my shortest bottle, then made a variety of spray tips to test. They had smashed ends and different amounts and angles of drilled holes. To join each 1-inch (25-mm) spray tip to the open spray wand only requires an inch of ordinary poly racking tubing. You'll want to use Oetiker or low pressure clamps — the pump will blow the spray tip out of its racking tube sleeve.

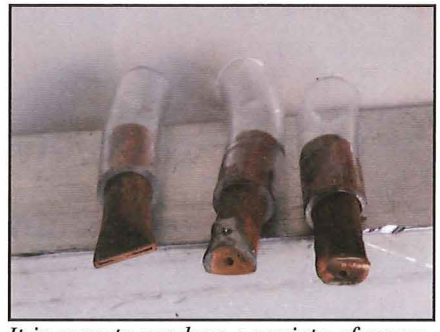
Pump Hookup

To complete the project, join each barbed fitting on the keg to the correct inlet or output fitting of your pump with clear tubing and clamp. Drill powered pumps cost less than $10 use garden hose fittings, and require no on/off valve. Barbed adaptors and ⅜-inch (10-mm) hose of suitable length complete this pump type. If you want to use your RIMS or transfer pump, I'd recommend quick disconnects as a time saver. ■

In next month's installment of Projects, Thom Cannell motorizes a malt mill.



The bottle support is versatile and holds nearly all types of bottles.



It is easy to produce a variety of spray tips, each with its specific purpose.

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BETTER-BOTTLE

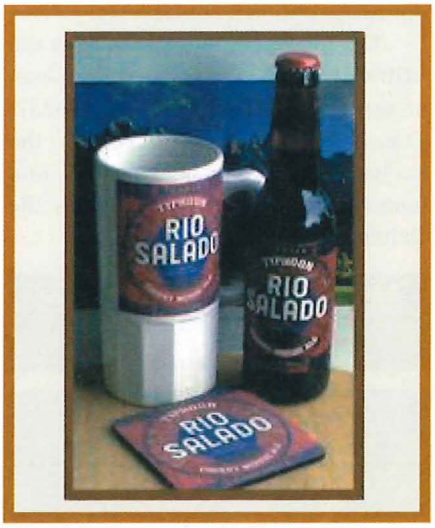
The Better-Bottle is a five-gallon carboy made from a new kind of PET (polyethylene terepthalate copolymer). PET is an unbreakable, colorless plastic. While most glass carboys weigh 12 pounds (5.4 kg) empty, the Better-Bottle weighs just 1.5 pounds (0.7 kg), making it easier to handle, especially during cleaning. The PET rinses as quickly as glass, making the carboy easy to sanitize. The new product is food-grade and FDA/NSF approved.

This high-tech form of PET does not impart a "plastic" flavor to beer. Tests show that even root-beer flavor, a particularly potent contaminant, rinses easily out of the Better-Bottle. In addition, the new plastic is almost entirely impermeable to oxygen.

A high-tech PET closure provides a tight seal at the neck. This stopper can accommodate attachments such as an airlock and a number of hose-barb adapter plugs. The rotating collecting-tube allows you to take a beer sample anywhere from 0.1–5 inches from the bottom of the carboy. A carrying handle snaps over the neck. For information, go to www.better-bottle.com.

CUSTOM BEER MUGS

The Coffee Mug Factory has expanded its product line to include



custom-made beer steins. The business transfers digital imaging and text from homebrew labels onto 16-ounce ceramic beer mugs. The mugs are dishwasher safe and highly durable. The Coffee Mug Factory's Website (www.thecoffeemugfactory.com) allows the homebrewer to upload his logo, images and text to be placed on the stein, and begin the design process. To compliment the mugs, The Coffee Mug Factory prints logos on washable rubber coasters; these have a striking resemblance to miniature mouse pads! Business owners Jim and Diane Kurtz came up with the idea after completing a ceramic tile project for the Rio Salado Brewing Company in Tempe, Arizona.

The project involved heat-transferring the brewing company's beer logo onto ceramic tiles for use in the bathrooms. The idea of putting logos onto ceramic mugs came naturally to the couple in the coffee (and now beer) mug business.

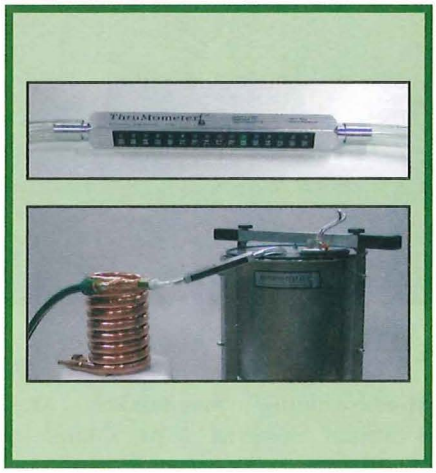
FIRST CERTIFIED ORGANIC HOMEBREW SUPPLIER

Seven Bridges Cooperative in Santa Cruz crossed another bridge for the world of homebrewers, becoming the first hombrew supplier to gain full certification under the USDA National Organic Program (NOP) by the California Certified Organic Farmers. Every product offered by Seven Bridges, including barley malt, hops, extract, brewing herbs, and adjunct grains are certified organic. Even the cotton straining bags fall within the organic certification guidelines.

The co-op also sells its own line of organic beer ingredient kits. The October 21, 2002 USDA Federal organic rule guarantees the consumer that organic products are grown without toxic pesticides, herbicides, or fertilizers.

Products labeled organic also cannot contain genetically modified organisms and are free from irradiation. The complete Seven Bridges catalog of products can be found online at www.breworganic.com, or a printed version of the catalog can be ordered by calling 1 (800) 768-4409.

THRUMOMETER

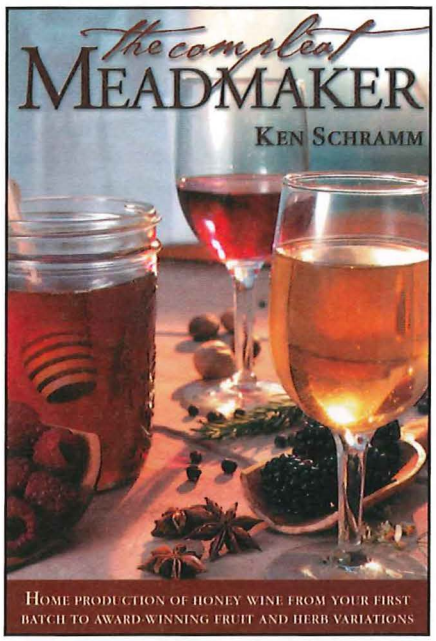


Blichmann Engineering has released a new in-line thermometer for measuring wort temperature. The "Thrumometer" allows the homebrewer to adjust the wort and water flow rates in his counterflow heat exchanger. This enables the brewer to dial in the exact wort temperatures that specific yeast cultures require. It differs from traditional in-line thermometers

in that it is constructed of a highly conductive aluminum, rather than pipe fitting — which is susceptible to bacteria. The inner passage of the Thrumometer is mirror smooth, permitting zero tolerance for bacteria to hide and contaminate your wort.

The liquid crystal thermometer responds quickly (up to 1 °F per second), and measures to 0.5 °F. Unlike digital and bi-metal thermometers, the Thrumometer will never need calibrating and is built to last a lifetime with a heat-treated, corrosion-resistant aluminum.

THE COMPLEAT MEADMAKER

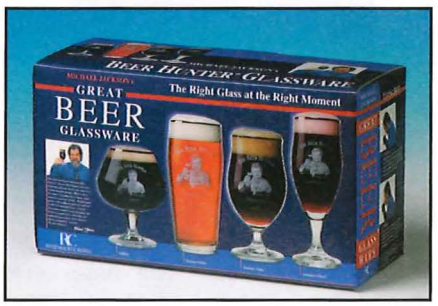


The Association of Brewers and award-winning meadmaker Ken Schramm released "The Compleat Meadmaker." Appropriate for the novice and experienced brewer alike, this book offers modern home production techniques for the world's oldest alcoholic beverage — mead or "honey-wine."

The 212-page book contains easy-to-follow procedures, simple recipes, and in later chapters, flavorful variations of mead that incorporate spices, fruits, grapes, and malt. Schramm is the founding competition director of the Mazer Cup, the oldest American mead competition and has twice prepared the commemorative mead for the AHA's national conference.

The book can be purchased at the AOB's Website at www.beertown.com or over the phone at (888) 822-6237. The book is also available on the shelves of many bookstores, and homebrew specialty shops across the United States.

MICHAEL JACKSON GLASSWARE



In conjunction with German glassware manufacturer Ritzenhoff Cristal, renowned beer writer Michael Jackson has designed a set of four purpose-specific beer glasses. In theory, Jackson believes good beer ought to be treated as well, or better than, fine wine.

The set of four glasses is packaged in an informative carton that will help guide beer enthusiasts in choosing the right glass for each style of beer. It is Jackson's longtime belief that serving beer in the right glass at the right time maximizes its flavor, appearance and enjoyment.

The set contains four high quality platinum rimmed glasses. Each set includes the following:

One snifter — perfect for stronger beers such as barley wines, imperial stouts, and strong Belgian ales.

One session glass — a stylized pint glass with thin edges meant to enhance the flavor of any ale or lager.

One tasting glass — a tulip-shaped glass that enhances the aroma and appearance of any beer.

One summer glass — ideal for fruit beers, wheat beers, and kolsch.

These glasses are available online at www.greatglassware.com or over the telephone at (877) 893-9621. ■

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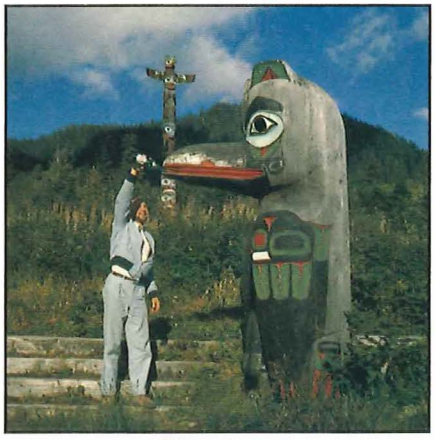
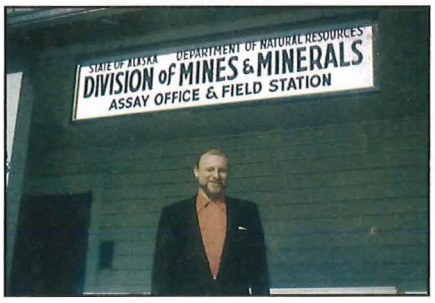
Assay Office Brew

Weighing the determination of brewers

by Ralph E. Pray





Homebrewing methods have improved over the years, but the determination of homebrewers never changes, as this essay about brewing during the 1960s in Alaska shows.

"Good morning. Alaska Division of Mines."

"Hello . . . Ralph?"

"Yeah."

"Paul Harris here. Can you assay a few rock samples for me?"

"Hi, Paul. Sure, but not for a few days. Sunday if you're in a hurry."

"OK, Sunday's fine. What, are you busy over there or something?"

"Yeah, I'm busy . . . making homebrew. The room where we weigh the assay gold beads has the crock pot in it. I taped the doors shut."

"You're kidding me."

"Nope, I'm trying to keep everyone out of the room so the temperature stays at 80 degrees."

"How long have you brewed beer?"

"This is my first batch. Five gallons. I'll save you a bottle."

I had got the recipe for my beer came from Tom Ford, director of the Ketchikan Community College where I taught night classes.

He laughed as he listed the ingredients. "Every one of my bottles blows up. Forget about drinking it. Sell the idea to the army."

"All of them exploded?"

"I'm not kidding. Never had a full bottle, just a few sips after separating the glass shards. They really blow up."

"Jeez, Tom. Where do you store your bottles during fermentation."

"In the furnace room, where my kids can't knock 'em over."

"I'm safe," I said. "I have a warm room where I can ferment the bottles."

I figured I needed a constant temperature, around 80°F (27 °C). That's what gave me the balance-room idea. The lab balances could accurately weigh a piece of paper the size of a dime, then give you the exact weight of the pencil dot on that paper. Temperature was important in that room to stabilize the balance beam and the hardware attached to it.

That night I started my first batch in the five-room analytical chemistry lab. I dumped the sugar and syrup in the hot ceramic crock and filled it to within five inches of the top with steaming water. I stirred with a long stick for two minutes. Then I stirred every ten minutes for a few seconds until the crock was no longer hot to the touch. I added a package of yeast and stirred some more. This pretty much followed Tom's instructions.

I wheeled the crock into the balance room and covered it. A day later I skimmed off the foam, dropped in a handful of raisins and a half a teaspoon of gelatin, plus water to fill the crock. I stirred it for about thirty seconds, covered the crock and taped up the doors.

Four days later, I opened the balance room and siphoned the brew into large, sterilized soda bottles containing a level teaspoon of sugar apiece. The place sure smelled good, not a chem lab at all. I filled each bottle to within two inches of the top, pressure-capped and stored them at 80 °F (27 °C).

With the sealing tape ripped from the door cracks, I could once again use the balance room to assay Alaskan gold ore samples for the public.

After the bottles fermented for five days, I put two in the residence fridge upstairs in the State building. The brew color was a deep, dark brown. That night around eleven I gingerly pulled out a cold bottle and levered the cap off. Pop! The steel cap hit the acoustic-tile meeting-hall ceiling six feet above me, and I slowly poured the bottle into a pitcher.

I drank the first glass standing by the fridge, the second sitting down, the third standing by the front window overlooking the moonlit ocean and the fourth while dialing Tom's number.

"Tom, you have to taste this homebrew. I can't describe it."

"I'm asleep."

"Well, wake up. I'm coming over."

Upon tasting it, Tom agreed that my homebrew was a fantastic elixir. Even with the doors taped shut, the sweet fragrance of fermenting brew permeated the government building. The assay office homebrew became popular among Southeastern Alaska's mining fraternity.

Prospectors who brought samples in from Juneau, Prince of Wales Island, Petersburg, Sitka or Wrangell all got a glass of the dark colored, habit-forming brew. I carried a box of bottles to outside parties around Ketchikan, and kept office hours — sometimes until nine — all because of this magic potion. The assay work gradually became scheduled around the brewing process, and everyone was happy.

Based on my limited experiences four decades ago, I have no business telling homebrewers today how to brew. However, it sure worked well at the assay office up in Alaska. ■

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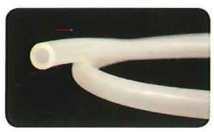

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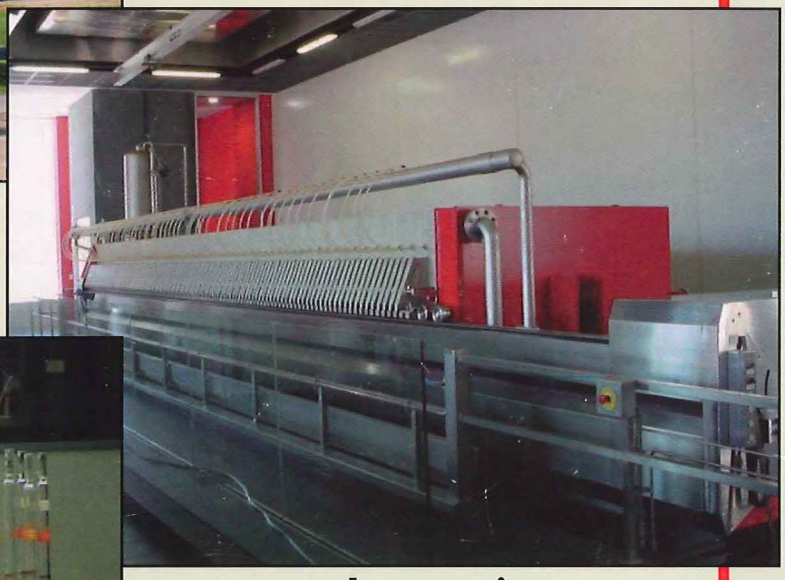

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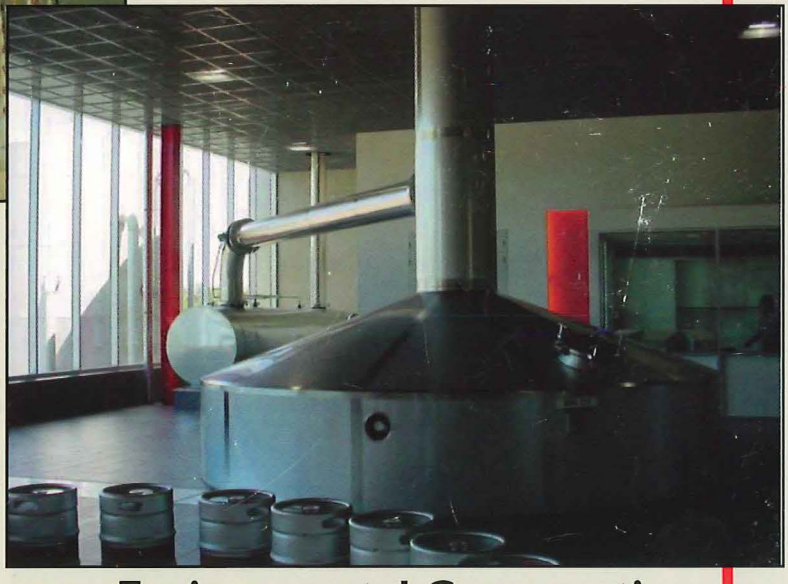

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