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MAY 2000, VOL.6, NO.5

THE HOW-TO HOMEBREW BEER MAGAZINE

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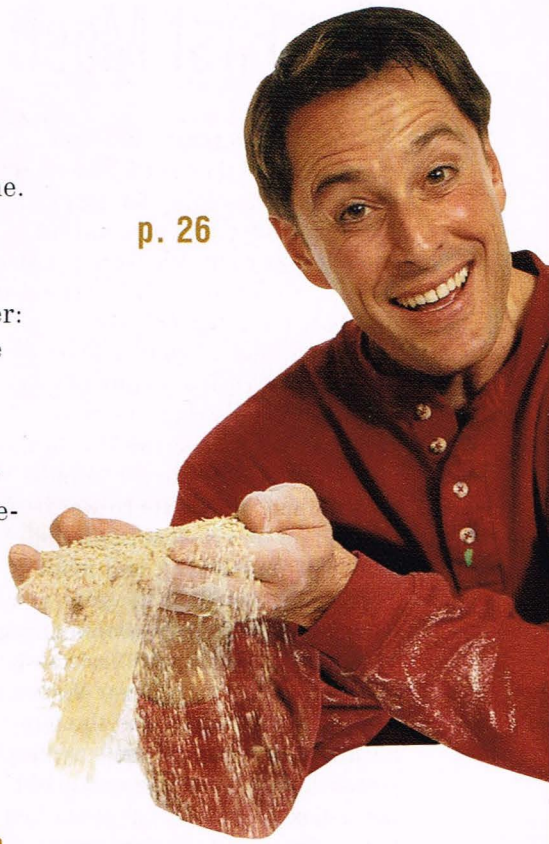

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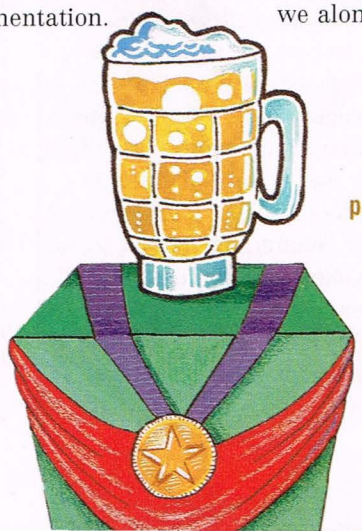

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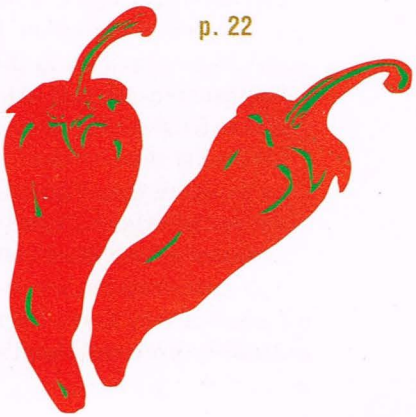

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Cover photography by Kent Lacin

Editor's Note

Our First Mash

I will always remember that wonderful day. Brad and I had been in this thing for several years. We were nervous, but we knew it was right. We were ready.

Yes. We were ready to brew our first batch of all-grain beer.

We sat down together and picked out a recipe: maple porter, since it was sugaring season in Vermont. We loaded the kids in the minivan and drove to the homebrew-supply store, where we stocked up on crushed malt, hop pellets, a smack-pack and more. Then we dropped off the girls at a friends' house. And we commenced.

To my surprise, our first mash was not only fun, but easy. We did a single-infusion mash and the temperature in the mash tun stayed steady for an hour. Our makeshift, three-tier, all-grain system worked like a charm. The sparge water flowed smoothly, sprinkling the grain bed at a nice, slow rate. The wort ran uninterrupted from our lauter tun to the brewkettle. Then we boiled away as usual. A month down the road, we toasted our newfound all-grain skills with the best batch of beer, hands down, that we've ever made.

If you're ready to step up to mashing, check out our cover story by Dawnell Smith, a former professional brewer who's now doing full-time mom duty at her home in Anchorage, Alaska. The article, which starts on page 26, includes everything you need to brew your first batch of all-grain beer: tips and techniques, step-by-step instructions, inexpensive equipment and a sure-fire recipe for her favorite Turnagain Pale Whale Ale.

As Dawnell says: "Dive into the mash pit!"

KATHLEEN

Contributors

Scott Russell

Want a recipe for a jalapeño chili lager? A pseudo-lambic fermented on fruit? A peat-smoked wee heavy or a foreign stout? Then Scott Russell's your man ... and ours!

Russell's beer-recipe file should be displayed at the Smithsonian. It's that eclectic, and that extensive. The same goes for his background. He has a bachelor's degree from Colby and is a scholar of French literature, with a master's from Middlebury and a doctorate from Brown. He's co-author of the "Seven Barrel Brewery Brewers' Handbook" (G.W. Kent) and author of "Basics of Homebrewing" (Optimus). His latest work, "North American Clonebrews," will be released this summer by Storey Books. Did I mention that he's a certified beer judge and the former manager of a homebrew shop?

When he's not brewing, Scott teaches high-school French at Thetford Academy in Vermont. He wrote a feature this month on chili beers (see page 22) and has been writing our regular "Recipe Exchange" column for the last five years. Next month, look for his article on classic British clone recipes. When it comes to far-flung styles, Scott's our go-to guy.

Brew Your Own
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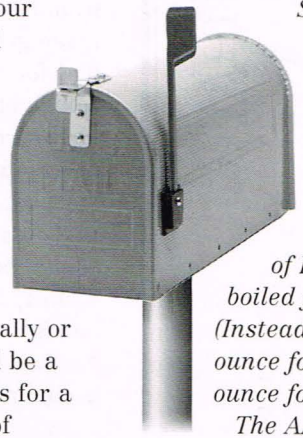
Dubbel Details

I have been following your brew schedule this year and am very happy (or hoppy) with the way things are going. I do have a few questions regarding the Belgian Dubbel ("Style of the Month," March 2000).



I am having trouble finding any French Strisselspalt hops, either locally or on the Internet. What would be a good substitute? Also, it calls for a starter made from a bottle of Chimay Red. I have the beer, but how do I make a starter from it? Do I make a regular starter (light DME, water and yeast nutrient) and pitch in the sediment?

Jarrod Bunyard
via e-mail

Style man Mikoli Weaver says: "The best substitute for the Strisselspalt would be Hersbruck hops. They are very similar.

"Now, for the Chimay starter. Cool the beer overnight and let the yeast settle. Open the bottle and remove the beer in one slow, continuous pour, leaving the sediment behind. Then pitch the sediment into the starter you describe (actually, I use a DME wort with an original gravity of 1.030, with no nutrient.) Let it sit at room temperature for at least one day, to take off."

Wee Heavy Hops

I had a few questions on the Moylan's Kilt Lifter Wee Heavy recipe in the March issue ("Three Great American Brewers"). There appears to be an inconsistency between the timing of the hops listed in the ingredients and the instructions for the hop additions farther down. Would you please clarify? Also, I'd like to know which method you use to calculate the AAUs for the hop additions.

Steve Dunkerken
via e-mail

Sorry for the confusion. The Step by Step instructions are correct. The ingredient list should have said that 1 ounce of Hallertauer hops are boiled for 60 minutes and 1 ounce of Hallertauer hops are boiled for 5 minutes. (Instead, it said to boil 1 ounce for 60 minutes and 1 ounce for 30 minutes.)

The AAU is the product of alpha-acid content multiplied by ounces. For example, 1 ounce of 5% alpha-acid hops equals 5 AAUs, as does 0.5 ounce of 10% alpha hops. The AAU calculation makes it easy to change the weight of hops added to a batch if the hops you buy have a different alpha-acid content than those in the recipe.

Heather Ale History

I read with interest the recipe for the Scottish Heather Ale sent to "Recipe Exchange" by Hal Warrick (February 2000). Perhaps a little history of the style would be interesting to add.

The original heather ales used the whole stem of the heather, which is an hallucinogen. The Picts would drink this concoction before going into battle, believing it would make them fierce warriors.

At the 1999 GABF, two microbreweries entered heather ales: the High Noon Saloon and Brewery in Leavenworth, Kansas (where I work) and the Alameda Brewhouse of Portland, Oregon. Alameda won a bronze for its heather ale.

This is definitely a style worth trying, if you can find it. I would look for Fraoch Heather Ale, brewed by Heather Ale Ltd. in Lanarkshire, United Kingdom (the website is www.heatherale.co.uk).

Ed Baldwin, Brewer
High Noon Saloon and Brewery
Leavenworth, Kansas

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Hot Tip for Tap Handles

I wanted to take this opportunity to pass along a neat little trick I just figured out. I found that the handles from the tools in some fireplace sets make great replacement tap handles for my jockey box. I found a couple of old redwood handles that have screw-on fittings at the top and bottom. They look better than those plain black plastic handles that come with the taps, and it should be easy to make shields for them to display a label, like the handles on English beer engines. Next time you're at a yard sale, this is one more thing you can look for.

Bill Wible
Philadelphia

Acronym Soup

I'm into malt-extract brewing right now and would like to get a little more advanced in the near future. At the end of your malt recipes I come in contact with the letters SRM and IBUs. Would you please explain these to me?

Carl Cuyner
Elizabethtown, Pennsylvania

Of the two, IBUs are the most important, and you should be using that calculation even with your extract brews — provided you are adding hops. IBU stands for International Bittering Units and is the method by which bitterness additions are determined for beer. For more information, see "Expand Your Hop Horizons" (June 1998).

SRM stands for Standard Reference Method. It's a method to determine color in both malt and beer. It requires a spectrophotometer. Each malt is rated by SRM or the older method, Lovibond. Also, finished beers are sometimes rated for color (for example, Bass Ale is 10 SRM). As an extract user, you are limited in this regard, since extracts have already been formulated and boiled or distilled (that process also creates color).

Several computer programs are available that will supposedly give you the color of a finished beer. These programs should be used as yardsticks at best, as there are other factors in the brewing process (the method of boil, for example) that will change the color of your finished homebrew.

Must Find Foam Scraper

Would you happen to know of a place that sells the "spatula" things that take the foam off of the top of a freshly poured beer? It looks kind of like a butter knife and you use it to "whack" off the head on a beer.

Mark Lyn
via e-mail

Those foam-scraper things were very popular decades ago and are not used much these days. Flea markets that carry beer memorabilia would probably be a good place to begin your search, because most of those scrapers are embossed with the name of a brewery. If you need a tool to whack the foam off your beer, a plastic ruler works just as well ... but doesn't look as cool!

Chill Haze Defined

I have seen the term "chill haze" come up in recent issues. Could you please tell me what that is?

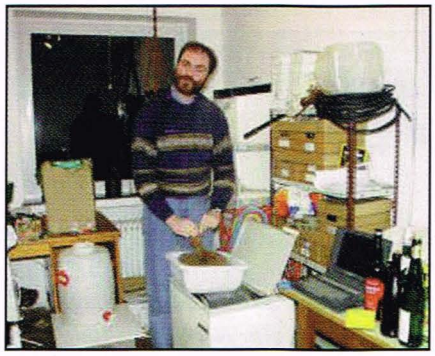
Eric Sabol
via e-mail

Chill haze is one of several types of haze that is sometimes found in beer. Beer haze is divided into two general categories: "biological hazes" associated with yeast or bacteria and "non-biological hazes" caused by protein-polyphenol (tannin compounds primarily from malt husks) interactions.

Chill haze is a type of non-biological haze that appears when finished beer is cooled and then disappears as it warms up. Most commercial beer is filtered very cold, so most of the chill-haze material is removed. If beer is repeatedly cycled from warm to cold, chill haze eventually fails to disappear from the beer upon warming. At that point, it's renamed "permanent, non-biological haze." ■

German Suds

The computer-controlled, top-loading, beer-brewing washing machine



After the mash, Fey removes the grain bag from his brewing machine.

For three years, I experimented with homebrewing. The beer was great, but my question was always the same: How could I invent the perfect brewing system? Then I had an idea. A washing machine! After all, in Germany they're just big stainless-steel kettles — with a built-in heater, mixer and pump.

A friend gave me an old top-loading machine, and my project began. First, I cleaned it up and replaced a few parts. Then I had to figure out a way to keep the grain from plugging the holes in my "kettle" during the mash. Out of clean cloth diapers, I made a big "tea bag" to hold the crushed malt.

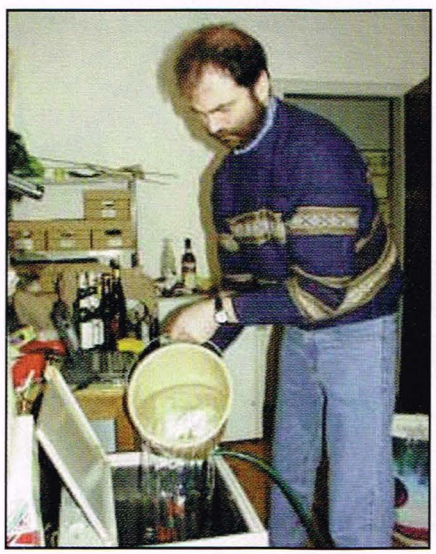
For the first test, I filled the machine with hot water, added the diaper grain bag and turned on the motor. As it swished back and forth, I waited to see if this system could actually convert water and malt into wort. It worked! But it wasn't perfect. To brew beer, I needed to control things like water temperature, mashing time and drum rotation. So I removed the machine's electronic panel, wrote a new program and connected it to a laptop. Voila! A computer-controlled, beer-brewing washing machine!

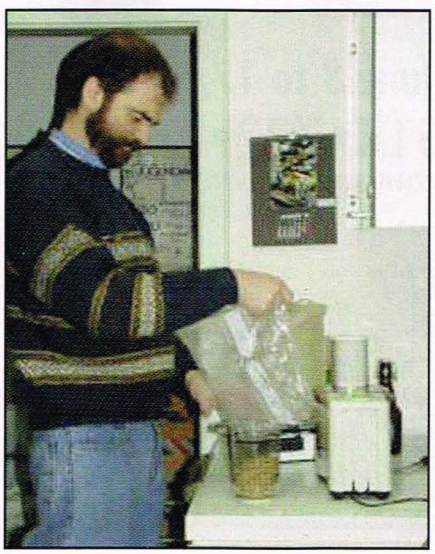
The machine is hooked up to our household water supply. On brewing day, I fire up the laptop and the kettle fills with water. I installed sensors, so the PC signals when the temperature is right for mash-in. I add the grain bag and close the lid. Controlled by the laptop, the machine conducts the mash. (When I brew altbier, it rests 15 minutes at 122° F, 20 minutes at 131° and 30 minutes at 166°.)

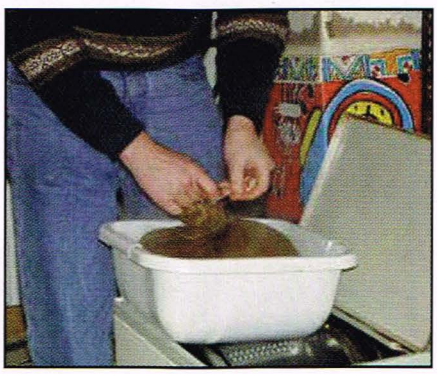
After the mash, I transfer the grain bag to a lauter tun, sparge, and add the liquid to the wort. The machine heats the water to boiling and I toss in a bag of hops. After the boil, the machine pumps the wort through a hose that runs to my fermenter. A month later, my beer is ready to drink. Prost!

Michael Fey
Oberhausen, Germany

If you speak German, check out Michael Fey's Web page at home.t-online.de/home/df6jm







Dirty socks verboten! Fey turned a washing machine into an automated brewing system by removing its electronic panel, writing a new program and connecting his laptop. Clean cloth diapers hold the grain.

Green Bay Ice Beer

Catch a pike, brew a batch

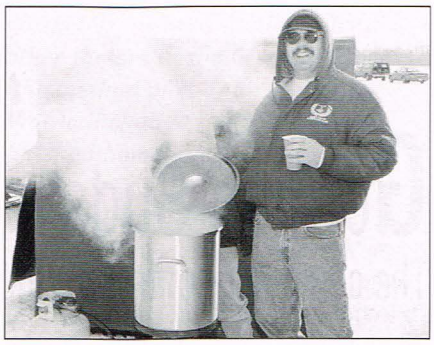
On January 15, the sun rose to the sound of augers drilling through 18 inches of ice on the Oconto River in Wisconsin, 30 miles north of Green Bay. It was a great day for fishing. And for the members of the Oconto County Brew Club, it was also a great day to brew Northern Pike Ale.

Brewing on the ice can be a challenge. We didn't have any problem with the propane burner, but since it was 25 degrees outside, it was tough to maintain a constant mash temperature. One member volunteered his insulated snowsuit. We wrapped it around the mash tun for 90 minutes, and it worked fine. After the boil, cooling the wort was easy! The brewing was fun, but we only caught one fish, a 20-inch pike.

Ice-brewing is only one of our annual events. Every fall, on "Sausage Day," we get together to make 325 pounds of homemade sausage (bratwurst, Polish, Irish, Swedish, Italian, meatloaf and sauerkraut). In the summer, we hold a fish-fry to share our winter catch. (It'll be hard to share one pike with the whole club. I think we'll have to pickle it for a brew-session snack). And we meet every month to brew. Last year, we made a 25-gallon batch. Not bad for eleven members!

We have an eclectic group, including two teachers, a minister, an architect and two retirees. What do we have in common? Good beer and good company! ■

Bill Reis
Oconto Falls, Wisconsin



What, me worry? Kevin Hodkiewicz sips a brew and monitors the boil.

Bill and Kevin: Northern Pike Ale to drink, one northern pike to pickle.

CIRCLE 25 ON READER SERVICE CARD

Making It Up

The instructive fable of a pseudo-lambic

by Scott R. Russell

Once upon a time, there was a homebrewer who had some bad luck. His mash efficiency was falling short, so his OGs were off by 20 points. The freezer where he stored his hops broke. And he lost track of time, allowing his yeast cultures to go far beyond their freshness dates.

He decided to try once more to brew a simple beer, a wheat beer, using up old ingredients and doing the best he could. If this one didn't come out, he declared, that was it. He'd sell his equipment and find another hobby.

Brew day came. He ground grains, heated mash and sparge water, carefully weighed malt extract and whole hop flowers and prepared the yeast slurry. He sparged meticulously, stirred his extract into the kettle and added the hops with precise timing. His chiller worked with unusual efficiency, and soon he had 5.25 gallons of wort at exactly the right temperature to pitch the yeast. Which he did.

As he sat back and pondered the mysteries of brewing, he realized that absolutely nothing had gone wrong. That was when he began to worry.

He was right to worry, for that night a cold snap hit, the room where he stored his fermenters dropped to 40° and his fermentation got royally stuck. After a few days of patience, he decided to pitch some more yeast. Some other creatures obviously got in at the same time, for a week later, he racked the beer to the secondary and tasted it. It tasted like a barn smells: sour, grassy, woody, sweaty. In short, he had accidentally made the homebrewers' equivalent of a Belgian lambic. A wry smile on his face, the brewer drank a toast to Bacchus and other gods who make sport of human endeavors. And the next weekend, he brewed again.

pStrawberry pLambic
(5 gallons, partial mash with fruit)

This is not the exact recipe the brewer used. But it will duplicate his results, without the risks of spontaneous fermentation. Hence the lower case "p," for "pseudo." Only a beer fermented spontaneously, using the airborne yeasts and bacteria of the Senne Valley in Belgium, can technically be called "lambic." The strawberries add sweetness and complexity.

Ingredients:

- 2 lbs. (Belgian) pale malt
- 2 lbs. (Belgian) wheat malt
- 1 lb. light crystal malt (30° Lovibond)
- 4 lbs. unhopped wheat DME
- 0.75 oz. of 4% alpha-acid Hallertau hops (3 AAUs)
- 1 qt. slurry containing any Belgian ale yeast with lambic bacteria (I used Wyeast 3278)
- 6 lbs. strawberries, pureed
- 7/8 cup corn sugar for priming

Step by Step:

Heat 8 qt. water to 163° F. Crush grains, mix into hot water and hold 90 min. at 152° F. Runoff to kettle, sparge with 12 qt. water at 169° F. Add dry malt extract to kettle, bring to boil.

Boil 30 min., then add hops. Boil additional 45 min., remove from heat, remove hops. Cool, add to fermenter with enough pre-boiled, chilled water to make up 5.25 gal. At 68° F, pitch yeast.

Ferment cool (60° to 62° F) for two weeks. Rack to secondary onto strawberries. Ferment for two weeks. (Check it regularly; chunks of fruit can get stuck in the blow-out tube!) Re-rack to another carboy, leaving fruit behind. Condition at 50° F for two weeks. Prime with corn sugar and bottle. Age five to six weeks.

OG = 1.063
FG = 1.016
Bitterness = 12 IBUs

Notes:

All-extract version: Steep 1 lb. each pale and wheat, plus the crystal, in 2.5 gal. water at 150°F for 45 min. Remove grains, add DME (increased to 5.5 lbs.) and proceed from boiling.

All-grain version: Omit the DME, increase the pale and wheat to 5 lbs. each. Mash in 15 qt., sparge with 18 qts. Proceed from boiling, timing hop addition to reduce volume down to 5.25 gal.

Reader Recipes

Happy Hop's Pineapple Ale (5 gallons, extract with grains)

This is a light, thirst-quenching beer that finishes with a crisp, fruity character. It also has a pleasant splash of pineapple and honey.

Tony Dimico
Happy Hop Homebrew
Spokane, Washington

Ingredients:

- 1 lb. crystal malt (10° Lovibond)
- 3 lbs. extra-light DME
- 1 lb. rice syrup solids
- 2 lbs. honey
- 8 oz. malto-dextrin
- 2 qts. pineapple juice
- 1 oz. of 5% alpha-acid Tradition hops (5 AAUs)
- 1 oz. of 3% alpha-acid Spalt hops (3 AAUs)
- Belgian Abbey yeast (Wyeast 1214 or equivalent)
- 3/4 cup dextrose for priming

Step by Step:

In 1 gallon water, steep crystal malt to boiling point, then remove. Add Tradition hops, boil 35 min. Add DME, rice syrup solids, honey, malto-dextrin and pineapple juice. Boil 20 more min. Add Spalt hops. Boil 5 min. Total boil is 60 minutes.

Top up wort to 5 gallons water. Cool to 68°F, pitch yeast and ferment at 68°F for 3 to 5 days. Transfer to secondary and finish fermenting for 6 days. Prime with 3/4 cup dextrose and bottle. Bottle-condition for 4 weeks.

OG = 1.055
FG = 1.008
Bitterness = 14 IBUs

Thunder Ale (5 gallons, extract with grains)

While traveling through Bar Harbor, Maine, I came across Thunder Hole Ale. As soon as I got home, I tried to clone it, and this recipe came fairly close. The finished beer has such a smooth flavor profile that my friends can't get enough of it!

Eric Burrough
Ottumwa, Iowa

Ingredients:

- 1/4 lb. chocolate malt
- 1/4 lb. biscuit malt
- 6 lbs. light malt extract syrup
- 1 lb. dark brown sugar
- 1 oz. of 8% alpha-acid Perle hops (8 AAUs)
- 1 oz. of 5% alpha-acid Willamette hops (5 AAUs)
- 1 oz. malto-dextrin
- 1 tsp. gypsum
- 1/2 tsp. Irish moss
- Wyeast 1318 (London Ale III) or equivalent
- 4 oz. corn sugar for priming

Step by Step:

Steep the chocolate and biscuit malts at 150° F for 30 minutes. Add the malt syrup and brown sugar

CIRCLE 18 ON READER SERVICE CARD

CIRCLE 1 ON READER SERVICE CARD

and bring the liquid to a boil.

Total boil is 65 minutes. After the first 5 minutes, add the maltodextrin, the gypsum and half the Perle hops. Boil 30 minutes more, add the rest of the Perle hops and the Irish moss. Boil 30 minutes more and add Willamette hops.

Remove from heat and steep for 30 minutes. Top up to 5 gallons with pre-boiled, cooled water and cool to 68° F. Pitch yeast and ferment at 68° F until primary fermentation ceases (3 to 4 days). Rack to secondary until clear. Prime with 4 oz. corn sugar and bottle. Bottle-condition for 3 to 4 weeks for best flavor.

OG = 1.051
FG = 1.017
Bitterness = 30 IBUs

Münster-Style Alt (5 gallons, extract with grain)

This style of alt beer is different from the more common styles, such as the Düsseldorfer and Hanover (Northern German) Alt, because it is much paler and uses 40 percent wheat malt. The most common commercial example is Pinkus Alt, brewed by Pinkus Müller in the town of Münster.

Peter Schaut
Beer Unlimited
Malvern, Pennsylvania

Ingredients:

- 0.5 lb. Weyermann's CaraHell malt
- 1 can (4 lbs.) Alexander's Wheat malt extract (syrup)
- 2 lbs. Munton's light dry malt extract
- 2 oz. of 5% alpha-acid Spalt hops (10 AAUs)
- German Ale yeast (Wyeast 1007 or equivalent)
- 1 cup light DME for priming

Step by Step:

Steep grains in as much water as your kettle will hold until water begins to boil. Remove grains. Turn off heat and add extracts, return to boil. Total boil is 60 minutes.

Add 7.5 AAU Spalt, boil 30 minutes. Add remaining 2.5 AAU Spalt, boil 30 minutes more. Cool wort to 75° F (add chilled preboiled water, if necessary, to make 5 gallons). Pitch yeast. Ferment at 70° F until primary fermentation stops. Transfer to secondary and lager at 40° F for 10 to 14 days. Prime and bottle, condition at 40° F.

OG = 1.046
FG = 1.012
Bitterness = 35 IBUs

Haystack Wheat (5 gallons, partial mash)

This recipe arrived at the Brew Your Own office some time ago, via e-mail, from the mysterious "Sirseth." Who is he? Who the heck knows? He doesn't answer our e-mails. But we like his recipe. So we're finally printing it.

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Ingredients:

- 1/8 tsp. winemaker's acid blend
- 2 lbs. Belgian pilsner malt
- 2 lbs. Belgian wheat malt
- 0.5 lb. medium crystal malt (55° to 60° Lovibond)
- 0.5 lb. flaked wheat
- 4 lbs. unhopped wheat dried malt extract (DME)
- 0.55 oz. 3.6% alpha-acid Saaz hops (2 AAUs)
- 1 gram spices (equal parts coriander, cumin, ginger, wintergreen and star anise, ground and mixed)
- 1 qt. yeast slurry of Belgian Wheat (Wyeast 3942 or equivalent)
- 7/8 cup corn sugar for priming

Step by Step:

Heat 7 qts. water to 162° F. Add acid blend. Crack pilsner and wheat malts. Add malts and flaked wheat to mash water. Hold at 153° F for 90 min. Run off to kettle; sparge with 2 gal. water at about 168° F.

Add DME to the kettle and bring to a boil. Total boil is 75 min. Boil 60 min., add hops. Boil 15 min. more, add spices, remove from heat. Cool and pour into fermenter. Top off with enough pre-boiled, chilled water to make 5.25 gal. Aerate well! At 70° F, pitch yeast.

Ferment cool (60° F) for two weeks, rack to secondary, and condition for two weeks near 55° F. Prime with corn sugar and bottle. Age in bottles 10 days.

Notes:

All-grain version: Mash 5 lbs. each malted wheat and pilsner malt, plus the same amounts of crystal and flaked wheat, at the same temperature and time, but increase mash water to 3.5 gal., sparge water to 4 gal. Time your boil to reduce to 5.25 gal. (add water to kettle if necessary).

All-extract version: Steep the crystal and flaked wheat in 3 gal. of water, heating gradually to 179° F, then remove grains. Increase dry malt extract to 8 lbs.

Wheat DME: Although there are some all-wheat dried malt extracts on the market, you'll get a better fermentation by using an extract that's a blend of wheat and barley (about fifty-fifty).

Spices: The blend I suggest above is a balanced one, especially if used in moderation. It is very easy to overdo. If you really object to one of the spices, leave it out.

OG = 1.064
FG = 1.015
Bitterness = 4 IBUs ■

Fame and Fortune

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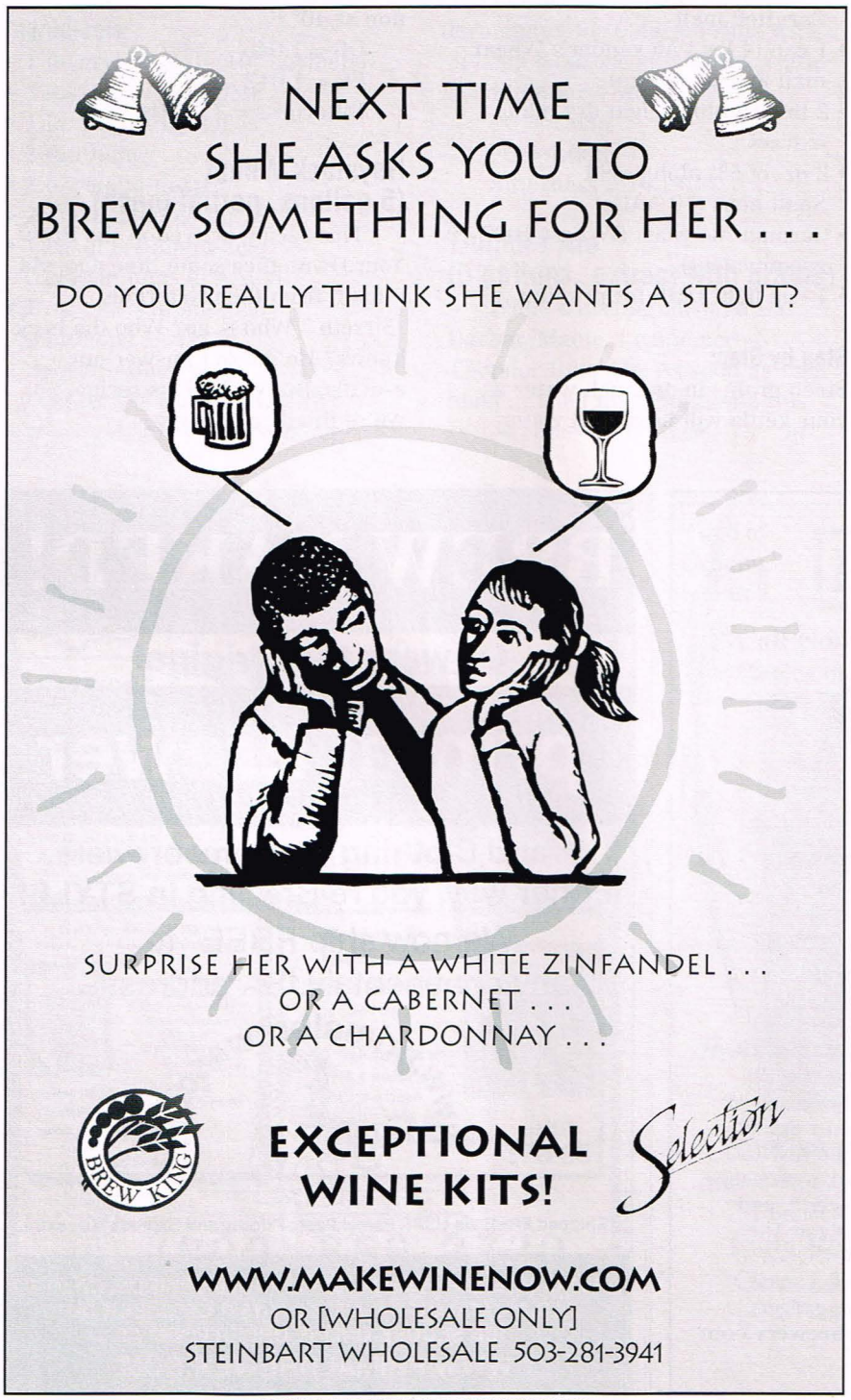

CIRCLE 9 ON READER SERVICE CARD

Foam Happens

The Wise Guy on excited fermentation and aggressive boils

Mr. Wizard

I am brewing a batch of "honey brew" using 6 pounds of amber extract and 2 pounds of honey. I purchased Wyeast 1056 (American Ale yeast) in the 6-ounce size. The package said the yeast was "pitchable" but I stepped it up anyway. Actually, I stepped it up twice: first to about a pint (approximately 1.033 gravity) and two days later to a little less than two-thirds of a quart (1.050 gravity). I brewed everything, cooled it off, and pitched the yeast into my 6.5-gallon carboy.

This is the first time I have used a glass carboy, instead of a 7-gallon bucket. I still chose to use the airlock, never thinking the krauesen would fill the remaining 10 inches of headspace in the carboy. The next morning I got up and found the headspace filled to capacity with krauesen. It was also spewing out of the air lock!

Can you step up yeast too much? What are my chances of contamination? I immediately sanitized some hose, a brass coupling and another stopper and set up a blow hose. Your insight would be graciously accepted.

Vance J. Stringham
Montague, MI

Although you had a giant mess on your hands with your excited fermentation, you may have added a normal amount of yeast.

In my experience, small yeast packets do not contain enough yeast after they swell to contribute a proper pitching rate to a 5-gallon batch of wort. My opinion is based upon observing the vigor of fermentation as well as performing cell counts on yeast from smack-packs with a microscope. Stepping up the pack is a good idea, although one step would have done the trick. My suggestion would be to propagate the yeast in two quarts of 1.048 wort, allow the fermentation to finish, decant the beer above the yeast and pitch the concentrated yeast solids. One to 1.5 cups of yeast solids per 5 gallons of wort is a good pitching rate.

Now the bad news: The krauesen spewing out of your carboy is directly related to your pitching rate. A wimpy rate usually results in a thin krauesen that will rarely leave the fermenter. Air locks can vent the gas from such a fermentation. Increasing your pitching rate increases fermentation rate, decreases certain aroma compounds, decreases the chance of contamination ... and increases the odds of making a mess!

The minimum precaution when fermenting in a carboy is to attach a blow-off hose. Still, I don't think you contaminated your beer by neglecting to use a hose. Any microscopic invaders were most likely pushed onto your floor along with the krauesen. Usually the headspace provided by a 6.5-gallon carboy is plenty for a 5-gallon fermentation, but sometimes foam happens!

Mr. Wizard

I just brewed an all-grain amber recipe from the May 1999 issue. This was my third all-grain attempt, and it raises a few questions. Since I started using a 100,000-BTU burner, I end up with a smaller volume than the recipes anticipate. I know this is due to a more aggressive boil, but I am concerned with having to top off my fermenter. Is this a problem? Should I start with more wort? Also, the recipe calls for the gravity to start at 1.064. My yield prior to the boil was 1.042. Does it change during the boil? Should I check it again after topping off to 5 gallons?

Rob Allen
Salt Lake City, Utah

Recipes printed in BYO give the "original gravity" of the wort. This number refers to the specific gravity of the wort prior to fermentation—in other words, after the boil. Wort gravity increases during boiling because the wort is concentrated as water is evaporated.

Most commercial brewers want to evaporate at least 8 percent of the wort volume during boiling to ensure adequate removal of volatiles, such as dimethyl sulfide. Excessive evaporation can result in the formation of unwanted flavors. It also wastes energy. Energy is not a huge concern with homebrewing, but imagine a commercial brewkettle with a pre-boil volume of 800 barrels (24,800 gallons). A typical boil can evaporate 64 barrels (1,984

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gallons) of water in 60 minutes! That requires a lot of energy.

For starters, to hit the target gravity and the target volume of a recipe you must know the efficiency of your brewing system. If you don't know your efficiency and strictly follow a recipe, you most likely will miss one of your targets. If your system is very efficient, you may hit the gravity target by over-shooting the volume target (by the way, adding water after the boil causes no problem as long as it is pre-boiled). Missing your target volume may not seem like a big deal, but it affects the bitterness of the final beer. More beer means a dilution of the hop bitterness. The bottom line is that getting a handle on your efficiency will help you. Your target was 1.064 post-boil and you had 1.042 pre-boil (which translates to about 1.050 post-boil); this indicates that your system may yield less from the malt than the recipe you followed.

Another technique you may want to adopt is tracking your evaporation. You can do this by calibrating your brew kettle and noting the pre- and post-boil volumes. Here's the formula to use:

Evaporation percent = 100 - (post-boil volume x 100 ÷ pre-boil volume).

For example: Say you collect 5.5 gallons of wort and boil it down to 5 gallons. This would be 100 - (500 ÷ 5.5), or 100 - 90.9, which equals an evaporation rate of 9.1 percent.

Most commercial brewers target between 8 and 10 percent evaporation during the boil. For homebrewers, a good evaporation rate is 6 to 8 percent per hour. A kettle that evaporates 6 percent per hour will evaporate 8 percent of the volume in 80 minutes. If another kettle evaporates 8 percent per hour, then a 60-minute boil will evaporate the same wort volume. As you collect more data, you can adjust your flame to fine-tune your evaporation rate. If you don't like topping off your batch with preboiled water, tweaking your boil is an easy way to eliminate this practice.

Mr. Wizard

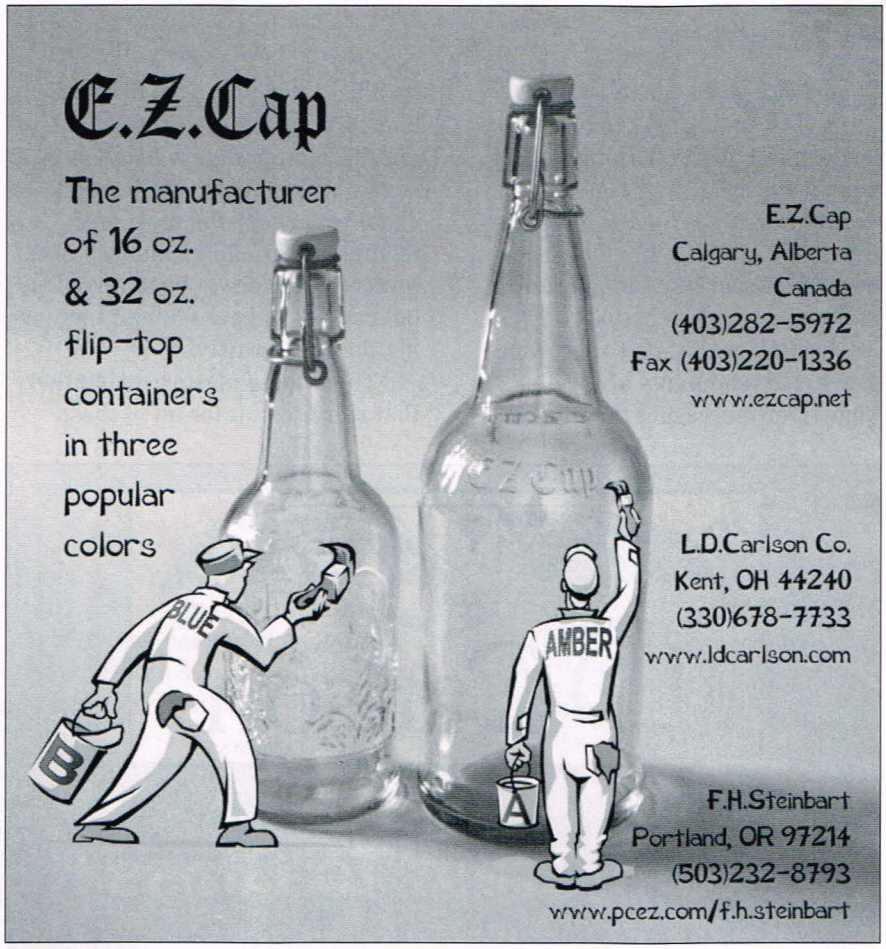
When formulating a recipe, it seems a great deal of time and energy is spent determining the original gravity of the beer. The final gravity seems to be an afterthought and left to whatever the yeast can accomplish. My question is, what is the best way to approximate your final gravity? If you use the same recipe, but change the yeast, can you just use the different attenuation figures for the new yeast? What if you plan a brew that you have made before and you keep all ingredients the same—except this time you go from 10 percent specialty grains to 20 percent? Is there a way to estimate what your final gravity will be? These questions were prompted by a friend who just started homebrewing. He asked why we couldn't make a beer with 50 percent crystal, and what would happen if we did.

Larry P. Steinmetz
via e-mail

You could brew a beer with 50 percent crystal. The final gravity would be much higher than a beer with less crystal, because crystal malt contributes a higher portion of non-fermentable sugar than pale malts. Personally, I wouldn't drink that beer, because beers with more than 15 percent crystal taste syrupy.

Your real question is predicting the final gravity of a brew. This is very difficult for numerous reasons. Yeast strain, yeast health, pitching rate, fermentation procedure, wort aeration, mashing, the type of malts used and the concentration of minerals, especially zinc, all affect wort attenuation. Yeast has a large influence on attenuation; suppliers cite typical attenuation rates for the strains they sell.

If all variables relating to yeast (health, pitching rate, aeration fermentation procedure, wort aeration and zinc concentration) are held constant, the final gravity of beer can easily be changed by altering the mash profile. Holding constant all variables relating to yeast is a monumental task, but it is possible!



CIRCLE 8 ON READER SERVICE CARD

In general, lower mash temperatures (140 to 150° F) produce more fermentable worts than high mash temperatures (155 to 160° F). Conversely, higher mash temperatures give better extract yields because of increased temperature and alpha-amylase activity.

Certain grains also affect final gravity. Crystal malts are well-known for increasing the final gravity and starch adjuncts, like rice and corn, can decrease the final gravity. Simple sugars (like white sugar, brown sugar and Belgian candi sugar) are the most fermentable ingredients and are used by some brewers to boost the alcohol content of beer without increasing the final gravity.

There is no master calculation that can account for all of these variables to predict final gravity. The brewers who are really concerned about hitting their final gravities are the big guys. They make the same beer day in and day out and are able to focus their attention on key variables. Their yeast is consistent; they are not experimenting with new raw materials. These brewers can adjust their mash profile to gain sufficient control over their final gravity. Some add zinc to wort in the brewhouse; small changes in concentration have a pronounced affect on yeast performance.

In my opinion, the brewer has the best shot at affecting final gravity during wort production. During fermentation, we can change the temperature of the beer or cause the fermentation to prematurely stop by cooling it, but this method is riddled with flaws. Yeast strain can also be changed based on the attenuation rate and the type of beer being brewed. Although yeast strain does influence final gravity, you can't really predict yeast performance based upon typical attenuation ranges, because the strain is influenced by too many environmental factors.

You have asked one of those questions that simply does not have a precise answer. In a sense, brewers set the stage and the yeast take it from there. We can augment the grain bill, tweak the mash temperature, adjust wort aeration rates, add yeast nutrients and play with pitching rates. After that the fermentation takes over and we become observers to a fascinating process. ■

Mr. Wizard, BYO's resident expert, is a leading authority in homebrewing whose identity, like the identity of all superheroes, must be kept confidential.

Do you have a question for the Wiz? Write to him c/o Brew Your Own, 5053 Main Street, Suite A, Mancheseter Center, VT 05255. Or send an e-mail to wiz@byo.com.

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Brew British Beers

A mild from the Midlands and a transatlantic IPA

by Mikoli Weaver

To usher in summer, we're going to brew a flavorful but easy-drinking mild ale from the Black Country of England and a bold, hoppy IPA that will be ready in early June. The Scotch ale and maibock we made in April are ready to drink as we brew these new beers.

Mild Ale: The Story

This beer is made for and by the working people of England's coal and steel industry. It is brewed primarily in the Midlands, in an area known as Black Country.

Mild ale is a light brown, sometimes slightly sweet ale with subtle chocolate flavors and a light body. Many people think mild is simply the draught version of a brown ale, but this is not always the case. The name "mild" refers to the beer's mild bitterness and not the color, alcohol or flavor as many claim—particularly when comparing milds to porters, browns or bitters.

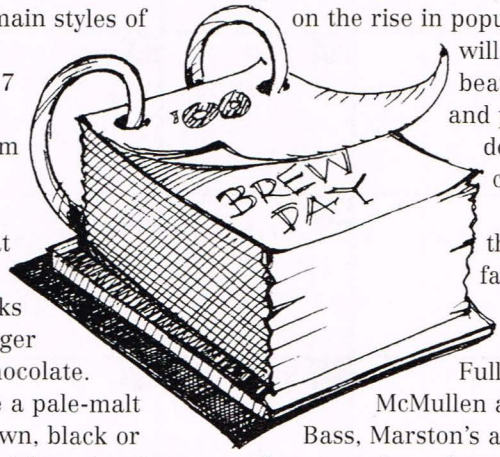
There are two main styles of mild ale: light and dark. Light is 8 to 17 SRM in color, while the dark ranges from 17 to 34 SRM. Both contain the same amount of alcohol at 3.2 to 4.0 percent by volume. The darks have a slighty stronger taste of malt and chocolate.

Most milds have a pale-malt base with some brown, black or chocolate malt added for color. They are sometimes fortified with sugar, adjuncts or caramel. The pale version is most likely to contain these adjuncts. The dark mild contains the above grains, and perhaps some sugar, plus crystal malts of varying degrees.

The milds of our day are different from the milds of the 1800s. Traditional milds were young ales, brewed with some dark malts to combat the green-beer flavors. These original milds were also dark in color, just like brown ales and other styles, due to the use of malts that were kilned with coke and roasted over wood fires.

Over time, technology and innovations in malting made for paler styles. This development, coupled with the mixing of brown and pale ales, eventually led to pale milds.

At one time, mild was easily the most popular style in England. Today it is mostly a regional style, with just a shadow of its former production. Some say mild is back on the rise in popularity, but it will likely never beat the bitters and pale ales that dominate the country today.



Some of the most famed English milds are brewed by Fuller's, McMullen and Sons, Bass, Marston's and Ansells. There are also a few milds produced in the United States. Grant's

ILLUSTRATION BY KRISTINE BYBEE

2000 Style Calendar

January: Barleywine and Roggenbier
A barleywine to age until the 2001 New Year's celebration and a flavorful German rye beer to balance out the dark season.

February: Cream Ale and Dublin Stout
Black-and-tan brewing month: A light, slightly sweet cream ale and a traditional Irish stout for St. Patrick's Day.

March: Belgian Dubbel and Pilsner
Belgian Brewing 101 (a Chimay "Red Cap" clone) followed by Lager Brewing 101 (a traditional Czech pilsner).

April: Maibock and Scotch Strong Ale
Maibock, of course, for celebrating next month, and a bold, peated Scotch ale high in both gravity and flavor.

May: IPA and Mild Ale
An old standby—a highly hopped American-style IPA—and an English beer that's new to the lineup, a mild brown ale.

June: Golden Ale and Oktoberfest
A "lawnmower" beer for the start of summer. And a tasty Oktoberfest that will be aged until early September.

September: Dortmunder and Oatmeal Stout
Dort is a light European export lager. Plus a new stout for this year's schedule — an English oatmeal.

October: ESB and Weizenbock
A deep amber, caramel-laden ESB and a gigantic German winter seasonal weizenbock to age until early January.

November: Dunkel and Belgian Tripel
This month has two warming beers to fight the cold winter nights: a dark Bavarian dunkel and a high-gravity Belgian tripel.

December: Christmas Ale and Spiced Ale
A new version of our annual Christmas ale. Plus a lightly spiced dark ale with a distinctly festive edge to end the year.

Brewery in Yakima, Washington, produces a Celtic ale often compared to a mild ale; Goose Island in Chicago has a dark mild; and the Gateway dark mild brewed by John Harvard's Brewhouse in Boston is a classic interpretation. A few years ago, Deschutes Brewery in Bend, Oregon, started brewing High Desert Mild, a hoppier-than-normal version of the light style.

This month's recipe is an all-grain version, modeled after Holden's Black Country Mild. Located in the town of Dudley in the West Midlands of England, Holden's was founded 80 years ago as a brewpub and now has 21 pubs around the region.

This is a dark mild made from Maris Otter pale, amber, light crystal and black patent malts. The target original gravity is 1.036 (9° Plato) with a terminal gravity of 1.008 (2° Plato). Alcohol by volume will be about 3.6 percent.

Mild ales should be hopped with English varieties, mostly Fuggles and Goldings, and should be hopped sparingly. The hops for Holdens' mild are Fuggles and Kent Goldings at the beginning, with more Goldings added at the end of the boil to achieve 24 IBUs. This is the high side of the bitterness range for this style of beer, which extends from 10 to 24 IBUs.

The fermentation is fairly typical, conducted at 68° F using an English ale or London ale strain. Fermentation is easily completed in 14 days. Conditioning takes an additional 7 days, with very little priming sugar. The proper carbonation for mild ales is around 1.0 volumes of CO2, which emulates a cask ale.

Many milds are not as well attenuated as our recipe, leaving 3 or 4 percent unfermented sugar in the beer (for a final gravity of 1.012 to 1.016). This is a throwback to the time when the leftover calories would help sustain the factory workers for the rest of the day. In this case, the brewer would want to choose a yeast strain that will finish the beer at a higher gravity, or force the yeast to stop working by inactivating it with cold temperatures and crashing it out of solution.

Mild Ale (5 gallons, all grain)

Ingredients:

- 5.5 lbs. pale malt
- 0.5 lbs. crystal malt (20° Lovibond)
- 0.25 lbs. amber malt (50° Lovibond)
- 0.125 lbs. black patent malt
- 0.5 oz. of 4.2% alpha-acid Fuggle hops (2.1 AAUs)
- 0.5 oz. of 5.4% alpha-acid Kent Goldings hops (2.7 AAUs)

May 2000

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
	1	2	3	4 PREP DAY • Assemble ingredients for British mild ale. • Soak equipment in sanitizer. • Start 1 pt. yeast starter	5	6 BREW DAY • Brew mild ale • Primary fermentation starts. Check original gravity and record. • Scotch ale from April is ready to drink
7	8	9	10	11 PREP DAY • Assemble ingredients for India Pale Ale • Soak equipment in sanitizer • Start 1 pt. yeast starter	12	13 BREW DAY • Brew IPA • Primary fermentation starts. Check original gravity and record. • Rack mild to secondary. Check gravity, record.
14	15	16	17	18	19	20 BOTTLE DAY • Rack IPA to secondary. Check gravity, record. • Sanitize bottles for mild. Record final gravity. Rack, prime and bottle.
21	22	23	24	25	26	27 BOTTLE DAY • Sanitize bottles for IPA. Record final gravity. Rack, prime and bottle. Age seven more days. • Maibock (from April) and mild are ready to drink!
28	29	30	31			

- 0.5 oz. of 5.4% alpha-acid Kent Goldings hops (2.7 AAUs)
- 1 pt. starter of Wyeast 1318 (London III) or White Labs WLP-002 (English Ale)
- 1/4 cup corn sugar for priming

Step by Step

Mash grain in 2 gal. of water at 150° F for 60 minutes. Sparge with 168° F water to collect 5.75 gallons of wort. Total boil time is 90 minutes. At beginning of boil add the Fuggle and first Goldings hops and boil 90 minutes. At end of boil add remaining Goldings. Whirlpool and cool to 68° F. Pitch yeast starter. Oxygenate-aerate well.

Ferment for seven days. Rack to secondary fermenter and continue for seven more days, until gravity is about 1.008 (2° Plato). Prime with corn sugar and bottle. Allow to carbonate and age at least 7 more days before drinking.

OG = 1.036 (9° Plato)
FG = 1.008 (2° Plato)
Color = 18 SRM
Bitterness = 24 IBUs

All-Extract Option:

Substitute the pale malt for 4.5 lbs. extract syrup and increase Fuggles to 0.75 oz.

Start with 5 gallons of 150° F water. Steep crushed grain for 30 minutes. Sparge grains with enough 170° F water to make 5.5 gallons. Heat to boiling and add extract syrup. Total boil will be 60 minutes. At beginning of boil add Fuggles and first Goldings, continue for full 60 minutes. Add remaining Goldings and whirlpool. Cool to 68° F and pitch starter. Oxygenate-aerate well. Ferment as above.

OG = 1.036 (9° Plato)
FG = 1.008 (2° Plato)
Color = 18 SRM
Bitterness = 24 IBUs

India Pale Ale: The Story

As most beer enthusiasts know, IPA is steeped in British military history. The full name, India Pale Ale, refers to the beer produced for delivery to troops and British citizens in occupied India from the early 1700s to the mid-1800s. IPA is the result of much experimentation and evolution during that time.

Early attempts to bring beer to India failed for a number of reasons, primarily the warm temperatures on the ships—even down in the cargo holds—and the warm temperatures of the tropical waters through which the ships sailed. These conditions, coupled with the constant motion of the beer within the casks and three to five months of storage time, made shipping a serious challenge. The darker, sweeter beers of the time fared no better and were much less popular in the hot tropical weather, so by

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CIRCLE 23 ON READER SERVICE CARD

Brewing schedule notes:

May 4: Prep day for mild

Assemble all ingredients for mild ale. Sanitize equipment and start yeast culture for brewing on Saturday.

May 6: Brew day for mild

Brew mild, check original gravity and record. Begin primary fermentation.

Scotch ale from April is ready to drink today!

May 11: Prep day for IPA

Assemble all ingredients for India Pale Ale and sanitize equipment. Start yeast culture for brewing on Saturday.

May 13: Brew day for IPA. Transfer day for mild ale.

Brew India Pale Ale, check original gravity and record. Begin primary fermentation.

Rack the mild to secondary and record the gravity. Continue aging for 7 more days.

May 20: Transfer day for IPA. Bottle day for mild ale.

The IPA should ready for transfer to secondary. Record gravity and check for off-flavors. Continue for 7 more days.

The mild should be ready to prime and bottle. Age for 7 more days before drinking.

May 27: Bottle day for IPA

The IPA should be done fermenting and ready to bottle today. Age one more week before drinking (June 3rd).

The mild is ready to drink and so is the maibock from last month!

June brews: Golden ale and Oktoberfest.

1722 brewers were experimenting with new methods for shipping pale beers. These methods included fermenting the beer on the ship and concentrating the beer before shipping and adding water to it after arrival. The experiments helped, but the hot conditions and long voyages were still too much.

Then George Hodgson of the Bow Brewery in London created a recipe based on the pale ale he sold in London. Upon hearing that some of the concentrate held well in cooler waters when fortified with spruce or extra hops, he decided that a higher-gravity beer with high hop rates would be better suited to travel. In 1790 he shipped out his first India Ale. In addition to the gravity and hop factors, it had a yeast strain that stayed in suspension longer, keeping the beer "alive" longer in turn. This helped prevent contamination and staling. Shortly afterward, Bass and Allsopp

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produced IPAs that were even more pale and had higher hop rates.

In 1827, a cargo boat carrying casks of IPA wrecked shortly after leaving port in London. The damaged casks were sold locally, and for the first time, people in England could taste the beer that had been exclusively reserved for the foreign market. Demand exploded, and the rest is history.

It's lucky for the rest of us that the ship wrecked, too. We may have had to wait a hundred more years for someone to discover IPA—or even worse, the style might have died with the Indian occupation. Just consider how different brewing would be today if it weren't for IPA. Such a bitter and "offensive" style might not have caught on at all, if it weren't for the cheaply auctioned shipwreck casks and the allure of "export only" pale ale.

Today, there are two types of IPAs: the traditional English variety and the American IPA. The style guidelines are the same, as far as the numbers go, but they really are much different. For the most part, American IPAs fall on the high side of the numbers and the English IPAs are on the low side.

One of the earliest American IPAs was probably brewed by the Bartels Brewing Company, named after founder Herman Bartels (1853-1910). He bought two existing breweries — one in Syracuse, New York; the other in Pennsylvania — and before long, added porter and IPA to the lagers already being produced at the Syracuse plant.

The guidelines for India Pale Ale (covering both American and English styles) are an OG of 1.050 to 1.070 (12.5° to 17.5° Plato); ABV of 5 to 7.5 percent; bitterness from 40-60 IBUs; and color of 8-14 SRM. English IPA is lighter in color, body and alcohol than the American version and much less bitter.

There are a wide variety of IPA's in production worldwide. From England, the best-known are brewed by Bass, Fuller's, Allsopp and Witbread. In the United States,

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look for super-hopped versions like Goose Island IPA (from Chicago), Pike Place IPA (Seattle), Old Dominion Tupper's Hop Pocket (Ashburn, Virginia), Anderson Valley Hop Ottin (Boonville, California), Bear Republic Racer 5 (Healdsburg, California), Three Floyds Alpha King Pale (Hammond, Indiana) and Castle Springs Brewing Lucknow IPA (Moultonboro, New Hampshire).

My personal favorite is probably the Pike. It is deep golden, very hoppy and well-balanced, with a fairly prominent caramel character. I'm also hooked on the Anderson Valley: It's floral and tastes like dry hops all the way through, with a dry, clean finish.

The malt bill for our IPA is a bit different from most IPA recipes, because the bulk of the gravity comes from two-row Beeston Maris Otter pale and Belgian aromatic pale. The Belgian pale is a great touch. I wish I'd thought of it earlier! It lends a richness to the flavor that compliments the Maris Otter perfectly and blows away any normal North American malts. The specialty grains are carapils, crystal 20 and crystal 60. Our original gravity should be about 1.064 (16° Plato) and the terminal should be 1.016 (4° Plato).

Since we are going for a hybrid English-American IPA, the hop program shapes up as the recipe chronicles: The monster Columbus hop from Washington's Yakima Valley for 90 minutes, Kent Goldings for 45 minutes and at the end of the boil. We'll dry-hop with Liberty during the secondary, simply because I really like it.

Remember: Anybody can super-hop a beer and call it an IPA. Our goal is to provide a good malt flavor and have some balance with yeast character and alcohol, too.

The yeast selection should fit the profile you desire for your beer. An American-style IPA may be drier and have no diacetyl flavor; it will be crisp and the hop presence will overshadow the yeast character completely. An English IPA, on the other hand, will owe a great deal of the overall flavor to the yeast. This recipe will use Wyeast 1318 (London III). Good alternatives for an American style are 1056, 1272 and 1087. Good English strains are 1084, 1098 and 1968.

Fermentation in our recipe is at 69° F, but the yeast strain works well from 68° to 71° depending on your brewing conditions. Anything over 71° will get a bit too estery, while anything under 68° may not reduce diacetyl well enough. So pay attention to your fermenting beer.

India Pale Ale (5 gallons, all grain)

Ingredients:

- 5 lbs. Maris Otter pale malt
- 4 lbs. Belgian pale malt
- 0.5 lb. carapils malt
- 1.5 lb. crystal malt (20° Lovibond)
- 0.5 lb. crystal malt (60° Lovibond)
- 1 oz. of 13% alpha-acid Columbus hops (13 AAUs)
- 1 oz. of 5.4% alpha-acid Kent Goldings hops (5.4 AAUs)
- 1.5 oz. of 5.4% alpha-acid Kent Goldings hops (5.4 AAUs)
- 1 oz. of 4.5% alpha-acid Liberty hops (4.5 AAUs)
- 1 pt. starter of Wyeast 1318 (London Ale III)
- 2/3 cup corn sugar for priming

Step by Step

Mash grain in 3.75 gal. of water at 150° F for 60 minutes. Sparge with 168-170° F water to collect 5.75 gallons of wort. Total boil time is 90 minutes. At beginning of boil add Columbus hops and boil 45 minutes. Add the first Kent Goldings, boil remaining 45 minutes. At end of boil, add last Kent Goldings to finish. Whirlpool and cool to 69° F to pitch starter. Oxygenate-aerate well.

Ferment at 69° F for 7 days

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then rack to secondary fermenter. Dry hop with 1 oz. Liberty and continue fermentation for 7 more days until gravity is 1.008 (2° Plato) or until fermentation stops. Let settle, rack, prime and bottle. Age 7 days before drinking.

OG = 1.064 (16° Plato)
FG = 1.014 (3.5° Plato)
Color = 17.5 SRM
Bitterness = 75 IBUs

India Pale Ale (5 gallons, extract with grain)

Ingredients:

- 8 lbs. pale extract syrup
- 0.5 lb. carapils malt
- 1.5 lb. crystal malt (20° Lovibond)
- 0.5 lb. crystal malt (60° Lovibond)
- 1 oz. of 13% alpha-acid Columbus hops (13 AAUs)
- 1.25 oz. of 5.4% alpha-acid Kent Goldings hops (6.75 AAUs)
- 1.5 oz. of 5.4% alpha-acid Kent Goldings hops (8.5 AAUs)
- 1 oz. of 4.5% alpha-acid Liberty hops (4.5 AAUs)
- 1 pt. starter of Wyeast 1318 (London Ale III)
- 2/3 cup corn sugar for priming

Step by Step

Start with 5 gallons of 150° F water. Steep crushed grain for 30 minutes. Sparge grains with enough 170° F water to make 5.5 gallons. Heat to boiling and add extract syrup. Total boil will be 60 minutes. At beginning of boil add Columbus hops and boil 15 minutes. Add the first Kent Goldings, boil remaining 45 minutes. At end of boil, add second Goldings to finish. Whirlpool and cool to 69° F to pitch starter. Oxygenate-aerate well.

Follow fermentation and dry-hop schedule for all-grain version.

OG = 1.064 (16° Plato)
FG = 1.014 (3.5° Plato)
Color = 17.5 SRM
Bitterness = 75 IBUs ■

Mikoli Weaver works at Belmont Station, a beer-retail business affiliated with the Horse Brass Pub in Portland, Oregon.

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HOT! HOT! HOT!

From jalapeño to habañero, how to brew scorching chili beers at home

At the back of every homebrew supply store, there is a secret door. It's covered with posters from malt and hop suppliers, labels from local brewpubs and microbreweries, price lists and other paperwork. You'd never even notice the door, if I hadn't told you about it.

The shop employees and management don't want the average customer to know about the door. It's reserved for "special" clientele, those in the know. You have to have a password to be admitted to the inner sanctum.

I am about to reveal that password. Be careful, though. Don't use it unless you are the only customer in the shop, and only if you are a good, loyal, customer. Even then, count on getting a nervous laugh, followed by an apprehensive glance around the shop to make sure no one is listening. Finally, the owner may say something like, "Why don't you come back here out of the public eye, and I'll see what I can find for you ..."

The secret password? "Do you have a recipe for chili beer?"

Most homebrewers, at one time or another, get this urge to try a chili beer. It's kind of a deep dark secret of our brother-and-sisterhood, one few of us will admit to the non-brewing population. These beers are the stuff of legend. Recipes and descriptions are passed down secretively from brewer to brewer. The experts at your local brewshop probably have their own favorite formula, but aren't likely to give it to just anybody.

What is it about chili beers that causes us to behave this way? The thought of combining sweet and bitter beer with hot and spicy peppers is, in a way, a perverse desire. On the other hand, the execution of this desire is a sure test of a brewer's skills. It's very easy to make a bad chili beer, and very tricky to get it right. Maybe it's the challenge that pushes us to delve into this alchemistic realm. Whatever it is, it's best we keep the experiment to ourselves until we get it right.

What do chili beers taste like? What do they look like? What are the do's and don'ts a first-time chili-beer brewer should heed? Well, come back here, out of the light, and I'll share my secrets. But don't tell anyone else.

First and foremost, a chili beer must be a beer. The chili is secondary. The beer itself must be

by Scott R. Russell

sound, solid, balanced and worth brewing. Second, even if you love hot food, a chili beer will be hotter than you think, and too hot for most people, so don't plan on taking it to a neighborhood potluck dinner. Third, ask yourself the very serious question, "Do I really want to do this?" If you answer yes, go ahead. Fourth and final recommendation: wash your hands with soap (water alone doesn't work), before, but especially after handling the peppers! Capsicum, the stuff in chilis that causes heat, can burn you big-time—your hands, eyes, nose. Some peppers are dangerous enough to warrant wearing disposable rubber gloves. Trust me, I've been there.

A word about peppers: The best peppers to use are little ones—several varieties can be found that are an inch to two inches long, and these fit neatly into beer bottles. Green, fresh peppers are not quite as intensely hot (usually) as dried red ones, and may have more sweetness to balance the heat. If you are not putting them into the bottles, you can use bigger ones in the boil or in the fermenter, which may be more economical. Part of it is presentation— a pepper in the bottle works like a worm in a bottle of mescal — a clear warning! The absence of a pepper may allow your beer to sneak up on the drinker.

Each of these recipes calls for adding a pepper to the bottle, but that is only one way to get chili in your beer. I like to think chilis react like hops: They contribute different degrees of flavor and aroma, depending on when and how they are added to the batch.

Add the chilis to the bottle if you want the drinker to know it's there, and if you want the chili flavor to increase as the beer ages. The alcohol in the beer will leach out the hot and the fruity-spicy pepper flavor over time, and it won't get overly harsh. This will also give you a fair amount of hot peppery aroma. The ultimate in "dry-hopping"!

Alternatively, you could add the chilis to the wort during the last 5 minutes of the boil and continue to steep them in the wort for 15 minutes after shutting off the heat. This method will get the spicy flavor into the beer, like a late-boil flavor hop addition. Little aroma will remain, but this will contribute a solid, clean hot flavor if it's done with finesse.

A third possibility is to put the chilis into the primary fermenter as you pitch the yeast and leave them there until you rack to secondary. This will give you good heat, good pepper-as-fruit flavor, and enough chili aroma to balance the beer aromas. This is the method that adds the most to the beer's complexity. A fourth possibility is to add the chilis to the mash.

The pluses and minuses of these methods are worth considering: A bottle of beer with a chili in it is a statement, a challenge. A drawback, one best solved by using the second method above, is the sanitation question. Do you know where your chilis have been? Putting them into finished, fermented beer is probably safe, as the alcohol will likely kill off anything nasty. But 5 minutes of boiling and 15 minutes of steeping will do even better.

Golden Chili Lager (5 gallons, partial mash)

This recipe is reminiscent of Cave Creek Chili Beer, brewed by Crazy Ed's Black Mountain Brewing in Cave Creek, Arizona. It looks harmless enough (unless there's a chili lurking in the bottle!) but if you're not careful, that hot stuff will reach right out of the glass and tear your throat open!

Ingredients:

- 1.5 lbs. pilsner malt
- 1 lb. carapils malt
- 4 lbs. unhopped extra light dry malt extract (DME)
- 1 oz. of 4% alpha-acid Hallertau hops (4 AAUs)
- 1 oz. of 4% alpha-acid Mt. Hood hops (4 AAUs)
- American lager yeast slurry (Wyeast 2035 or equivalent)
- 7/8 cup corn sugar for priming
- 48-52 jalapeño peppers

Step by Step:

Heat 5 quarts water to 163°F. Crush grains, mix into liquor and hold at 152°F for 75 minutes. Runoff and sparge with 8 quarts water at 168°F. Add DME, heat to boiling.

Total boil is 60 minutes. Add Hallertau hops, boil 45 minutes. Add Mt. Hood hops, boil 15 minutes, remove from heat. Cool, pour into fermenter with enough preboiled, chilled water to make 5.25 gallons. At 65°F or cooler, pitch lager yeast.

Ferment cool (60°F) for two days, then move to a cooler place (50°F) and ferment two weeks. Rack to secondary and lager three to four weeks at 40°F. Prime with corn sugar, add 1 pepper to each bottle, cap. Age cool (45 to 50°F) for three to four weeks.

OG = 1.048 (12° Plato)
FG = 1.010 (2.5° Plato)
Bitterness = 20 IBUs

Chili Stout (5 gallons, partial mash)

Perfect for celebrating Saint Patrick's Day in Tijuana, this dry, black stout will drive the snakes out of any place you want. Roasted barley goes well with hot peppers, if only you let it.

Ingredients:

- 1 lb. pale malt

Chili Tips from CooperSmith's

If you happen to be in Fort Collins, Colorado, sample a pint of Sigda's Green Chili Beer at CooperSmith's Pub and Brewery. Head brewer Dwight Hall produces 120 barrels each year, and says it "never gets a tepid response. People either love it or hate it."

To start, Hall brews nine barrels (279 gallons) of a crisp, blond ale. Then he adds 55 pounds of Anaheims to the fermenter (30 pounds of hot, 25 pounds of mild). After transferring the beer to an aging tank, he adds "a few pounds" of serranos. "This beer starts with a nice sweetness, followed by a long, round green-chili flavor," says Hall. "And at the end, there's some definite heat." Here are his chili-beer tips:

- "Start conservative. You can always drink an underflavored beer, but an overflavored beer is going to be unpleasant, to say the least."
- "The beer should compete with the chilis. Don't let either one completely overpower the other."
- "Start with a light, crisp ale. In my opinion, chilis don't go as well with heavier beers, like stouts and porters."

Another world-class chili beer to try: Cerveza Chili Beso ("Kiss of Chili"), brewed by the Great Basin Brewing Company in Sparks, Nevada (near Reno). It won a GABF gold medal in 1994, 1997 and 1999.

- 0.5 lb. dark crystal malt (90°Lovibond)
- 0.5 lb. roasted barley
- 1/4 lb. black patent malt
- 4 lbs. unhopped dark dry malt extract (DME)
- 0.75 oz. of 9% alpha-acid Northern Brewer hops (7 AAUs)
- Irish Ale yeast slurry (Wyeast 1084 or equivalent)
- 1/4 cup brown sugar for priming
- 1/2 cup amber DME for priming
- 8-10 habañero ("Scotch bonnet") peppers, cut into 50 strips.

Step by Step:

Heat 6 quarts water to 163°F. Crush grains and mix into liquor. Hold at 152° F for 75 minutes. Runoff and sparge with 9 quarts at 168°F. Add DME, bring to a boil.

Add hops, boil 60 minutes. Cool, add to fermenter along with enough chilled preboiled water to make up 5.25 gallons. At 68°F or so, pitch yeast. Ferment at 65-68°F for two weeks, then rack to secondary. Condition at 60°F for three weeks.

Prime with DME and brown sugar. Bottle, placing a piece of habañero in each bottle, and seal. (Warning: wear gloves when you're working with habañeros, and keep your hands away from your face!) Condition at 55° F for three weeks.

OG = 1.048 (12° Plato)
FG = 1.012 (3° Plato)
Bitterness = 30 IBUs

Smoked Chili IPA (5 gallons, partial mash)

For the beer drinker who has tried everything before, just to prove that he or she hasn't. This beer is malty and fairly big underneath and hoppy in the middle, with a waft of beechwood smoke near the end. And, of course, you get dragon's breath for hours after!

Ingredients:

- 3 lbs. pale malt
- 1 lb. toasted pale malt (toast in oven for 30 minutes at 350°F)
- 1 lb. beechwood smoked rauchmalt
- 1 lb. medium crystal malt (50° to 60° Lovibond)
- 4 lbs. unhopped light dry malt extract (DME)
- 2/3 oz. of 12% alpha-acid Chinook hops (8 AAUs)
- 3/4 oz. of 8% alpha-acid Perle hops (6 AAUs)
- 1 oz. of 4% alpha-acid Kent Goldings hops (4 AAUs)
- 1 oz. of 4% alpha-acid Fuggles hops (4 AAUs)
- 1 large dried Anaheim chili
- English ale yeast slurry (Wyeast 1098 or equivalent)
- 1 lb. oak chips (optional)
- 1 cup light DME for priming
- 25 medium dried Anaheim chilis, cut in half

Step by Step

Heat 10 quarts water to 164°F. Crush grains, mix into liquor and hold at 152°F for 90 minutes. Runoff and sparge with 15 quarts water at 169°F. Add DME to kettle, bring to a boil.

Total boil is 90 minutes. Add Chinook hops, boil 30 minutes. Add Perle hops, boil 30 minutes. Add Kent Goldings hops, boil 30 minutes. Turn off heat, add Fuggles hops and 1 dried Anaheim, chopped into small pieces. Steep 30 minutes. Remove hops and pepper, chill wort.

Steam (15 minutes) and toast (350°F, 30 minutes) oak chips, if desired, and place in fermenter. Add wort to fermenter along with enough preboiled and chilled water to make up 5.25 gallons. At 65° to 68°F, pitch yeast.

Ferment relatively warm (68-70°F) for two weeks. Rack to secondary and condition cool (55-60°F) for three to four weeks. Prime with DME, add half an Anaheim pepper to each bottle. Seal and condition for six weeks.

OG = 1.070 (17.5° Plato)
FG = 1.020 (5° Plato)
Bitterness = 55 IBUs ■

Scott Russell is a regular BYO contributor. He wrote "Hot Tips For Making Smoked Beers" in the April issue and writes the "Recipe Exchange" column every month.

Scott's Top Ten Brew-Worthy Chilis

Scoville heat units measure the hotness of chili peppers. The scale ranges from zero (bell, pimento) to 350,000 (habañero).

Type of Pepper	Description	Scovilles	Brewing Tips
Habañero	This round pepper is also known as a "scotch bonnet."	200,000–350,000	I like to put scotch bonnet peppers into Scotch ales. One or two in five gallons is plenty!
Cayenne	A bright red, curled and twisted pepper.	30,000–50,000	Great in a *biere de garde* or Belgian dubbel. Hard to get into the bottle, though!
Tabasco	The basis of Creole cooking and a famous hot sauce.	30,000–50,000	This small, round, red pepper is great in a rich, malty brew such as barleywine or old ale.
Thai Dragon	Use in small amounts: This is one hot pepper!	40,000	Use sparingly, only in the boil. Adds a nice touch, with ginger and orange peel, to a holiday brew.
Serrano	A small pepper best used whole, green and fresh.	7,000–25,000	I put five serrano peppers into a five-gallon batch of a simple golden ale once, and it was just right.
Hungarian Hot Wax	Long, yellow peppers with a different kind of spicy flavor.	5,000–15,000	Dried, crushed and steeped at the end of the boil, they add a bite to porters, stouts and dark lagers.
Czechoslovakian Black	A nice, old variety; dark purple and ripening to red.	5,000	Will tint a beer reddish. Use as a surprise in a Bohemian pilsner!
Jalapeño	These peppers range from mild to medium hot.	1,000–5,000	With a bright, sweet tangy flavor (like salsa), they're perfect to add to a light lager.
Ancho	It tastes quite sweet at first, then the mild heat hits!	1,000–3,000	Chop up dried anchos and "dry hop" an IPA with them (age with oak chips to smooth out the flavor).
Anaheim	A flavorful red pepper that's "mild" in comparison.	1,000–1,500	A nice touch to add to a brown ale. Blends well with smoky or roasty flavors.

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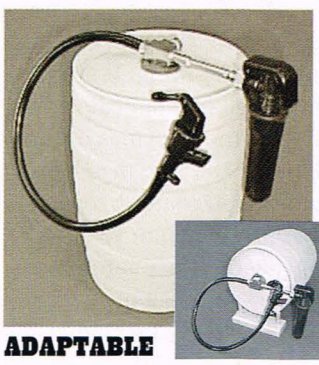

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STEP UP to MASH

by Dawnell Smith

All-grain brewing takes more time, more equipment and more brain activity than extract brewing, so why do it? For starters, diving into the mash pit yields excellent results. By producing your own malt extract, you get a broader perspective of the brewing process, learn how to make better beers and bloom into a more creative, balanced brewer.

Adding the mash to your brewing regimen really isn't that difficult or intimidating. It elevates the brewing experience without costing too much money or time. If we view extract brewing as a two-week vacation on a balmy island beach, then all-grain brewing is like wandering the Himalayas for a month. It's the difference between an ordinary vacation and a trek that inspires the soul. Though both activities bring fun and satisfaction, only the high-altitude hiking expedition builds knowledge and skills. With that in mind, let's follow the steps that lead to your first mash.

What is "the mash"?

"Mashing" refers to the process of extracting wort from malted barley and then collecting it. More specifically, it involves mixing hot water with the milled malt, which allows enzymes to dissolve the starches and then convert them to fermentable sugar.

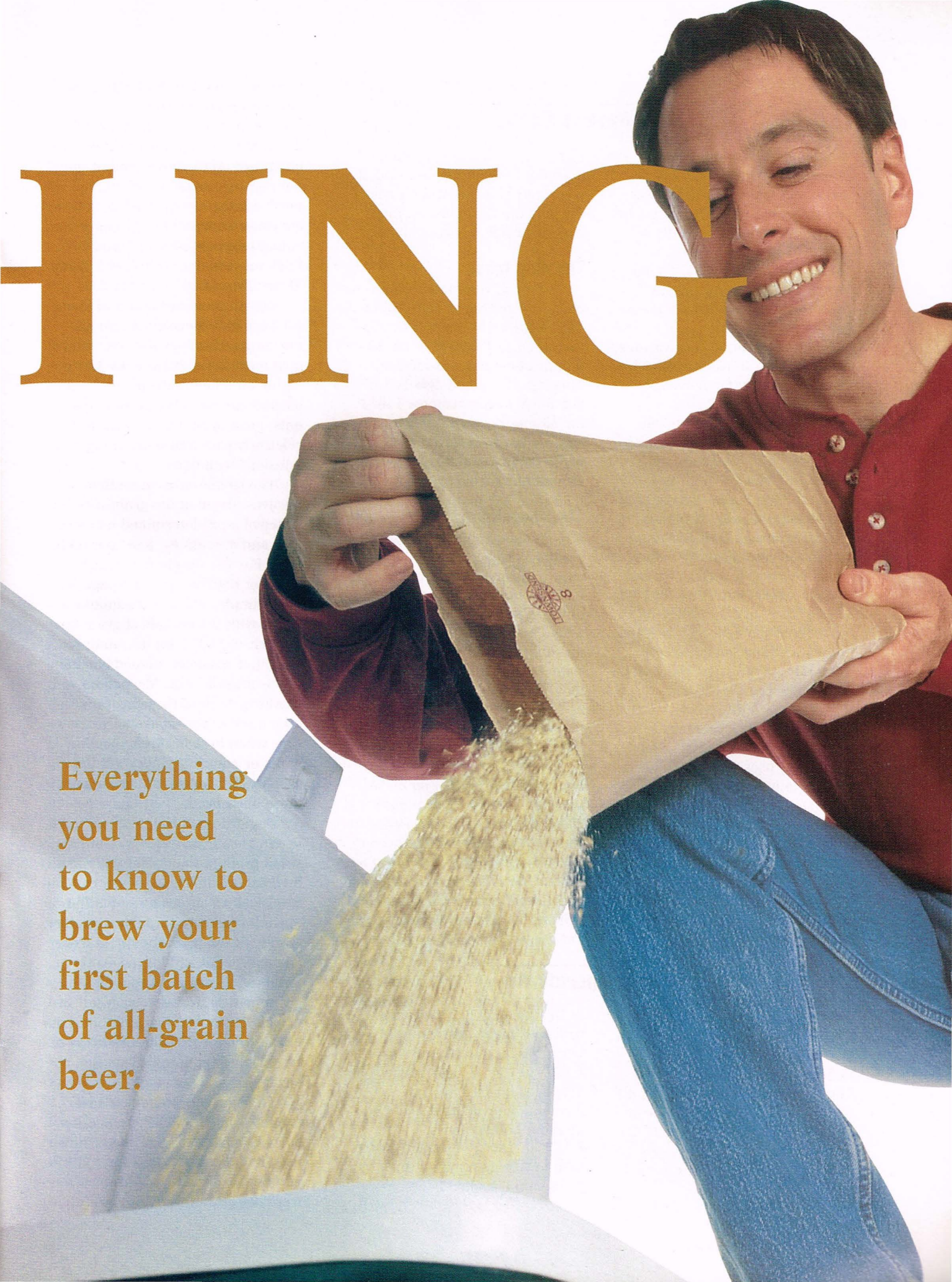
To understand mashing, it helps to know a bit about malted barley. "Two-row" barley makes excellent grain for brewing. It has plump kernels, which means more starch and a greater potential extract yield than "six-row" barley. For that reason, most homebrewers and craft-brewers use two-row malt when brewing. Brewers occasionally use six-row malt due to its greater enzyme potential, which becomes an advantage when using adjuncts like corn or rice that don't contain the enzymatic tools that are necessary for starch conversion.

When barley is converted to malt, the grain is steeped in water, allowed to germinate and then kilned. "Highly modified" malt has a high amount of material that's been converted to soluble starch during the malting process. "Undermodified" malt has much less soluble starch. These days, the vast majority of homebrewers used highly modified malt because it's much easier to mash.

Regardless of the malt used, the process of mashing accomplishes the same thing. It starts when hot water sets in motion a chemical chain of events that makes starch and enzymes accessible to one another. Some of the enzymes break down soluble starch into various carbohydrates while others break down proteins into yeast nutrients. Both types of reactions are important. The enzyme "beta-amylase" releases the sweet-tasting sugar maltose in an orderly fashion at moderate temperatures as low as 130° Fahrenheit. The enzyme "alpha-amylase" also produces fermentable sugars like glucose, maltose and maltotriose, but acts randomly on relatively small starch molecules at temperatures as high as 170° F or more. Of the two, beta-amylase is more temperature sensitive.

Consequently, the temperature range in which both enzymes can act is relatively narrow. This "brewer's window" of opportunity is about 148 to 160° F. If you go too high, then you prevent beta-amylase from breaking down large

HING



Everything you need to know to brew your first batch of all-grain beer.

Other Ways to Mash

Single-infusion mashing works for almost every beer style and takes relatively little time, but it isn't sufficient when using undermodified malts or adjuncts like corn, rice and other unmalted grains. That's when the "temperature-step" and "decoction" mashing methods come into play.

Both techniques use various temperature steps to emphasize specific enzymatic activity. A "protein rest" at 122° Fahrenheit breaks down cell walls, allows proteins to dissolve and begins the cultivation of yeast nutrients. A step-up to 148° to 160° F allows for starch conversion. Finally, a top-out temperature around 170° F stops the conversion process.

Decoction incorporates two starch-conversion steps, at 140° and 158° F, to emphasize the activity of the beta-amylase and alpha-amylase enzymes. You can also do the same thing when step mashing.

The main difference between the two methods is in how the mash is heated. Step mashing uses additional hot water to make temperature changes, while decoction calls for boiling a portion of the wort and adding it back to the mash. Both methods require an addition vessel and heat source.

For the most part, you can make any style of beer by using single-step infusion. If you're using adjuncts, step mashing does the trick admirably. And, if you really want to make a bock the way the Germans do, then conduct a full decoction mash.

The step mash

A typical step-mash would bring the grain and water to 122° F for a 30-minute protein rest, then to 150-158° F for 30 minutes of starch conversion. This last step could also be broken down into two steps: 150° F for 15 minutes to emphasize the work of the beta-amylase and 158° F for 15 minutes to emphasize alpha-amylase.

The decoction mash

This method achieves the same results as step mashing, but uses a distinct heating regimen. To raise temperature, portions of the grist are boiled and then added back to the mash. This mashing method achieved consistency in the brewing process long before thermometers were invented. It continues to predominate in Germany as a traditional brewing process.

For more information on mashing chemistry and techniques, check out these two excellent books: "New Brewing Lager Beer" by Gregory J. Noonan (Brewers Publications, 1996) and "The Principles of Brewing Science" by George Fix (Brewers Publications, 1999).

Mash temperatures

The conversion temperature you choose will affect the final brew, so determine your goals ahead of time. Obviously, how much grain you use makes a difference, too. Still, the following characteristics will hold true if you use the same recipe, but alter the mash temperature. Here's a quick guide:

- 149° to 152° F: This range produces highly fermentable wort that leads to thinner beers.
- 153° to 156° F: This range produces moderately fermentable wort that leads to medium-bodied beers.
- 157° to 160° F: Produces wort with low fermentability that leads to full-bodied beers.

molecules; too low, and alpha-amylase never gets started.

When using malt that already has a high level of modification, you can mash on the lower end of the temperature scale. In addition, mash consistency will affect the way enzymes work. All things being equal, enzymes survive better in thick mashes than thin *(see "Thick Mash, Thin Mash" on page 31).*

For all these reasons and more, brewers have developed various mashing technologies, each with its own merits and drawbacks. Since highly modified malts have plenty of useable amino acids as yeast nutrients, most brewers can stick to the relatively easy and quick "single-infusion" technique.

The single-infusion method involves blending the grain with hot water of a predetermined temperature and amount for a set period of time. For the simple five-gallon batch of IPA described on page 30, for example, you mix 9.5 quarts of water with 9.5 pounds of grain and let it sit at 153° F for 45 minutes.

Other mashing methods include "step-infusion" and "decoction" mashing. Both of these procedures take more time and are only necessary when brewing with specific malts or adjuncts. Check out the sidebar *(left)* to learn more about these options.

Regardless of the method, you'll need to separate the wort from the spent grain at the end of the mash by using a lautering system, which is basically a set-up that puts the mash ingredients through a strainer. Merely draining all the liquid from the spent malt still leaves plenty of fermentable sugars trapped in the grain bed, so brewers "sparge," or dribble hot water over the top of the mash, to maximize the collection of sweet liquor and deactivate the enzymatic activity.

The sparge water must hover around 168° to 170° F to stop the conversion of starch to sugar. Never use water that's hotter than 170° F; you might extract unpleasant flavors from the grain husks.

What you need

To mash, you need two vessels — a mash tun to hold the malt and water without losing heat and a lauter tun to separate the wort from the spent grains.

Plastic picnic coolers work great as cheap, efficient mash tuns. The tall, cylindrical coolers work wonderfully, but you can make do with any cooler or insulated container *(see "Mash and Lauter" at right).*

If you want to avoid buying a food-grade cooler for this purpose, you can use your brewpot as a mash tun as long as it can hold about 10 pounds of grain and 10 quarts of water. When using a brewpot, monitor the temperature every 10 minutes and apply or remove heat as necessary. To help maintain temperature, you can put the pot in the oven or into some other insulated container like a Styrofoam box.

When deciding what to use, keep in mind that many commercial breweries use simple insulated vessels as mash tuns. The stainless steel and copper may look fancy, but they do pretty much what coolers do. What you use doesn't have to be pretty or expensive, it just has to be clean and effective.

For an easy lauter tun, use a 5-gallon plastic bucket with a spigot placed a half-inch above the bottom. Then fasten a grain bag to the bucket so the bag's bottom hovers a few inches from the bottom of the bucket. The idea is to create a false bottom that lets sweet liquor drip from the grains and flow through the spigot without getting stuck.

If you have a cylindrical cooler, you may be able to put the grain bag in the cooler during the mash, then pull it up a few inches when ready to separate the liquid from the grains. This would eliminate the need for a separate lauter tun.

On the other hand, if you have a food-grade bucket lying around, you can make a lautering system by drilling a bunch of holes (about an eighth-inch in diameter) into the bottom of the bucket. Just put the bucket over a brewpot and let things flow.

Again, the equipment doesn't need to look fancy, it just needs to work. For other ideas, check your local homebrew supply store or homebrew club. Homebrewers come up with all sorts of ways to build cheap equipment. If you keep in mind the simplicity of the goal — to maintain mash temperature and collect the wort — then you can build a mash system that won't mash your pocketbook.

Doing the mash

Now comes the fun part. Start with a sure-fire recipe, like my Turnagain Pale Whale on the next page! Then buy the grains. If you're not sure how to crush the malt, your homebrew shop can do it for you *(or see "Great Grain" in the March issue of BYO.)*

Before jumping into the fray, you need to figure out how much water to use, what temperature to shoot for and how long to let it mash. Fortunately, you can rely on a few simple rules.

Before heating the mash water, decide on a suitable mash temperature. You'll want to hit somewhere between 148° and 160° Fahrenheit for 45 minutes to an hour. Higher mash temperatures will lead to fuller-bodied beers due to faster starch conversion and a higher level of unfermentable carbohydrates. Most pale ale recipes call for mash temperatures of 150° to 154° F, while Scotch ale recipes usually opt for a higher range of 154° to 158° F. Clearly, the mash temperature needs to suits the style.

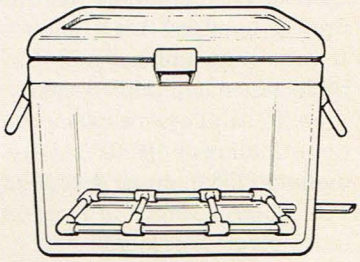
Once you know the desired mash temperature, heat a quart of water for every pound of grain you plan to use. You'll need to heat the water 16° to 18° higher than the desired mash temperature in order to compensate for heat loss when the water meets the grain. For instance, a pale ale recipe may call for a mash of 152° F, so heat the water to 168° to 170° F.

With water and grains ready,

Mash and Lauter

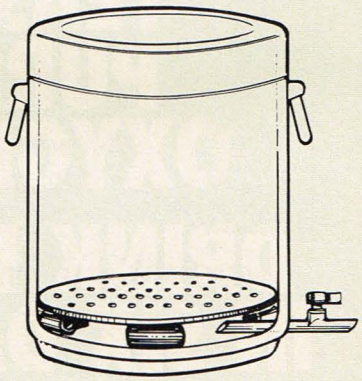
With some simple modifications, standard plastic food-grade coolers make great containers for both mashing and lautering.

Picnic Cooler



This picnic cooler will hold the mash at a constant temperature. When it's time to collect the wort from the grains, the liquid runs out through an easy-to-build "strainer" made from plastic piping with drilled holes. A spigot emerges from the side.

Water Cooler



Like the picnic cooler, the water cooler holds the mash temperature nice and steady. When it's time to collect the wort, the "false bottom" (made from a colander, a pizza screen or anything else that works) holds back the grain and lets the liquid flow out the spigot. For step-by-step instructions, see "Build a $50 Mash Tun" in the September 1999 BYO.

Turnagain Pale Whale

Here's a tried and true IPA recipe that celebrates the whimsical Beluga whales that feed in the waters near Anchorage, Alaska. Created by yours truly. Enjoy your first batch of all-grain beer!

Ingredients:

- 8.5 lbs. 2-row pale malt
- 1 lb. crystal malt (40° Lovibond)
- 2 oz. of 7% alpha-acid Northern Brewer hops (14 AAUs)
- 0.5 oz. 3.6% alpha-acid Hallertauer hops (1.8 AAUs)
- 1 oz. 6% alpha-acid East Kent Goldings hops (6 AAUs) (optional dry hops in secondary)
- 0.5 tsp.Irish Moss (during boil for clarity)
- Wyeast 1028 (London Ale)

Step by Step:

Add 9.5 quarts of water at 171° F to the grain for a final mash temperature of 153° F. Mix grain and water thoroughly and let sit for 45 minutes. Meanwhile, heat 4.75 gallons of sparge water to 170° F. Move mash contents to the lauter tun, sparge and collect the wort.

Bring wort to a boil for 90 minutes. Add Northern Brewer hops with 60 minutes left in the boil. Toss in the Hallertauer hops at the end of the boil, then chill. Pitch ale yeast at 75° F and let ferment at about 68° F for a week or until fermentation has stopped. Prime the batch with 3/4 cup corn sugar. Bottle. Let sit for a week or so at 60° F, then refrigerate at 40° F for a few days before drinking.

OG = 1.055
FG = 1.015
Bitterness = 55 IBUs

slowly add the malt and water at the same time (it helps to bribe an assistant), stir thoroughly and close the lid. If you're working alone, you can add the grain to the water, but do it fast. The idea is to wet all the grain particles without letting any of them get too hot. As mentioned before, the higher temperatures destroy beta-amylase enzymes.

Now you can spend the next hour or so relaxing with a good brew. But before you get complacent, start heating a gallon of sparge water for every two pounds of grain.

Collecting the elixir

Voila! You just extracted sweet liquor from grain. Now you need to stop conversion via hot sparge water, which inactivates enzymes, and then collect the wort.

First, set up the lauter tun and add sparge water of around 170° F until it sits four to six inches above the false bottom. This foundation

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water will prevent the grains from compacting too much, which can stop or slow the flow of wort and lead to a "stuck mash."

Now alternately add a portion of the mash, then a portion of sparge water, always making sure that the level of liquid is higher than the top of the grain bed. Once you add all the contents of the mash, slowly collect the wort from the spigot.

At this point, you can do one of two things. Some brewers simply sprinkle the rest of the sparge water over the top and collect the wort. Others pour the collected wort back over the grain bed until the wort coming out of the spigot looks clear. As a good compromise, do the latter step for five to ten minutes to ensure that the bigger chunks of debris end up in the spent grain pile rather than the brewpot.

Whatever you do, go slow and gentle as you use up the sparge water and never let the grain bed go dry. Again, this will prevent compaction and a stuck mash.

Likewise, let wort flow slowly and gently into your brewpot. Avoiding agitation will also avoid potential off-flavors. Once you collect six gallons, start your boil and proceed as usual. Congratulations! You've just completed the mash and made your first batch of wort. And to think that this is where extract brewing begins!

As you can see, all-grain brewing adds a few hours to a brewing project, but it also gives you insights into the marvelous world of malt. Though the best extract brews win awards, few can muster the subtleties of a good all-grain brew. ■

Dawnell Smith is a former professional brewer and a frequent BYO contributor. She also wrote "Prime Time! A Guide to Adding Bubbles to Your Beer" in this issue. She lives in Anchorage, Alaska.

Thick mash, thin mash

A thick mash has a higher concentration of enzymes, which increases enzymatic activity. This creates highly fermentable wort but reduces total yield from the grains.

If you decide to play around with mash consistency, adjust the amount of water you add during the sparge or boil. Remember: You still need six gallons in the kettle to end up with five in the keg.

Very thick mash: 2.2 parts water, 1 part grain. High fermentability, low yield.

Thick mash: 2.5 to 3 parts water, 1 part grain. Moderate fermentability and yield.

Thin mash: 3.5 to 5 parts water, 1 part grain. Low fermentability, high yield.

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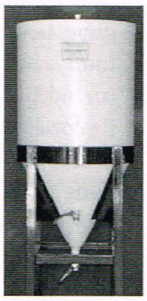

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FACTS ABOUT WATER

HARD

To brew better beer, get to know your local water supply

Whether you brew with extract, grain, or both, it's the ingredient that makes up 85 percent of every batch of homebrew. But how much consideration do you devote to your water?

Throughout history, water has helped define beer styles, improve beer styles and even determine the location of breweries. It's no accident the Anheuser-Busch plant was built at the confluence of the Missouri and Mississippi, where the rivers provided a constant source of brewing water and easy access to barges for transportation. Water has also been used in ad campaigns for some of the world's biggest breweries. In a recent example, Pete Coors, CEO of Adolph Coors, stands by a stream to describe a beer that's made from "pure Rocky Mountain spring water."

Entire texts have been devoted to the science of water and its effects on the brewing process. But you don't need a biochemistry degree to understand water. It's pretty easy, in fact, to manipulate water and fine-tune future batches of homebrew.

Is my water good enough?

In the early days of homebrewing, the general rule of thumb was that if the water looked, smelled, and tasted good, then it would make good beer. This rule holds true today. But if the water has a cloudy turbidity, harsh mineral or metallic flavors, or an aroma of chlorine, then the finished beer will likely taste or smell a bit off.

Even if the water looks, smells and tastes great, problems still can surface during the brewing process. That's why every homebrewer should obtain an analysis of his local water supply. While this sounds expensive or difficult, all it takes is a call to the local water department. By federal law, they are required to regularly perform tests on the drinking-water supply and furnish the results to anyone who requests it.

A water analysis may be one or several pages long. But most will contain the same information: the source of the water, the compounds and minerals in the sample, federal or local standards with regard to the measurements, and any corrective action or treatment taken.

Most municipal water departments have engineers who can explain the information. For homebrewers who get their water from a well or other source, private companies can analyze your water supply.

In many places, water is blended from several sources. In southern California, where I live, local well water is supplemented during periods of high demand by water pumped through aqueducts from as far away as the Colorado River or the Central Valley. Depending on the time of year, test results fluctuate a lot, so the report may include averages or degrees of variation.

How to read a water report

Begin by looking to see what kind of treatment the water undergoes. Many cities treat their water supply with chlorine, for the same reason that homebrewers use bleach to sanitize equipment: It's an extremely effective sanitizer. A slight or mild chlorine condition in otherwise-good water can be cured with a brisk preboil for 10-15 minutes before brewing. This will drive off the volatile chlorine compounds.

Unfortunately, chlorine's extreme volatility and lack of staying power has led many towns to use new compounds called "chloramines." Chloramines are more stable than chlorine, so less is needed to sanitize a given volume of

water over time. This stability means that chloramines are difficult to break down and remove from the water. When brewing, chloramines may react with organic compounds in the water to create "trihalomethanes" (THMs). THMs can pose health risks and are limited by the EPA to levels of no more than 100 parts per billion in drinking water. Even in safe amounts, this reaction can give off-flavors and aromas to your finished beer.

The analysis will also list various harmful bacteria, such as coliform and cryptosporidium, that may be present in the water supply. It's important to note that drinking water can meet the guidelines for health and safety, but still contain measurable levels of bacteria.

From the household standpoint, this usually doesn't matter much. But it can pose a problem when unboiled water comes into contact with wort, which is a great medium for explosive bacteria growth! For this reason, all water used to top up fermenters should undergo a brisk 20-minute boil. Even malt-extract recipes that promote just adding the extract to warm water should be boiled for at least 20 minutes to ensure sanitation.

A matter of minerals

Also present in the analysis will be a breakdown of the various minerals present. Mineral content is one key reason why beers from different regions have different flavors and characteristics. If you're trying to duplicate a beer style, first you need to know your own water's mineral baseline. Then you can modify it to match another locale.

The water supply in Southern California contains a lot of minerals. The water used in Pilsner Urquell, the distinctive Czech beer, is extremely low in minerals. So although I can brew many styles, I can't reproduce an authentic Bohemian pilsner. I'd have better luck brewing a good English ale—like a pale ale or bitter—that benefits from a high mineral level.

Many excellent brewing textbooks, such as "New Brewing Lager Beer" by Greg Noonan, provide the exact mineral breakdown of the world's renowned brewing centers, from Dortmund to Dublin. By comparing these numbers against a copy of your own local water analysis, it'll be easy to see what styles you can create with little or no water modifications.

If there are brewpubs, micro or regional breweries in your area, you can also look at the styles they brew. If possible, talk to the brewers about how they treat their water.

Understanding hard and soft

The report will also tell you how hard your water is. Hardness is a measure of water's calcium and magnesium content; the more of these minerals that are present, the "harder" the water. These levels are measured in parts per million (ppm) and are directly related to the milligrams of minerals per liter of solution (mg/L).

The ppm scale ranges from zero to 500. Zero to 100 is considered very soft to soft; 100 to 200 is soft to medium; 200 to 300 is medium to moderately hard; 300 to 400 is moderately hard to hard; and 400 to 500 is hard to very hard.

To keep this straight, think of soap: Hard water, due to the extra minerals, will not lather soap very well, so it is "hard" to get a good lather. Soft water will create a rich, thick soap lather. With beer, certain minerals will affect the efficiency of the mash, the boil, and the flavor perception of hops and malt.

In general, soft water is great for brewing. Think of it as a clean slate. You can add minerals to mimic brewing water from around the world!

Bohemian pilsners and many continental lager styles, like bock and helles, benefit from soft water. The low mineral content creates a soft flavor profile, characterized by a delicate malt character and the

The Ion Overview

Many ions are important in brewing, but these four are especially critical:

- CALCIUM is key to mash efficiency and yeast health. It also contributes to wort clarity, increases bitterness and reduces astringent flavors. The calcium ion can be increased by adding calcium chloride or calcium sulfate.
- SODIUM will accentuate the flavor in beers that emphasize malt, like brown ale or old ale. Sodium is easily added as common table salt, but when overused (more than 75 mg/L), it can give finished beer a salty or harsh mineral flavor.
- CHLORIDE also helps round out a beer's flavor profile. Rich, malty lagers like bock or doppelbock, and ales like Scotch ale or barleywine, can be shaped by adding chloride in the form of calcium chloride or sodium chloride.
- SULFATE sharpens hop bitterness. If you're brewing a bitter or an ESB, adding calcium sulfate will accentuate the hop character.

Remember: Individual ions cannot be added to brewing liquor. Ions are only available when paired in the groups of cations (positively charged ions) and anions (negatively charged ion) that form minerals. For example, sulfate is commonly available as "calcium sulfate," better known as gypsum.

With the minerals mentioned above, start with 1/2 teaspoon for a five-gallon batch. Change the amount as experience dictates.

by John Oliver

The Water John Oliver Brews With: Brea, California

PARAMETER (UNITS) (a)	MAXIMUM CONTAMINANT LEVEL	STATE PHG	FEDERAL MCLG	IMPORTED WATER				GROUNDWATER	
				DIEMER		WEYMOUTH			
				RANGE	AVERAGE	RANGE	AVERAGE	RANGE	AVERAGE
Primary Standards —Mandatory Health-Related Standards Established by the State of California, Department of Health Services									
CLARITY									
Turbidity	0.5 (b)	NS	NS	0.05–0.07	0.06	0.06–0.08	0.07	.2	.2
ORGANIC CHEMICALS (mg/L)									
Alachlor	0.002	0.004	0	ND	ND	ND	ND	NA	NA
Atrazine	0.003	NS	0.003	ND	ND	ND	ND	ND	ND
Bentazon	0.018	NS	NS	ND	ND	ND	ND	ND	ND
Carbofuran	0.018	NS	0.04	ND	ND	ND	ND	ND	ND
Chlordane	0.0001	0.00003	0	ND	ND	ND	ND	ND	ND
2,4–D	0.07	0.07	0.07	ND	ND	ND	ND	ND	ND
Dalapon	0.2	0.79	0.2	ND	ND	ND	ND	NA	NA
Dibromochloropropane (DBCP)	0.0002	NS	0	ND	ND	ND	ND	ND	ND
Dinoseb	0.007	0.014	0.007	ND	ND	ND	ND	NA	NA
Diquat	0.02	NS	0.02	ND	ND	ND	ND	NA	NA
Endothall	0.1	0.58	0.1	ND	ND	ND	ND	NA	NA
Endrin	0.002	NS	0.002	ND	ND	ND	ND	ND	ND
Ethylene dibromide (EDB)	0.00005	NS	0	ND	ND	ND	ND	ND	ND
Glyphosate	0.7	1	0.7	ND	ND	ND	ND	ND	ND
Heptachlor	0.00001	NS	0	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	0.00001	NS	0	ND	ND	ND	ND	ND	ND
Lindane	0.0002	NS	0.0002	ND	ND	ND	ND	NA	NA
Methoxychlor	0.04	NS	0.04	ND	ND	ND	ND	NA	NA
Molinate	0.02	NS	NS	ND	ND	ND	ND	ND	ND
Oxamyl	0.2	0.05	0.2	ND	ND	ND	ND	NA	NA
Pentachlorophenol	0.001	0.0004	0	ND	ND	ND	ND	NA	NA
Picloram	0.5	0.5	0.5	ND	ND	ND	ND	NA	NA
Polychlorinated Biphenyls (PCBs)	0.0005	NS	0	ND	ND	ND	ND	NA	NA
Simazine	0.004	NS	0.004	ND	ND	ND	ND	ND	ND
2,4,5–TP (Silvex)	0.05	NS	0.05	ND	ND	ND	ND	ND	ND
Thiobencarb	0.07 (#0.001)	NS	NS	ND	ND	ND	ND	ND	ND
Toxaphene	0.003	NS	0	ND	ND	ND	ND	NA	NA
Benzo(a)-pyrene	0.0002	0.000004	0	ND	ND	ND	ND	NA	NA
Di (2-ethylhexyl) adipate	0.4	NS	0.4	ND	ND	ND	ND	NA	NA
Di (2-ethylhexyl) phthalate	0.004	0.012	0	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	0.001	NS	0	ND	ND	ND	ND	NA	NA
Hexachlorocyclopentadiene	0.05	NS	0.05	ND	ND	ND	ND	NA	NA
2,3,7,8-TCDD (Dioxin)	$3x10^{-8}$	NS	0	ND	ND	ND	ND	NA	NA
Benzene	0.001	NS	0	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	0.0005	NS	0	ND	ND	ND	ND	ND	ND
1,2–Dichlorobenzene	0.6	0.6	0.6	ND	ND	ND	ND	ND	ND
1,4–Dichlorobenzene	0.005	0.006	0.075	ND	ND	ND	ND	ND	ND
1,1–Dichloroethane	0.005	NS	NS	ND	ND	ND	ND	ND	ND
1,2–Dichloroethane	0.0005	NS	0	ND	ND	ND	ND	ND	ND
1,1–Dichloroethylene	0.006	NS	0.007	ND	ND	ND	ND	ND	ND
cis-1,2–Dichloroethylene	0.006	NS	0.07	ND	ND	ND	ND	ND	ND
trans–1,2–Dichloroethylene	0.01	NS	0.1	ND	ND	ND	ND	ND	ND
Dichloromethane (methylene chloride)	0.005	NS	0	ND	ND	ND	ND	NA	NA
1,2–Dichloropropane	0.005	NS	0	ND	ND	ND	ND	ND	ND
1,3–Dichloropropene	0.0005	NS	NS	ND	ND	ND	ND	ND	ND
Ethylbenzene	0.7	0.3	0.7	ND	ND	ND	ND	ND	ND
Methyl tert-butyl-ether (MTBE)	0.005	NS	NS	ND	ND	ND	ND	ND	ND
Monochlorobenzene	0.07	NS	0.1	ND	ND	ND	ND	ND	ND
Styrene	0.1	NS	0.1	ND	ND	ND	ND	NA	NA
1,1,2,2,–Tetrachloroethane	0.001	NS	NS	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	0.005	NS	0	ND	ND	ND	ND	ND	ND
Toluene	0.15	NS	1	ND	ND	ND	ND	ND	ND
1,2,4–Trichlorobenzene	0.07	0.005	0.07	ND	ND	ND	ND	NA	NA
1,1,1–Trichloroethane	0.200	NS	0.2	ND	ND	ND	ND	ND	ND
1,1,2–Trichloroethane	0.005	NS	0.003	ND	ND	ND	ND	ND	ND
Trichloroethylene	0.005	NS	0	ND	ND	ND	ND	ND	ND
Trichlorofluoromethane	0.15	0.7	NS	ND	ND	ND	ND	ND	ND
1,1,2–Trichloro–1,2,2–trifluoroethane	1.2	4	NS	ND	ND	ND	ND	ND	ND
Vinyl Chloride	0.0005	NS	0	ND	ND	ND	ND	ND	ND
Xylenes	1.750	1.800	10	ND	ND	ND	ND	ND	ND
Total Trihalomethanes (d)	0.10	NS	NS	Dist. System: Range: 0.01-0.02			Avg.: 0.02		
Microbiological (Presence/Absence) (c)	5%	NS	0	Dist. System Range: 0			Avg.: 0		

Format by the Municipal Water District of Orange County.

PARAMETER (UNITS)	MAXIMUM CONTAMINANT LEVEL	STATE PHG	FEDERAL MCLG	IMPORTED WATER				GROUNDWATER	
				DIEMER		WEYMOUTH			
				RANGE	AVERAGE	RANGE	AVERAGE	RANGE	AVERAGE
Primary Standards —Mandatory Health-Related Standards Established by the State of California, Department of Health Services									
INORGANIC CHEMICALS (mg/L)									
Aluminum	1 (#0.2)	NS	NS	0.076-0.240	0.145	0.081–0.211	0.134	<.05	<.05
Antimony	0.006	0.020	0	ND	ND	ND	ND	<.05	<.05
Arsenic	0.05	NS	NS	.0022-.0030	0.0025	.0013–.0029	0.0023	<.002	<.002
Asbestos (f)	7	NS	7	ND	ND	ND	ND	NR	NR
Barium	1	NS	2	0.080-0.089	0.084	0.080–0.089	0.085	<.1	<.1
Beryllium	0.004	NS	0.004	ND	ND	ND	ND	ND	ND
Cadmium	0.005	NS	0.005	ND	ND	ND	ND	<.001	<.001
Chromium	0.05	NS	0.1	ND	ND	ND	ND	<.01	<.01
Cyanide	0.2	0.15	0.2	ND	ND	ND	ND	ND	ND
Fluoride (h)	1.4–2.4	1.0	NS	0.22–0.35	0.29	0.20–0.35	0.29	.27	.27
Mercury	0.002	NS	0.002	ND	ND	ND	ND	ND	ND
Nickel	0.1	NS	NS	0.002	0.002	0.002	0.002	ND	ND
Nitrate (as N)	10.(i)	10	10	0.14-0.30	0.23	0.14–0.29	0.22	5.7	5.7
Nitrite (as N)	1	1	1	ND	ND	ND	ND	NA	NA
Nitrate plus Nitrite (as N)	10	10	10	0.14-0.30	0.23	0.14–0.29	0.22	NA	NA
Selenium	0.05	NS	0.05	ND	ND	ND	ND	ND	ND
Thallium	0.002	NS	0.0005	ND	ND	ND	ND	ND	ND
Copper	(g) (#1.0)	0.17	1.3	Dist. System:		Range: .009		Average: .009	
Lead	(g)	0.002	0	Dist. System:		Range: .002-ND		Average: .00006	
RADIONUCLIDES (pCi/L) *(analyzed every four years, for four consecutive quarters)* (j)									
Gross Alpha	15	NS	NS	ND–11.7	6.5	ND–10.0	6.6	NR	NR
Gross Beta	50	NS	NS	1.2–11.2	7.8	1.4–10.3	6.8	NR	NR
Radium-226 (k)	5	NS	NS	ND-2.8	1.2	ND–1.1	ND	NR	NR
Radium-228 (k)	5	NS	NS	ND	ND	ND–1.6	1.0	NR	NR
Strontium-90	8	NS	NS	ND–1.3	ND	ND–1.0	ND	NR	NR
Tritium	20,000	NS	NS	ND	ND	ND	ND	NR	NR
Uranium	20	NS	NS	3.3–4.7	4.4	3.4–5.7	4.9	NR	NR
Secondary Standards — Aesthetic Standards Established by the State of California, Department of Health Services									
(Unit is mg/L except as specified)									
Chloride	**250	NS	NS	64-86	75	62–86	76	28.4-53.4	40.9
Color (units)	15	NS	NS	Dist. System:		Range: <3		Average:<3	
Turbidity (NTU)	5.	NS	NS	Dist. System:		Range: 0.2		Average: 0.2	
Corrosivity	noncorrosive	NS	NS	(l)	(l)	(l)	(l)	noncorrosive	noncorrosive
Foaming Agents–MBAS	0.5	NS	NS	ND	ND	ND	ND	ND	ND
Iron	0.3	NS	NS	ND	ND	ND	ND	<.01	<.01
Manganese	0.05	NS	NS	ND	ND	ND	ND	<.03	<.03
Odor Threshold (units)	3	NS	NS	Dist. System:		Range:		Average:	
pH (units)	NS	NS	NS	8.00-8.04	8.02	8.01–8.13	8.06	7.60	7.60
Silver	0.1	NS	NS	ND	ND	ND	ND	ND	ND
Specific Conductance (µmho/cm)	**900	NS	NS	742-992	875	715–995	883	556	556
Sulfate	**250	NS	NS	161–250	208	153–250	210	65.3	65.3
Total Dissolved Solids	**500	NS	NS	450-622	538	429–622	542	384	384
Zinc	5.0	NS	NS	ND	ND	ND	ND	ND	ND
Additional Parameters									
(Unit is mg/L except as specified)									
Alkalinity as $CaCO_3$	NS	NS	NS	104–128	117	101–124	115	160–224	192
Calcium	NS	NS	NS	52–75	63	51–75	64	88.8	88.8
Hardness as $CaCO_3$	NS	NS	NS	215–298	258	206-301	260	278	278
Magnesium	NS	NS	NS	19.5–28	24.5	19–28	24.5	20.1	20.1
Perchlorate	NS	NS	NS	ND–6	4	ND–6	4	ND	ND
Potassium	NS	NS	NS	3.5–4.6	3.9	3.5–4.6	4.0	2.8	2.8
Sodium	NS	NS	NS	66–92	80	64–93	82	35.7	35.7

Dist. System = Local Distribution Facilities

Organic Chemicals = elements containing carbon, with some exceptions
Inorganic Chemicals = elements not containing carbon, with some exceptions

ABBREVIATIONS:

MCL = Maximum Contaminant Level
NA = Not Analyzed
NS = No Existing MCL (No Standard)
ND = Not Detected
NR = Not Required
NTU = Nephelometric Turbidity Units, a measure of the suspended material in water
mg/L = Milligram per Liter (Parts per Million)
pCi/L = PicoCuries per Liter
CFU/100 mL = colony-forming units per 100 milliliters
CFU/mL = colony-forming units per milliliter
µmho/cm = micromhos per centimeter
* = Proposed Primary Standard
# = secondary standard
** = recommended level

The Federal and State standards for acrylamide and epichlorohydrin are treatment techniques with which Metropolitan complies.

(a) Data shown are annual averages and ranges

(b) The turbidity level of the filtered water shall be <= 0.5 NTU in 95% of the measurements taken each month and shall not exceed 5.0 NTU at any time

(c) Total coliform MCLs: No more than 5.0% of the monthly samples may be total coliform-positive. Fecal coliform/E. coli MCLs: The occurrance of 2 consecutive total coliform positive samples, one of which contains fecal coliform/E. coli, constitutes an acute MCL violation. These MCLs were not violated in 1998. Standards and results are based on distribution system monthly sampling averages. compliance is based on the combined distribution system sampling from all the filtration plants. 10,210 samples were analyzed in 1998.

(cont.)

(d) Calculated from the average of monthly filtration plant effluent samples. Compliance is based on a running annual average of more than 40 quarterly distribution system samples, which was 0.024 mg/L for 1998.

(e) Calculated from the average of monthly filtration plant effluent samples. Compliance is based on running annual average of more than 40 quarterly distribution system samples, which was 0.047 mg/L for 1998.

(f) Measured in million fibers per liter (longer than 10 microns)

(g) The Federal and State standards for lead and copper are treatment techniques requiring agencies to optimize corrosion control treatment

(h) State MCL level is dependent upon air temperature (State MCL is 45 mg/L as Nitrate, which equals 10.16 mg/L as N.

(i) State MCL is 45 mg/L as Nitrate, which equals 10.16 mg/L as N.

(j) The 1998/99 4-quarter radiological monitoring program is in progress. Results will be reported in the 1999 report.

(k) Standards are for Radium-226 and -228 combined

(l) Corrosivity is measured by the Langlier Stability Index. A positive index, indicating non-corrosivity, was maintained at the plant effluents.

In addition to the above parameters, we have conducted monitoring for unregulated organic chemicals for which the California Department of Health Services and USEPA have not yet set a standard and the information is available at our office. If you have any questions about your water quality or this report, please call Jerry Mesa at (714) 990-7691. For information on water imported from Metropolitan Water District of Southern California, contact Mark Buehler, Director of Water Quality, at (213) 250-6647.

Public Health Goal – The level of a contaminate in drinking water below which there is no known or expected risk to health. PHGs are set by the California Environmental Protection Agency.

Maximum Contaminate Level Goal – The level of a contaminate in drinking water below which there is no known or expected risk to health. MCLGs are set by the U.S. Environmental Protection Agency.

Maximum Contaminate Level – The highest level of a contaminate that is allowed in drinking water. MCLs are set as close to the PHGs and MCLGs as is economically and technologically feasible.

Primary Drinking Water Standard – Primary MCLs, specific treatment techniques adopted in lieu of primary MCLs, and monitoring and reporting requirements for MCLs that are specified in regulation.

FACTS ABOUT WATER...

1. The water in Brea comes from three sources, depending on the time of year. In spring and early summer, when rainfall and snowmelt from the surrounding mountains replenish the aquifer, the majority of the water comes from local groundwater sources, such as wells. During the dry summer months, when temperatures skyrocket, rainfall is nonexistent and water use increases, the supply is supplemented by water that's piped through aqueducts from remote sources.

2. "Microbiological presence" indicates the levels and types of bacteria in the water supply. While the local water is bacteria free, it's important to remember that this is after treatment. The line directly above indicates trihalomethane (THM) content, which is the result of the water-treatment process. If the water supply shows no microbiological presence, but this is because it has been heavily chlorinated, then there will probably be some THM. The water in this example is excellent; it is clean and not heavily chlorinated.

3. pH is a measure of the water's acidity; it ranges from 1 (strong acid) to 14 (strong alkaline). For brewing, a neutral 7 is perfect. pH varies dramatically based on the water source and time of year. It's simple to treat brewing water with acids, such as lactic acid or phosphoric acid, to achieve a proper mash pH. The amounts used will differ depending upon the time of year, with local groundwater in the 7.6 range and imported water as high as 8.13!

4. Hardness as CaC03 (calcium carbonate) is the figure that determines the relative hardness of the water supply. Brea water is pretty hard, from 206 mg/L to 301 mg/L. Note: Each of the imported sources have wide variations in hardness while the local groundwater is a consistent 278 mg/L. Water this hard is well suited for brewing ale styles: pale ale and IPA, stout and porter, bitter and ESB.

5. Both the sulfate and chloride level of the water vary widely depending on the source. For a beer that accentuates hops, like a pale ale, it would be beneficial to boost the sulfate level by adding calcium sulfate. For a maltier beer, the chloride levels are low and could be increased by adding calcium chloride. Sodium chloride would do the same thing, but calcium aids in mash efficiency and yeast health. And high sodium levels make beer minerally.

subtle nuance of noble hops. With hard water, this profile would be much harsher and sharper. The classic Pilsner Urquell, for example, is brewed with water that contains only 25 to 30 ppm.

If you have very hard water, you'll have to boil it or treat it with some sort of filter system. Boiling the water will cause the "temporary hardness" to drop out; temporary hardness describes minerals that can be removed by boiling.

Hard water that's rich in ions is great for styles like Munich helles or any of the Burton-style ales that derive their characteristics from the mineral-rich water of Burton-on-Trent, England. The aggressive hop profile of these ales benefits from a high mineral content. This water is very high in ions like calcium and sulfate and measures as hard as 250-plus ppm.

A final note: In higher concentrations, minerals like iron and copper can be detrimental to yeast health. This results in poor, sluggish fermentations or haze in the finished beer.

What if my water is bad?

If your local water is not satisfactory, you have two choices: You can treat your water, or get it from another source. Totally unsatisfactory water would have excessive levels of ions like lead, iron or copper (anything higher than 0.05 mg/L can create problems with yeast health and fermentation.) Elements like mercury, zinc or silver will detract from mash and fermentation efficiency and should not be present in any more than trace levels.

Depending on how often you brew and your batch size, the best alternative may be to use bottled or purified water. Unless your annual water usage is large enough to justify it, it's cheaper and easier to buy bottled water than to treat the water that flows into your home. Remember: A certain amount of minerals is required — not only for mash efficiency, but for proper yeast health — so it's best to use water labeled as "drinking water" rather than purified or distilled water.

If your local brewing water is good but excessive in certain ions, like calcium or sulfate, a satisfactory compromise is to blend your regular water with purified water to dilute the overall ion concentration. This is a simple process: If you blend your brewing water with an equal amount of purified water that's completely devoid of ions, you'll be cutting the ion concentrations in half.

For brewers whose water usage and budget justify some form of home water treatment, there are a number of alternatives. Many types of filtration are available, from simple activated-charcoal units to cartridges that use silver to kill microbes or cartridges that can remove trace elements of heavy metals, like lead. There are even reverse-osmosis units that will literally strip all dissolved solids from the water supply. Many of these unit can be fitted directly onto a faucet or under the sink.

One common system, the traditional water-softener unit — like the kind you get from Culligan — is entirely unsuitable for brewing. These units work through a principle called "ion exchange." Simply put, the calcium ion is removed from the incoming water and is replaced with two sodium ions. The resulting water will help soap lather and keep the mineral scum off your dishes. But water with very high sodium content is bad for brewing. At more than 75 mg/L, it can give the finished beer a salty flavor.

When Olympia put the slogan "It's the Water" on every bottle of beer it produced, it acknowledged the key role water plays in the brewing process. By understanding your own water, you can fine-tune the flavor of your favorite recipes. Olympia was right: It's the water! ■

John Oliver is a BJCP National Judge who continually monitors water quality as head brewer for BJ's Brewery in Brea, California.

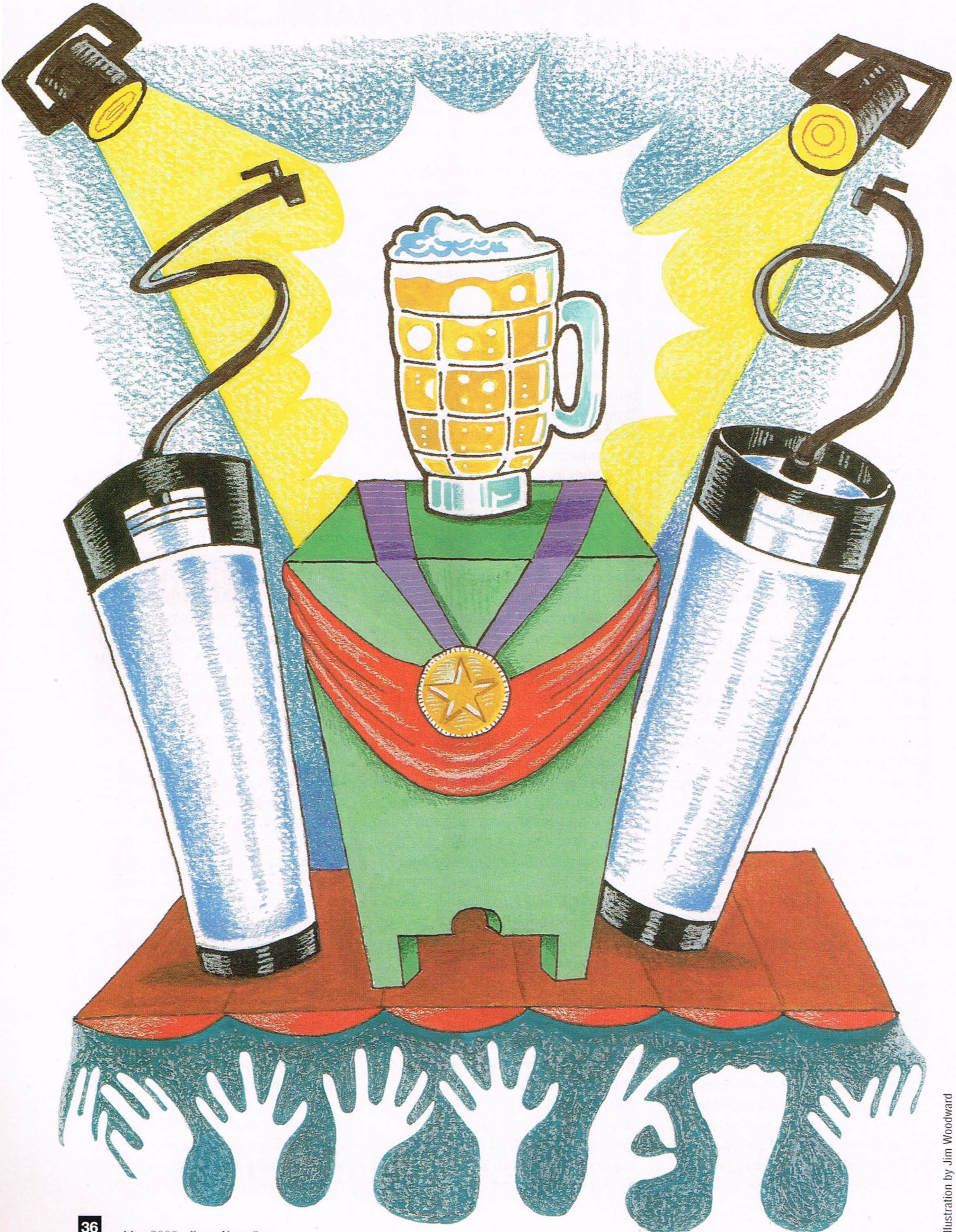


Illustration by Jim Woodward

Carbonate With Your KEG

How to achieve the ideal balance between brew and bubbles

This article is the second in a two-part series on kegging. The first article, "Life Beyond the Bottle: A Guide to Kegging Your First Batch of Beer," ran in the April issue of BYO.

Congratulations! You've filled your first keg. You've even managed to dispense your beer, allowing your friends to savor the experience of a freshly kegged brew. Maybe it was a little foamy, or a little flat, but you got it from the keg to the glass, right?

But as you've probably figured out, there's more to the art of carbonation than getting the beer out of its container with a head on it. Much, much more.

Carbonation is an important component of beer. It contributes to mouthfeel, the sensation of fullness on the tongue. If you doubt the powers of carbonation, think of how your brew tastes straight from the fermenter versus two weeks later from your keg.

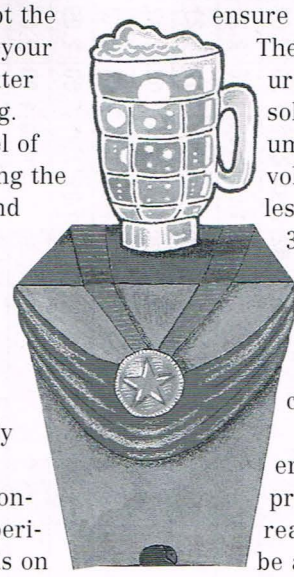
Carbonation affects the mouthfeel of beer through several factors, including the amount of gas in solution, the size and number of bubbles, the presence of another type of gas (nitrogen, for example), and the degree of saturation. Some beers, such as light American lagers, are meant to be served cold and well-carbonated. Ales, on the other hand, are generally less carbonated.

How do you achieve perfect carbonation? It will certainly take some experience. Mastering the skill also depends on understanding the properties of carbon dioxide and the process of carbonation.

Carbonation: A Quick Primer

Carbonation is the process of dissolving carbon dioxide (CO_2), a gas, into beer or other liquids. In addition to making the beer effervescent, versatile CO_2 can enhance the flavor of light-bodied beer and minimize the sweetness of heavier beers. Knowing the proper carbonation level for your beer is one of the keys to creating a perfect brew.

Beer absorbs CO_2 over time. So the layer of gas on top of your beer, inside the keg — called the head pressure — will gradually dissolve into the liquid, as long as the liquid is not yet saturated. That's why one application of carbon dioxide may not be enough to ensure adequate carbonation.



The amount of dissolved CO_2 is measured in volumes: one liter of gas dissolved in one liter of beer = one volume. Most beers contain around 2.5 volumes of CO_2. That's quite a bit less than soda pop, which averages 3.5 volumes. While the amount of CO_2 a beer can absorb is temperature dependent, only a finite amount of CO_2 can be absorbed before it reaches equilibrium, called the saturation point.

The colder the beer, the higher its saturation point at any given pressure. However, once the beer reaches that point, no more gas can be absorbed.

by Gretchen Schmidhausler

Determining Carbonation: Volumes of CO_2

Pounds per Square Inch Applied

Temperature of Beer (Degrees Fahrenheit)	0 psi	1 psi	2 psi	3 psi	4 psi	5 psi	6 psi	7 psi	8 psi	9 psi	10 psi	11 psi	12 psi	13 psi	14 psi	15 psi	16 psi	17 psi	18 psi	19 psi	20 psi	21 psi	22 psi	23 psi	24 psi	25 psi	26 psi	27 psi	28 psi	29 psi	30 psi
30°	1.75	1.82	1.92	2.03	2.14	2.23	2.36	2.48	2.60	2.70	2.82	2.93	3.02																		
31°	1.73	1.78	1.88	2.00	2.10	2.20	2.31	2.42	2.54	2.65	2.76	2.86	2.96																		
32°	1.70	1.75	1.85	1.95	2.05	2.16	2.27	2.38	2.48	2.59	2.70	2.80	2.90	3.01																	
33°	1.68		1.81	1.91	2.01	2.12	2.23	2.33	2.43	2.53	2.63	2.74	2.84	2.96																	
34°	1.65		1.78	1.86	1.97	2.07	2.18	2.28	2.38	2.48	2.58	2.68	2.79	2.89	3.00																
35°	1.63			1.83	1.93	2.03	2.14	2.24	2.34	2.43	2.52	2.62	2.73	2.83	2.93	3.02															
36°	1.60			1.79	1.88	1.99	2.09	2.20	2.29	2.39	2.47	2.57	2.67	2.77	2.86	2.96															
37°	1.58				1.84	1.94	2.04	2.15	2.24	2.34	2.42	2.52	2.62	2.72	2.80	2.90	3.00														
38°	1.55				1.80	1.90	2.00	2.10	2.20	2.29	2.38	2.47	2.57	2.67	2.75	2.85	2.94														
39°	1.53					1.86	1.96	2.05	2.15	2.25	2.34	2.43	2.52	2.61	2.70	2.80	2.89	2.98													
40°	1.50					1.82	1.92	2.01	2.10	2.20	2.30	2.39	2.47	2.56	2.65	2.75	2.84	2.93	3.01												
41°	1.48						1.87	1.97	2.06	2.16	2.25	2.35	2.43	2.52	2.60	2.70	2.79	2.87	2.96												
42°	1.45						1.83	1.93	2.02	2.12	2.21	2.30	2.39	2.47	2.56	2.65	2.74	2.82	2.91	3.00											
43°	1.43						1.80	1.90	1.99	2.08	2.17	2.25	2.34	2.43	2.52	2.60	2.69	2.78	2.86	2.95											
44°	1.40							1.86	1.95	2.04	2.13	2.21	2.30	2.39	2.47	2.56	2.64	2.73	2.81	2.90	2.99										
45°	1.38							1.82	1.91	2.00	2.08	2.17	2.26	2.34	2.42	2.51	2.60	2.68	2.77	2.85	2.94	3.02									
46°	1.35								1.88	1.96	2.04	2.13	2.22	2.30	2.38	2.47	2.55	2.63	2.72	2.80	2.89	2.98									
47°	1.33								1.84	1.92	2.00	2.09	2.18	2.25	2.34	2.42	2.50	2.59	2.67	2.75	2.84	2.93	3.02								
48°	1.30								1.80	1.88	1.96	2.05	2.14	2.21	2.30	2.38	2.46	2.55	2.62	2.70	2.79	2.87	2.96								
49°	1.28									1.85	1.93	2.01	2.10	2.18	2.25	2.34	2.42	2.50	2.58	2.66	2.75	2.83	2.91	2.99							
50°	1.25									1.82	1.90	1.98	2.06	2.14	2.21	2.30	2.38	2.45	2.54	2.62	2.70	2.78	2.86	2.94	3.02						
51°	1.23										1.87	1.95	2.02	2.10	2.18	2.25	2.34	2.41	2.49	2.57	2.65	2.73	2.81	2.89	2.97						
52°	1.20										1.84	1.91	1.99	2.06	2.14	2.22	2.30	2.37	2.45	2.54	2.61	2.69	2.76	2.84	2.93	3.00					
53°	1.18										1.80	1.88	1.96	2.03	2.10	2.18	2.26	2.33	2.41	2.48	2.57	2.64	2.72	2.80	2.88	2.95	3.03				
54°	1.15											1.85	1.93	2.00	2.07	2.15	2.22	2.29	2.37	2.44	2.52	2.60	2.67	2.75	2.83	2.90	2.98				
55°	1.13											1.82	1.89	1.97	2.04	2.11	2.19	2.25	2.33	2.40	2.47	2.55	2.63	2.70	2.78	2.85	2.93	3.01			
56°	1.10												1.86	1.93	2.00	2.07	2.15	2.21	2.29	2.36	2.43	2.50	2.58	2.65	2.73	2.80	2.88	2.96			
57°	1.08												1.83	1.90	1.97	2.04	2.11	2.18	2.25	2.33	2.40	2.47	2.54	2.61	2.69	2.76	2.84	2.91	2.99		
58°	1.05												1.80	1.86	1.94	2.00	2.07	2.14	2.21	2.29	2.36	2.43	2.50	2.57	2.64	2.72	2.80	2.86	2.94	3.01	
59°	1.03													1.83	1.90	1.97	2.04	2.11	2.18	2.25	2.32	2.39	2.46	2.53	2.60	2.67	2.75	2.81	2.89	2.96	3.03
60°	1.00													1.80	1.87	1.94	2.01	2.08	2.14	2.21	2.28	2.35	2.42	2.49	2.56	2.63	2.70	2.77	2.84	2.91	2.98

As anyone who has left a glass of beer unattended for a period of time knows, it will be warm and flat when they return. As beer warms up, dissolved CO_2 comes out of solution. As the CO_2 disappears, the beer becomes flatter.

Forced Carbonation: It's a Matter of Numbers and Style

Pressure also dictates how much carbon dioxide a beer can hold. Applying pressure — forcing CO_2 from your tank into your beer — raises the saturation level. This process is called "forced carbonation." The pressure is expressed in pounds per square inch (psi).

Knowing the temperature of your beer and the desired level of carbonation will help you determine the correct pressure to apply when you force-carbonate. For example, to achieve about 2.5 volumes of CO_2 in 60° F beer, you would need to apply approximately 23 psi of CO_2. If your beer is 45° F, you would only need to apply 15 psi. Confused? Don't worry. We've included a chart designed to help you calculate the right volume of CO_2 for your beer *(see "Determining Carbonation: Volumes of CO_2" at left).*

Keep in mind: You are not working with totally flat beer, although it may seem that way to you. As yeast consumes fermentables in your beer, it produces alcohol and CO_2. Therefore, your "flat" beer already contains some CO_2 in solution.

What is the right volume of CO_2 for your beer? As mentioned earlier, most beers contain about 2.5 volumes of CO_2. How you carbonate your beer will depend on several factors, including personal preference, style, and practicality.

Although you may choose to carbonate your beer at any level you wish, certain beer styles dictate specific carbonation levels. This often has a basis in the individual beer's history *(see "Carbonation by Beer Styles" at right).*

Lagers, for example, tend to have higher carbonation levels than ales. Because lagers are cold-conditioned, they absorb carbon dioxide more readily. And because they are stored for a longer period of time than ales, they naturally build up more CO_2. In fact, traditional pitch-lined casks were designed to withstand more pressure than the barrels used to condition ales.

Modern American commercial lagers depend largely on adjuncts rather than pure malted barley. They also tend to be lightly hopped. Because they are designed to be less flavorful than hoppier, full-bodied beers, a higher volume of carbon dioxide helps to bring out the minimal flavor and bitterness.

Cask-conditioned ales also are a product of their times. These beers traditionally were fined, lightly primed, sealed and allowed to carbonate naturally. Because this style predates compressed gas, they were dispensed using either gravity or a hand pump, also called a beer engine. In this scenario, the displaced beer was replaced with air.

Many modern breweries that make cask-conditioned ales have replaced the standard cask with a conditioning tank, although the philosophy is the same. The ale is also often pushed with nitrogen, or a combination of 75 percent nitrogen and 25 percent carbon dioxide. This helps prevent oxidation, while ensuring that the beer does not become more carbonated.

Served warmer (at about 50° to 55° Fahrenheit) and with much lower carbonation levels than lagers, cask-conditioned ales are often described as "flat" by the untutored American palate. Although the higher temperature and lower carbonation show off the malt and hop flavors to wonderful effect, many find this style to be something of an acquired taste.

Too Much Fizz? Too Little? Here's how to fix it.

Even though you now know the basics of carbonation, you may still have trouble carbonating your beer

Carbonation by Beer Styles

The average CO_2 level for beer is about 2.5 volumes, although this varies by style. (For the sake of comparison, soda pop usually averages around 3.5 volumes.)

Lighter beers are generally more effervescent than darker ones. How you carbonate your beer is a really matter of personal preference, although if you want to enter your beer in a homebrew competition, you'll need to conform to some specific style guidelines.

Listed below are some beer styles and their ideal carbonation levels in volumes of CO_2:

Beer Style: Cask-conditioned British ales (like milds and bitters). Also: barleywines.
Volumes of CO_2: 1.5 to 2.0
Kegging Tips: Try to rely solely on priming; avoid forced carbonation. Allow adequate time for conditioning.

Beer Style: Porters and stouts.
Volumes of CO_2: 1.5 to 2.2
Kegging Tips: Try to rely solely on priming; avoid forced carbonation. Allow adequate time for conditioning.

Beer Style: European lagers, like pilsner and Munich helles.
Volumes of CO_2: 2.4 to 2.6
Kegging Tips: Chill and force carbonate.

Beer Style: North American beers, like American pale ales and American light lagers.
Volumes of CO_2: 2.5 to 2.6
Kegging Tips: Chill and force carbonate.

Beer Style: Wheat beers
Volumes of CO_2: 3.0 to 5.0
Kegging Tips: Chill and force carbonate. Consider priming as well if the final carbonation level is not to your satisfaction.

to your satisfaction. First of all, remember this rule: When carbonating, always start with cold beer.

Is your beer overcarbonated? Maybe you used too much priming sugar. If that's the case, better luck next time. Or did you try to hedge your bets by priming, and then force-carbonating at the usual level? If so, try releasing some of the pressure before serving.

Overcarbonated beer can also be the result of a bacterial contamination. The presence of bacteria is usually obvious, manifesting itself in off-flavors, haze and gushing beer. How to avoid contamination? Wash and sanitize everything that comes in contact with your beer: equipment, countertops, your hands, you name it. If the beer doesn't taste too awful, you may want to consider chilling it down considerably to tame the carbonation.

Low carbonation, on the other hand, may be caused by underpriming or undercarbonating. Here's how to handle it:

If you force-carbonated in the keg: Try, try again. Chill the beer. Apply the recommended amount of CO_2. Agitate keg to disperse carbon dioxide. Repeat if necessary.

If you primed in the keg: First of all, did you add the right amount of priming sugar? When kegging a five-gallon batch, 1/3 cup is needed (half the 2/3 cup usually recommended for priming a 5-gallon batch for bottling).

If you added the right amount of sugar and your beer is still flat, try adding some more sugar. Also, check your CO_2 lines, tank and keg fittings for possible leaks. (Remember: If your beer needs more umph, you can always inject it with a little CO_2 to boost the carbonation level prior to serving.)

A note on foam: If the carbonation seems right but the beer lacks a foamy head, you may not have completely rinsed away the cleaning agents you used when brewing or kegging. Have you ever ordered a pint and received a lifeless glass of liquid? Don't blame the beer. Often, a busy bartender will neglect an important part of the job: thorough rinsing. The soapy residue clinging to the glass will kill foam faster than you can say, "I'll take a bottle, please!" How to tell if this is the problem? Your beer may actually have a soapy or chemical taste. Rinse your equipment well. Also, check into no-rinse sanitizers.

Above all, be patient! Carbonation is an art. You may need to experiment before you achieve the perfect balance. ■

Gretchen Schmidhausler is site brewer at Basil T's Brewpub and Italian Grill in Toms River, New Jersey. She wrote "Life Beyond the Bottle: Kegging Your First Batch of Beer" in the April issue of BYO.

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Ready for Prime Time

A simple guide to adding bubbles to your beer

by Dawnell Smith

When we talk about the prime of our lives, we're talking about a period of great vigor and accomplishment. The same can be said for priming beer. The process may not take long, but it adds the satisfying zest and satiating fullness we expect from a good brew. Without those bubbles, even the most fabulous ale will taste flat and undrinkable.

For the most part, homebrewers rely on priming sugars to achieve this goal. When hydrometer readings remain unchanged for a few days, fermentation has ended and the beer is ready for priming. At this point, you add sugar to kickstart the dormant yeast, which consumes the sugar and produces carbon dioxide. When primed and placed in a sanitized, closed vessel—like a keg or a bottle—the beer absorbs the trapped carbon dioxide and gains that satisfying fizz.

Other Ways to Get the Fizz

Priming with sugar is only one way of carbonating beer. Many brewers inject carbon dioxide into the final product after fermentation and filtration. This method, called "forced carbonation," saves time and ensures consistency, two factors that can make or break a brewery. Homebrewers can duplicate this method if they have a kegging system and a carbon-dioxide tank. Forced carbonation does little to improve the finished beer, though it allows rapid carbonation and can save a keg of brew that lost pressure due to a leak in the system. *(For more on carbonating with kegs, see page 36.)*

Another technique for carbonating beer involves capping the beer before fermentation ends. You can do this by moving the beer into a closed container when it drops to a predetermined specific gravity. For instance, if your bock always finishes with a specific gravity of 1.012, you can cap it around 1.018. As fermentation continues, the beer absorbs the trapped carbon dioxide. If you're bottling, this is a risky bit of guesswork (read: exploding bottles) since homebrews often fluctuate from batch to batch. If you're kegging the beer, you can bleed off excess head pressure that might build up in the keg as the beer carbonates. You'll want to maintain about 12 psi at 38° F.

As another option, you can "kraeusen" or add fermenting wort to beer to ignite carbonation. Kraeusening can alter the beer's composition through chemical changes and, when used in a closed vessel, creates what's known as "natural" carbonation. To successfully kraeusen, you need a ready source of wort that's about 24 hours into active fermentation. For homebrewers, the obvious solution is to brew one day, set aside some fermenting wort, and use it the next day to prime a batch that's ready to bottle or keg. You can use wort from almost any beer style, though the amount you use depends on the specific gravity.

Sugar: The Simple Solution

Most homebrewers use priming sugars — the simplest, easiest and handiest method of carbonating beer. All you need is a sugar source and a few good rules of thumb. Adding too much sugar, shaking the bottles or letting them get too hot can turn a case of beer into two dozen bursting missiles.

Fortunately, a little forethought can prevent such calamities. As a general rule, add 3/4 cup of corn sugar or 1-1/4 cup dried malt extract to five gallons of beer for bottling. However, every beer style has its own ideal amount of carbonation based on tradition, flavor profiles and packaging.

For the best results, check out books, articles and Internet sites that describe recipes for specific beer styles. The "classic beer style" series from Brewers Publications offers great insights into brewing and can provide details on some traditional priming methods.

Otherwise, follow these guidelines for getting plenty of bubbles without the bang or the bust.

What sugars should I use?

Corn sugar is the standard priming sugar, though you can use almost any sugar source, like dried malt extract (DME) or "gyle" (fresh, cold wort). You can find corn sugar and DME at homebrew stores.

Corn sugar is easy to store and use, works quickly and consistently, and makes priming a snap. But it doesn't jive with the Reinheitsgebot, the German Purity Law of 1516. If you want to stick to the purity law by using the four principle beer ingredients—malt, hops, water and yeast—then use DME or all-malt gyle as a priming agent.

DME has 60 to 80 percent of the fermentable sugar that corn sugar has, which means you'll need more of it to do the job. It also takes longer to complete, foams when boiled in water, often hardens during storage and may leave a protein film on the beer. On the bright side, it creates smaller, softer bubbles than corn sugar and imparts a creamier texture. You can use any DME to prime, though most people use light DME for pale ales and other light brews and dark DME with porters, stouts and the like.

How much should I use?

Keep in mind that you need to adjust the amount of priming sugar based on the type of packaging you plan to use. You use less sugar when kegging to avoid foaming up the entire system.

As mentioned before, add 3/4 cup of corn sugar or 1-1/4 cups DME for every five gallons of beer when bottling. You can safely up the levels a bit by using another quarter cup, but chill the beer before opening in order to avoid gushing.

For kegs, use about 1/3 cup of corn sugar or 2/3 cup DME for five gallons of beer. Pour the priming agent into the keg, then gently siphon the uncarbonated beer into the keg without aerating it. Displace the remaining airspace with carbon dioxide by adding a shot from your tap system while purging air off the relief valve.

How should I handle it?

Regardless of whether you use corn sugar or dried malt extract, boil it in a pint of water for five minutes, cool it rapidly in a cold-water bath and add it to the priming container (a sanitized bucket, keg or carboy). Now place the container below the full carboy of uncarbonated beer and gently siphon the brew into the priming vessel, leaving a half inch or so of sediment behind.

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If you transferred the beer directly into a keg, simply clamp it shut, purge the airspace and set it in a dark room at a temperature between 60° and 70° F. If you brewed a beer with a yeast strain that works well at low temperatures, you can store it at colder temperatures. Let the keg age for one to two weeks and refrigerate for three days before drinking.

If you're bottling the beer, then do a second transfer from the priming container to cleaned and sanitized bottles. Leave an inch of airspace in each bottle and cap.

Once complete, set the bottles upright in a dark, quiet part of the house. The temperature should be between 65° and 70° F depending on the yeast used and the speed in which you need to get the beer carbonated. Let the beer age for ten to 14 days, then refrigerate a few days before drinking.

Priming with fresh wort

If you're bored with these tried-and-true methods, try adding wort as the priming agent. This method of carbonation strictly conforms to the German Purity Law of 1516 and makes your favorite all-malt beverage truly "all malt."

For logistical reasons, few homebrewers prime with fresh wort, but a little advance preparation can solve the problem. All you need to do is store some unfermented sterile wort, called "gyle," in a sealed container in the refrigerator. I recommend using it within a week. If you notice any bubbles or off-colors, then don't use it.

When collecting the wort on brew day, be sure to get it before adding the yeast. When bottling time comes around, just toss the gyle into the priming container with the uncarbonated beer.

In order for this to work, you need to know how much to use. Though every batch of wort has a unique set of variables, you can use a simple formula explained by Charlie Papazian in his must-have book, "The New Complete Joy of Home Brewing" (Avon Books). Simplifying a complicated equation and assuming a priming rate based on 3/4-cup corn sugar per five gallons of beer, Papazian came up with this simple piece of math:

- Quarts of gyle = (12 x gallons of wort) divided by (specific gravity - 1.000) x 1000.

Below you'll see an example for a pale ale wort with a starting gravity of 1.045:

- Quarts of gyle = (12 x 5) = 60.
- Specific gravity = (1.045 - 1.000) x 1000 = 45.
- 60 divided by 45 = 1.33 quarts of gyle.

Once you know the amount of gyle to add, simply toss it into the

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priming vessel, add the green beer and proceed from there. Over time, you'll learn how to adjust amounts to increase or decrease the carbonation level for a specific recipe.

What if things go wrong?

Even in the best of times, bottles burst or kegs lose pressure. If the bottles explode, all you can do is review your priming procedure (did you use too much sugar?) and clean up the mess. If your keg of beer ends up flat, just use the "quick-draft" method. Chill the keg to 40° F, apply 25 to 30 pounds per square inch of carbon dioxide and shake it up for ten minutes or let it set for a few days. Then tap the keg and enjoy. After all, by the time you discover flat beer, you're primed for a cold one and deserve a quick fix, not a headache. ■

Dawnell Smith is a freelance writer in Juneau, Alaska.

Priming Sugars: A Snapshot

When fermentation has ended, the beer is ready for priming. By adding sugar, you kick-start the dormant yeast, which consumes the sugar and produces carbon dioxide. When primed and placed in a sanitized, closed vessel, the beer absorbs the trapped CO_2. Here are three easy priming agents:

Corn Sugar (dextrose)
Pros: Fast, easy, consistent and effective. Cons: Leaves harsher, bigger bubbles than some of the other methods. Usage: As a very general rule, use 2/3 cup of corn sugar per five gallons of bottled beer and 1/3 cup per five gallons of kegged beer.

Dried Malt Extract (DME)
Pros: Makes an all-malt brew with softer, smaller bubbles than most sugars. Cons: Can leave a protein film on top of beer; may harden during storage; takes longer to work. Usage: As a general rule, use 1-1/4 cup per five gallons of bottled beer or 2/3 cup per five gallons of kegged beer.

Gyle (unfermented wort)
Pros: Conforms with Purity Law if made with malt, hops and water. Cons: The risk of contamination from infected wort; requires forethought and a little math. Usage: quarts gyle = (12 x gallons of wort) divided by (specific gravity - 1.000) x 1000

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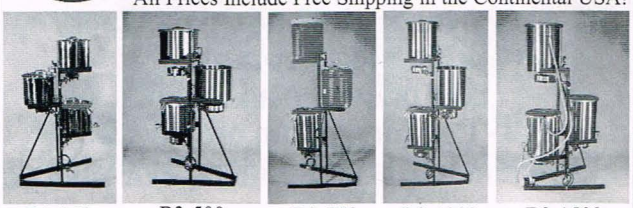

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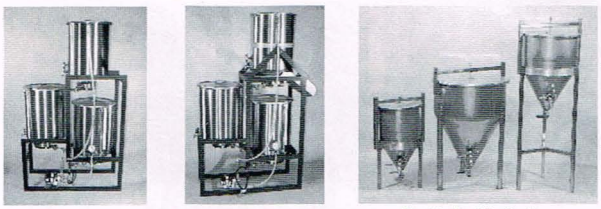

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Fine-Tune Your Flame

If your propane burner is slow to boil, get out the grinder

by Thom Cannell

A year ago my wife gave me an eight-gallon stainless steel boiling kettle. No more partial boils in Grandma's black enamel canning kettle. I was set for full-volume boiling. To my surprise, it took longer to heat three gallons of water than before. After adding extract and wort from a mini-mash, it took even longer to boil.

My new kettle fit the burner support better and allowed flames to heat more surface. It should have heated almost as fast, given equal volumes of water (stainless steel requires more heat input than copper, aluminum or cast iron.)

So I looked to the burner, a bargain purchased at Sam's Club for $30 including stand and propane control valve. The ring of flames were nice and blue and evenly distributed, indicating sufficient air. But there didn't seem to be as much flame as there could be. With the kettle filled to 6.5 gallons it was difficult to keep a roiling boil going. I took it apart.

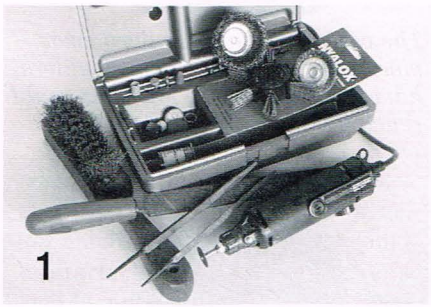
To my surprise, there were metal stalactites growing from the surface of the casting. OK: Not actual calcium deposits, but metal flash from a poorly executed casting. They blocked air flow, and also prevented smooth gas-air flow to the burner. This is not good. A smooth stream flows better than an unruly one. This is why manifolds for every race car are "ported" (the intake opening matched to the succeeding orifice) and "polished" (smoothed.)

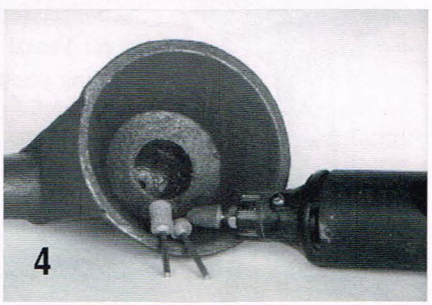
I did the same to my burner, and the results were a significantly faster boil. I didn't do any measuring, but my guess is that it improved performance by at least 20 percent. If you also have a cast-iron burner, it is likely a little effort on your part can shorten the brewing day.

Port and polish for burners

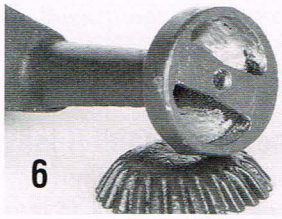
For this project, my pal Carl Glarner at The Red Salamander homebrew supply store in Grand Ledge, Michigan, lent me a new burner that needed improvement.

The most important tool is a Dremel or other small die grinder. Perhaps you could use grinder bits for your drill motor, but be sure you can get deep into the casting; this is critical. And you'll need some small round files or a variety of grinder bits, and a wire brush.





1) Here are the tools you'll need: flat, rounded and contoured files; wire wheels or grit-impregnated nylon wheel for cleaning; Dremel tool with various grinding bits. 2) Our propane burner. Looks pretty good from the outside, doesn't it? To get started, unscrew the long bolt securing the burner ring; unscrew the brass gas inlet. 3) Note the sharp "corner" or shoulder the air must bump against as it enters the burner. And how rough the burner-ring grooves are. 4) I used a cone-shaped bit to grind the mixing port. Examine the edges and you'll see several pea-sized casting flaws, plus a rough texture. 5) Completed port. The edges are beveled and most of the roughness is smoothed and rounded.



The air-intake side required even more work. Note how the shoulders have been smoothed. My tools could reach only two-thirds of the area.

Burner ring after polishing. The grooves are uniform; gas will flow smoothly for a larger, hotter flame.

Start by disconnecting and disassembling your burner. Our example required unscrewing a long connecting bolt and the gas connector.

If your burner lives outside and is rusty, you'll have to clean it with a wire brush by hand, or use brushes that can chuck into your drill motor. Once everything is shiny, inspect the casting.

Our burner orifice plate at first looks smooth. But the passages could be smoother and more uniform. The main casting shows lots of little projections and bumps, both at the air intake and mixture end.

The procedure is straight forward: Chuck up a grinder bit and start smoothing out any large casting flaws. (Before you start, please put on your safety glasses and hearing protectors.)

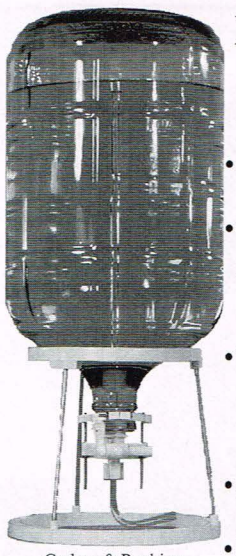
The second phase is more subtle. Try to smooth out the casting to its "true" shape. By that I mean don't introduce any low spots with excessive grinding. The air mixture will flow best through a round tube with smooth, equal radius bends. Look at both ends, and smooth as deeply as you can reach.

When finished with the body, look at the grooves in the fuel mixture delivery ring. Is each groove smooth? Of equal size and shape? Try to make them clean and smooth with a round file or die grinder-Dremel tool.

The next step is painting. I chose the easy way out, matching the red enamel on the casting. If it were my own burner, I'd clean all the paint from the burner and its stand and repaint with a high-temperature enamel (1200° F). This is available almost everywhere.

The final step? Fire up your burner, boil and brew! ■

Thom Cannell wrote "Build a $50 Mash Tun" in the September 1999 issue of Brew Your Own.



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Mead Made Easy

A drink made of honey, water and history

by Alison Crowe

As far as modern historians can tell, mead, a fermented drink made of honey and water, is the most ancient of all alcohol-containing beverages. Cave drawings in Belgium thought to be between 14,000 and 12,000 years old depict the gathering of honey for mead. Traditional cultures all over the world, from the Australian Aborigines to the ancient Celts, also made fermented honey beverages.

Homebrewers and winemakers may be disappointed to learn that their favorite fermented brew didn't arrive on the scene first. But it makes sense that before beer and wine, there was mead.

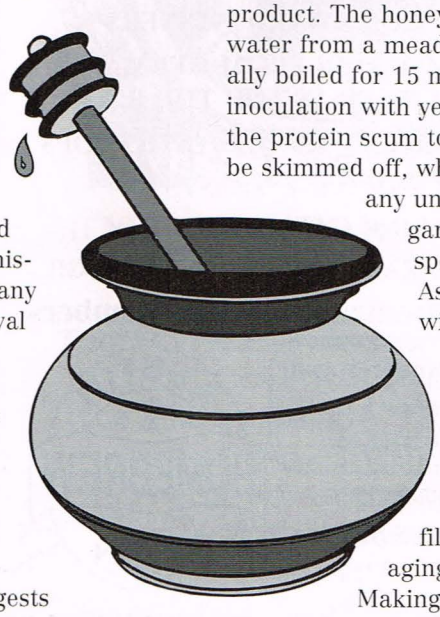
Unlike fruit-based wines and malted grain-based brews, meads—or "wines" that are made out of honey—take a minimum of human intervention for fermentation to begin. Honey is the nectar of flowers transformed by the enzymes in a bee's digestive tract. Since honey was available in the wild, it has been a popular source of sweetness and fermentable sugar in food and beverages throughout history.

As you might suspect, the flavor of the honey—and as a result, your mead—will be affected by where the bees have ranged in their search for blossoms. It's best to use honey that's produced locally, if you have a place to buy it. As opposed to supermarket-bought honey that has been homogenized and tastes fairly bland, local farm-raised honey has a distinctive flavor and provenance. (Supermarket honey may also be loaded with preservatives and stabilizers, which will inhibit fermentation.) Often you can find specialty honey that has been gleaned by bees from lavender, citrus trees, or other interesting flowers. Farmer's markets and natural food stores seem to be the best places to find local honey.

Even though mead is the oldest fermented beverage, honey still needs special attention when used for homebrewing. Honey is a great natural sugar source and is more than 99 percent fermentable. But it still lacks the tannins, acids and yeast nutrients that make grapes and malted barley better all-around home-beverage choices.

The good thing about modern mead-making is that all of these shortcomings can be dealt with during fermentation. Tannins help give structure and mouthfeel to meads, and even though it's not a traditional ingredient, those who are used to drinking wine might enjoy adding no more than one teaspoon of tannin powder per gallon of mead. (You can buy tannin powder at a home winemaking shop.)

Adding acid is another common amelioration in mead making. It also has historical precedent: Many recipes, from medieval England to the Victorian era in the United States, direct that citrus juice be added to the fermenter. Today we can add lemon or orange juice (one Victorian recipe suggests adding "the juice of four lemons, the rinds of but two" for a four-gallon batch). If you prefer, you could use tartaric acid or a winemaker's acid blend, which is equal parts citric, malic and tartaric acid. Either way, add 1 teaspoon per gallon of mead. There are no pH "magic numbers" for mead. Still, I'd keep it within the 3.3 to 4.0 range.



Yeast nutrients are another thing that will help your honey fermentation. Why? Because honey lacks sufficient macro- and micronutrients, particularly nitrogen, which wine and beer yeast depend upon for survival. Two teaspoons of yeast nutrient or yeast hulls (both available through your local homebrewing or home-winemaking supply shop) per gallon of mead should be sufficient.

Honey is also rich in albumen proteins, a potential haze-forming agent that might cloud your final product. The honey and some of the water from a mead recipe are usually boiled for 15 minutes before inoculation with yeast. This allows the protein scum to coagulate and be skimmed off, while also killing any unwanted microorganisms that might spoil the mead. As in fruit-based winemaking, we can also take advantage of sulfur dioxide's antimicrobial benefits—as well as those of filtering, barrel aging and bottling. Making mead is very

similar to making wine, especially because you can modify recipes to yield a drier, sweeter, oakier or spritzier product.

True meads have no other flavoring besides honey. When any kind of fruit is added, the result is called a "melomel." If herbs or spices are added to mead, it's called a "metheglin." Future mead-making columns will explore these fruit and spice additions. They can range from traditional recipes such as "cyser" (an apple mead) and "hippocras" (mead with grape juice and spices) to not-so-traditional variations, like a raspberry melomel or a hop metheglin.

Make a Basic Mead

The mead recipe that follows will serve as an introduction to mead-making. It will produce a one-gallon batch, a nice starting size. Mead isn't for everyone. Some people find they don't like the flavor that honey — especially some of the wilder, stronger honey varieties — contributes to a beverage.

This recipe produces a dry mead; in other words, a mead that isn't too sweet. If you want slightly more residual sugar, use more honey (2.5 to 3 pounds per gallon for medium sweetness, 3 to 4 pounds per gallon for very sweet mead) and hit it with about 50 ppm sulfur dioxide to halt fermentation once the specific gravity gets to 1.010 or 1.020, respectively.

Another way to tinker with residual sweetness is by selecting a different yeast strain. I've tasted meads that were made from the same batch of honey and water, but used different strains to tweak the sweetness of the finished product.

The recipe is not written to be sparkling, since it is likely that the original honey brews weren't spritzy. However, if you like a little fizz in your mead, take the raw material this recipe yields and follow directions in a homebrewing or home-winemaking book for bottling in beer or champagne bottles with crown caps. Honey can be used as the priming sugar at the rate of 50 milliliters per gallon of mead.

Note: If you want to try this, don't add any sulfur dioxide to the recipe. It'll conk out the yeast, and once that happens, carbonation will be out of the question.

Basic Dry Mead (one gallon)

Ingredients:

- 2 pounds honey
- 3 qts. water (enough to bring volume to 1 gallon)
- 1 tsp. tannin powder
- 1 tsp. tartaric acid
- 2 tsp. yeast nutrient
- 1 tsp. dry champagne yeast (like Red Star Pasteur Champagne)

Step by Step:

Pour honey and water into a non-reactive stockpot or kettle. Boil

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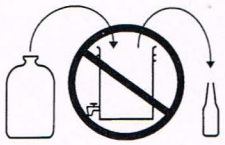

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for 15 minutes, skimming off any scum. Take off heat and cool until it is still warm to the touch.

When cool, add tannin powder, tartaric acid and yeast nutrient, stirring well to incorporate each addition. Transfer to a clean, glass 1-gallon jug. Cover the jug with kitchen plastic wrap or cheesecloth, to keep out microbes as you prepare for inoculation.

Disperse the dry yeast in 1/2 cup of 105° F water. Let stand for 10 to 15 minutes. If the liquid is bubbling and frothy, add to the honey mixture, stirring gently to disperse the yeast. If the yeast have not activated, it might mean your yeast is old or has lost its ability to rehydrate. In that case, buy a new, fresher packet or container from your local homebrewing supplier.

After adding the rehydrated yeast to the jug, top up with warm, preboiled water and fit with a fermentation lock. Take an initial specific gravity reading. It should be between 1.070-1.075. If fermented to dryness, this will provide an ending specific gravity of 0.995-0.997.

Set in a moderately warm, dry place (65 to 75° F). Monitor the sugar level (specific gravity) to check for fermentation progression and completion. After about 5 days, the sugar level should start to drop dramatically. Check for dryness (below -0.5 degrees Brix, around 0.995-0.997 specific gravity) if you are aiming for a dry mead, or go by taste to determine how sweet you'd like your finished product.

With a clean siphon hose, rack the mead to a second clean one-gallon glass jug, topping up with chilled, preboiled water as necessary. Move to a cooler location, preferably around 60° F. Top with a bung and fermentation lock. Allow the fermentation to go to completion in this secondary fermenter. Monitor with hydrometer every other day until dryness is achieved. For semi-dry or sweet mead, monitor by taste and hydrometer every other day until the desired level of sweetness is reached.

Transfer the mead into a clean, one-gallon jug, leaving the sediment behind. If you have the apparatus, you could filter the mead at this point, though it is not necessary.

Top up jug with chilled, preboiled water and cap or bung securely. Mead is ready to drink when it is clear and settled out, but it will improve if aged for three to eight months. In fact, stronger meads will age very well up to two or three years, if properly handled and packaged.

If you wish to bottle it, or if you have expanded the recipe to fit into a five-gallon carboy, you may bottle at this time. You can use traditional wine bottles, if you have the equipment required to cork them securely. Homebrew bottles would work very well, too.

Let the mead sit in bottles for at least another month before consum-

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ing. This basic recipe can be expanded to fit into a five-gallon carboy, or even odd-sized cooperage. Simply multiply the ingredients by the volumes of your containers.

Mead with an Ale Twist

Homebrewers interested in making mead might also be interested in a variation traditionally known as "small mead." Small mead uses an ale yeast, instead of a wine or champagne yeast, and contains about half the honey of most mead recipes. The result is an ale-like mead with a faster fermentation.

Basic Small Mead (one gallon)

Ingredients:

- 1 lb. honey
- 3 qts. water (enough to bring volume to one gallon)
- 1 tsp. tartaric acid
- 2 tsp. yeast nutrient
- 1 tsp. dry ale yeast, such as Munton & Fison Ale Yeast
- 1 campden tablet

Step by Step:

Pour honey and water into a non-reactive stockpot or kettle. Boil for 10 to 15 minutes, skimming off any scum. Take off heat and cool until it is still warm to the touch.

When cool, add tartaric acid and yeast nutrient, stirring well to incorporate each addition. Transfer to a clean, glass one-gallon jug. Close the jug with an airlock and stopper, to keep out microbes as you prepare for inoculation.

Rehydrate the yeast by dispersing in 1/2 cup of 105° F water. Let stand for 15 minutes. If the liquid is bubbling and frothy, add to the honey mixture, stirring gently to disperse the yeast. If the yeast have not activated, buy a fresher packet from your homebrewing supplier.

After adding the rehydrated yeast to the jug, top up with warm, preboiled water and fit with a fermentation lock. Take an initial specific gravity reading. It should be between 1.032 and 1.040. If fermented to dryness, this will provide you with an ending specific gravity of 0.995 to 0.997.

Set in a moderately warm, dry place (65 to 75° F). Monitor the sugar level (specific gravity) to check for fermentation progression and completion. After about 5 days, the sugar level should start to drop dramatically. Check for dryness (below -0.5 degrees Brix, around 0.995-0.997 specific gravity) if you are aiming for a dry mead, or go by taste to determine how sweet you'd like your finished product.

With a clean siphon hose, rack the mead to a second clean one-gallon glass jug, topping up with chilled, preboiled water as necessary. Move to a cooler location, preferably around 60° F. Top with a bung and fermentation lock. If it hasn't done so already, allow the fermentation to go to completion in this secondary fermentor. Monitor with hydrometer every other day until dryness is achieved. Once this point has been achieved, add one crushed campden tablet dissolved in about 1/4 cup of water.

Transfer the mead into a clean, one-gallon jug, leaving the sediment behind. Top up jug with cold, preboiled water and cap or bung securely. Mead is ready to drink when it is clear and settled out, but it will improve if aged for three to eight months.

If you wish to bottle your mead, or if you have expanded the recipe to fit into a five-gallon carboy, you may bottle at this time. You can use wine bottles, if you have the equipment required to cork them securely. Homebrew bottles would work, too. Let the mead sit in bottles for a month before consuming. ■

Alison Crowe is a graduate of the University of California at Davis, Department of Viticulture & Enology. She's currently making wine commercially in the Santa Cruz mountains of California.

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The Best of All Possible Worlds

In the vast expanse of space-time, we alone possess beer

by Chris Colby

My college literature professor regarded "Voltaire" by Candide as the most influential satire ever written. Candide's work is so brilliant that I'm sure it would have profoundly affected me had I bothered to read it.

The "Cliff's Notes" guide to the book, however, yields some fascinating insights. First, apparently the author's name is Voltaire and the title of the book is "Candide." I wish I'd known that. It would have helped. Secondly, there is a character in the book named Dr. Pangloss who believes we are living in the best of all possible worlds.

After college, I went to graduate school and did read some books. Books about how the universe formed. Books about how life evolved. That and "The Complete Joy of Homebrewing" by Charlie Papazian. Now, after years of brewing beer and pondering the ways of the universe, I have come to one inescapable conclusion: Dr. Pangloss was right. We are indeed living in the best of all possible worlds.

I base this conclusion on three facts. 1) Beer has only existed on one planet, occupying a tiny fraction of the total volume of the universe. 2) Beer has only existed for a minute fraction of the history of the universe, and 3) Here I am in this narrow sliver of space-time, drinking beer.

To get some idea of how lucky we are, consider the size of the universe. If you tried to stack twelve-ounce beer bottles from one end of the universe to the other . . . you'd be wasting your time, and a lot of beer. For one thing, space-time is curved and you'd eventually end up back where you started. Suffice it to say the universe is large—like a WalMart store that sells WalMart stores, only much larger. And somewhere, in a single aisle of a single store, between a four-gallon jar of mayonnaise and a 55-gallon drum of Turtle Wax, is a single six-pack of beer. The only one. And that's how rare beer is.

Next, let's take a look at the history of the universe. The universe began with a rapid expansion of space-time called the Big Bang. Scientists call it the Big Bang because they can't think of a better name. The Big Bang started the universe on the road to beer. The road was a good road, but it was long.

Initially, the universe was hot. It was so hot that atoms couldn't exist. It was so hot that the four forces that now shape our universe—gravity, electromagnetism, the strong nuclear force, and its punk cousin the weak nuclear force—were all mushed together into one force. In short, the early universe was hot, hot, hot. Or, as the British say, cellar temperature.

Approximately 15 billion years separate the hot Big Bang from the cold frosty mug. It took a million years for the universe to cool enough for atoms to even exist, and then only hydrogen and helium were present. Hydrogen was the first historical marker on the road to beer. Hydrogen is a key component of water, and water is a critical component of both living creatures and beer. (Helium, most scientists agree, is just plain silly.)

It was another couple million years before stars formed and started producing bigger atoms—like carbon, an important atom in beer and homebrewers. From there, it was about 10 billion years until our Earth formed. As the planet evolved, the building-blocks of beer evolved along with it: water, fermentation and photosynthesis (a prerequisite of plants, like hops and barley.) And finally, approximately 4.6 billion years later, some carbon-based ape-derived bipeds brewed the first fermented-grain beverage.

At this point, the astute reader might ask, "What about the existence of Zima?" Aren't we also living in the only sliver of space-time in which this abomination existed? That is a good question, one for which I have no answer. I suppose that, in the future, someone who actually did read "Candide" may provide some insight. In the meantime, I plan to have a beer and relax with a book— "Love in the Time of Cholera." I've always been interested in epidemiology. ■

Chris Colby is a technical editor for Holt Rinehart Winston. His last article for BYO was "High-Gravity Brewing for All-Grain Brewers" (February 2000). He lives in Bastrop, Texas with one wife, six cats and a ten-gallon brewery.

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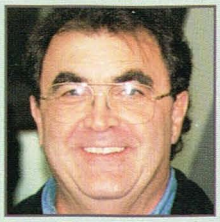

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