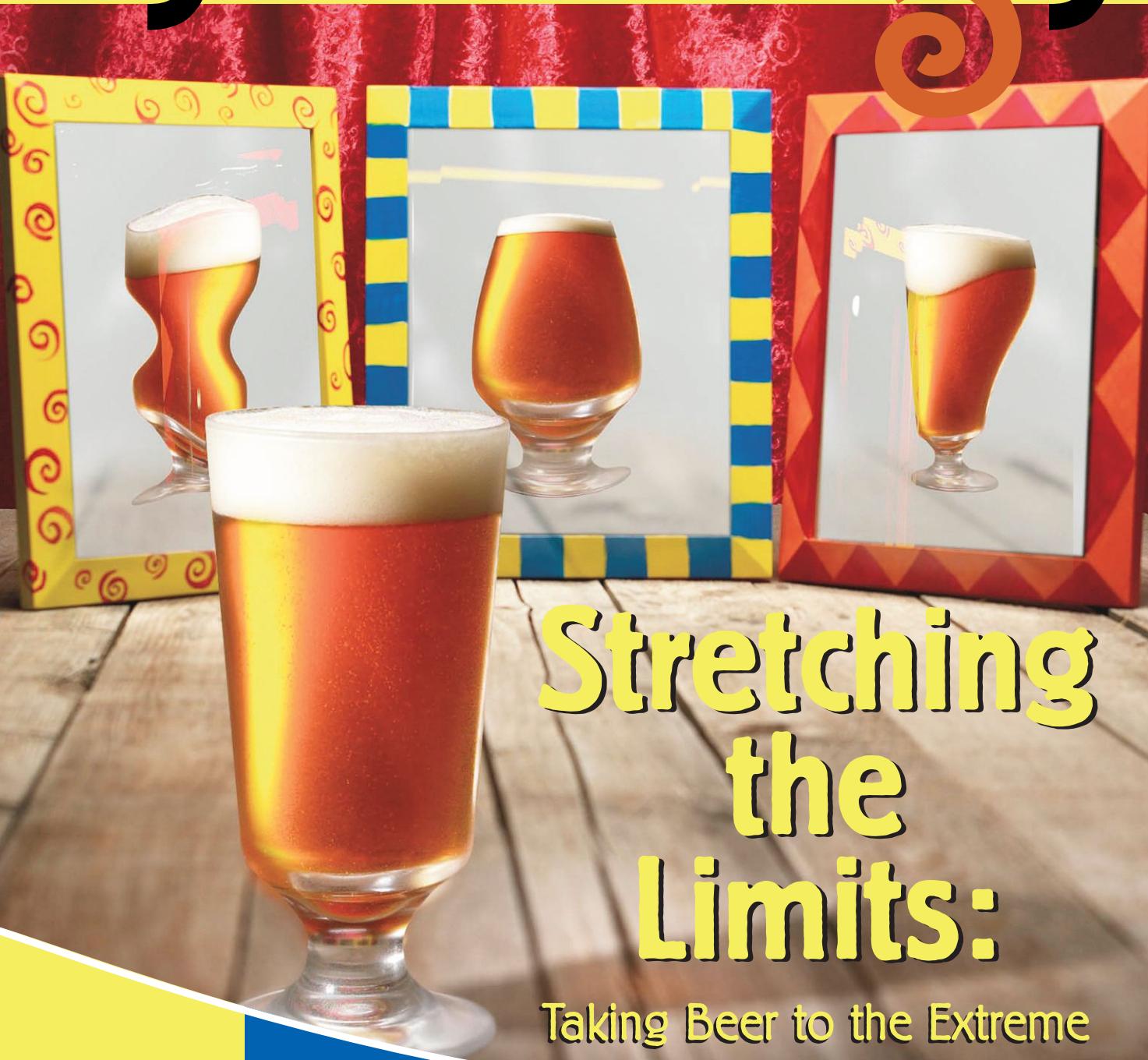


FOR THE HOMEBREWER & BEER LOVER

Volume 28 * No. 6 | November/December 2005

zymurgy

■ The Journal of the American Homebrewers Association ■



Stretching the Limits:

Taking Beer to the Extreme

In this issue:

10 BEERS YOU CAN BREW

Hop
to it for
BIG BEERS

Beyond
Barleywine
Wheat, Rye & Oats

Mastering
Mead
by
Ken Schramm



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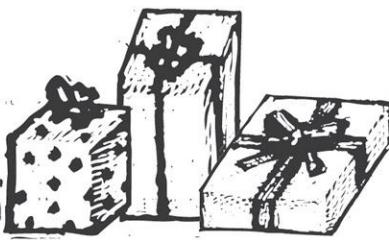
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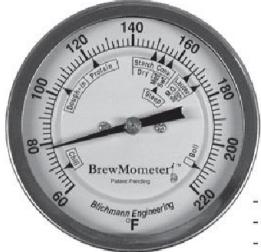
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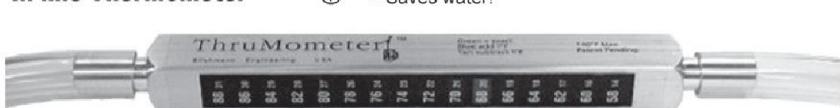
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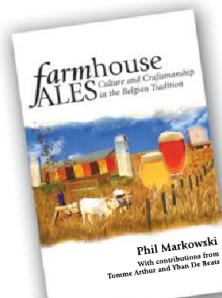
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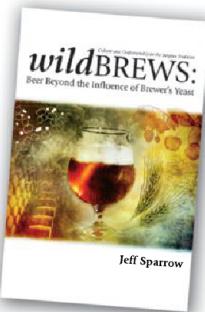
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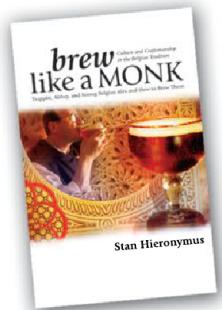
The Belgian Series: Why not have all three?



Today's farmhouse styles resulted from years of evolution, refinement, interpretation and re-interpretation of the simple, rustic ales once brewed on farms in Flanders and Wallonia. *Farmhouse Ales* defines these Saison and Bière de Garde brews in modern and historical terms while guiding today's brewers toward credible and enjoyable reproductions of these old world classics. Includes recipes and illustrations.



Wild Brews explores the world of Lambics, Flanders red and brown beers and American brews in a similar style. Includes coverage of wood-barrel aging, blending and the use of fruit in wild fermentations.



Discover what makes the heavenly brews of Belgium so good in this new book by long time *All About Beer* contributor, Stan Hieronymus. In *Brew Like a Monk*, he details the beers and brewing of the famous Trappist producers along with dozens of others from both Belgium and America. Sip along as you read and, if you find yourself divinely inspired to brew some of your own, try out the tips and recipes as well.

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Bigger, Bolder Beers

With summer behind us, thoughts begin to turn to bigger, bolder beers to brace us against winter's chill.

In the past, that meant winter warmers and barleywines. But in recent years, craft brewers—both professional and amateur—have been expanding the boundaries when it comes to big beers.

From the mid-1950s to 1980, EKU held the title of "World's Strongest Beer." At 11-percent alcohol by volume, it went where no beer had gone before. The Kulmbacher brewers actually allowed ice crystals to form in the lagering bock beer to concentrate its strength.

The brewers at the Swiss brewery Hurliman toppled EKU in 1980 with their Samiclaus. They used an experimental yeast strain to achieve 14 percent ABV and earn a place in the *Guinness Book of World Records* in 1982.

That stood until Jim Koch of the Boston Beer Company introduced his Triple Bock, a 17.5-percent ABV beer, at the 1994 Great American Beer Festival. Koch used two different yeast strains along with maple syrup to create the first American "extreme beer" and start what has turned into an alcohol arms race that has now spread to Germany. A brewer there recently announced producing a beer with 25.4 percent ABV. Look in Beer-o-Scope on page 5 for a list of the world's strongest beers.

There's more to the extreme beer movement than the battle of the ABVs. Brewers are building bigger, bolder versions of many classic beer styles: imperial porters, double alts, wheatwines, to name just a few.

But as any brewer who has dared to push the bounds of beer to the extreme has learned, there is more to making big beers than just ratcheting up a recipe.

So we have turned to some of the bigger brains in the beer world for some tips on brewing extreme beers. Jamil Zainisheff is the 2004 National Homebrew Competition Ninkasi Award winner and attacked brewing with such a vengeance that in his first few years of brewing, he brewed every style in the Beer Judge Certification Program's style guidelines just so he could be a better judge. With a nickname of Mr. Malty—and his own Web site with that same name—who better to explore the art of building big worts for big beers? You can read his tips on page 26.

You'd be hard pressed to find a bigger hop-head than Tom Nickel. Rumor has it if you prick his finger his blood runs green. Not only did he brew some of the most IBU-riffic beers around during his stint with Oggie's that earned him a Champion Small Brewing Company Brewmaster award in the 2004 World Beer Cup, but his O'Brien's Pub in San Diego could easily be called "The Hoppiest Place on Earth." He gives his hopping hints on page 36.

There is an old saying that "brewers make wort, yeast makes beer." This is especially true for extreme beers, where these single-celled beermakers work overtime. Dr. Chris White of White Labs offers some advice on the care and feeding of yeast for big beers on page 32.

And Dan Morey weighs in with his recipes from his experiments in using alternative grains for big beers on page 40.

Alert readers will notice the absence of two regular features this issue. Commercial Calibration and Winners Circle have not been dropped; they will return in the New Year.

Cheers,
Jim Parker
Editor-in-Chief

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By Jamil Zainasheff

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32 | Yeast for Your Beast

By Dr. Chris White

Really big beers need two things: a lot of very healthy yeast and a high percentage of fermentable sugar. The founder of White Labs steers you in the right direction.

36 | For Big Beers, Hop to It

By Tom Nickel

Just as with lighter beers, big beers require finesse and fine tuning to avoid unharmonious flavors and a harsh finish. We look at unique ways to use hops before and after the boil as well as some alternatives.

40 | Beyond Barley(wine)

By Daniel Morey

In this issue of thinking big about beer, barleywine gets a makeover with the nontraditional use of wheat, rye and oats instead of malted barley.

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By Zymurgy Staff

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PLUS: OFF-THE-WALL GIFT GUIDE



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>> GET THERE!

Great International Beer Festival

The Great International Beer Festival returns for its 12th year November 12 in Providence, R.I.

The festival features craft beers from across the United States as well as several imports. For the ninth year, it will also include the Great International Beer Competition. Brewers will compete in eight beer categories as well as cider.

The festival is held at the Rhode Island Convention Center and attendance is expected to top 4,500 for the two sessions (1-4:30 p.m. and 6:30-10 p.m.). Attendees will sample the wares of 50 breweries and cideries, with 250-plus beers and ciders available. There will be live music and food from local restaurants. Tickets for each session are \$30.

For information or to buy tickets online, visit www.beerfestamerica.com.

October 29

New England Beer Fest Boston, MA.
Web: www.beeradvocate.com/fests

October 29

Washington Cask Beer Festival Seattle, WA. Contact: Lisa Miyashita, Phone: 206-915-0015, E-mail: lisa@washingtonger.com Web: www.washingtonbeer.com

November 5

3rd Annual Georgia Craft Brew Challenge Atlanta, GA.
E-mail: mark@worldclassbeer.org
Web: www.worldclassbeer.org

November 5-6

The Brookdale Lodge Brewery Advertising, Beer Can & Antique Show, Swap and Sale Brookdale, CA.
Phone: 415-515-5093

November 9

Malt Advocate's WhiskyFest New York City, NY. Phone: 610-967-1083 Web: www.maltadvocate.com/html/ny.html

For a complete listing of beer festivals and events, see www.beertown.org/craftbrewing/events.asp.



December 2-4

Holiday Ale Fest Portland, OR. Phone: 503-252-9899,
Web: www.holidayale.com

May 6, 2006

10th Annual Boonville Beer Festival Boonville, CA.
Anderson Valley Brewing Company,
Phone: 707-895-2337, E-mail: info@avbc.com
Web: www.avbc.com/news/boontbeerpfest.html

May 31-June 4, 2006

Mondial de la Biere Montreal, Quebec. Phone: 514-722-9640, Web: www.festivalmondialbiere.qc.ca

September 28-30, 2006

Great American Beer Festival® Denver, CO. Contact:
Nancy Johnson, Phone: 888-U-CAN-BREW x 131,
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BREW NEWS: Moortgat to Brew Ommegang

First came the Belgian ales. Then American craft brewed versions of Belgian ales. Now, for the first time, an American Abbey ale has been brewed in Belgium and shipped back to the United States.

Brewery Moortgat, brewers of Duvel Golden Ale and owners of Brewery Ommegang in Cooperstown, N.Y. since 2003, announced it has brewed several batches of Ommegang Abbey Ale that are now available in the United States.

Ommegang Abbey Ale is Ommegang's first and flagship beer, a rich dubbel-style ale. In early 2005, Ommegang brewmaster Randy Thiel realized he didn't have the brewing capacity to keep up with demand for the dark, potent brew. So he contacted Duvel brewmaster Hedwig Neven, who accepted the challenge of creating Ommegang Abbey Ale in the Old World with typical Belgian passion and precision. After recipe discussions, transatlantic taste tests and blind samplings, the efforts have paid off. Thiel says, "The Ommegang Abbey Ale that Hedwig and Duvel brew is everything we brew our own Ommegang Abbey Ale to be: dark, aromatic, malty and deliberately luscious and rich." He also cheerfully admits, "I do have some mixed emotions, as I probably couldn't brew it better myself."

The 750-milliliter bottles of Belgian-brewed Ommegang Abbey Ale (which look virtually identical to existing bottles) are being sold wherever Ommegang beers are available. Meanwhile, Ommegang Abbey Ale in 12-ounce bottles, and occasional kegs, will continue to be brewed in Cooperstown.

For more information, visit www.ommegang.com.

GREAT GADGET

WHAT'S NEW FROM OFFICIAL BEER GLOVE

Official Beer Glove

Why should baseball players and Michael Jackson be the only ones to make a single glove into a fashion statement? Now beer drinkers have their own "official" hand accessory.

That's right, now you can keep your digits from getting chilled while gripping a cold beer with The Official Beer Glove. Makers of the mica-flex acrylic glove promise it will keep your hand warm and your beer cold. It even has nifty raised puffy ink lettering that helps improve your grip and prevent party foul fumbles. Think of it as a no-slip sock for your beer hand. They are even customizable.



Sure it's silly, but for only \$4, or \$7 for a pair, it makes a great stocking stuffer for a beer buddy.

Check them out at www.officialbeerglove.com.



BEER QUOTE

"In wine there is wisdom,
in beer there is strength,
in water there is bacteria."
—David Auerbach (2002)

>> BEER JOKE

The Returning Drunk

A really sloppy drunk is draped over the bar. The bartender tells him, "OK, you've had enough. I'm not going to serve you any more, so get out of here and go home."

The drunk leaves the bar. Ten minutes later the drunk comes in through the back door. The bartender tells him, "I told you to go home, I'm not serving you anything more, you've had enough, now go home."

The drunk leaves again.

Ten minutes later the drunk comes in through a side door. Again, the bartender tells him, "Man, I told you, you're wasted. I'm not serving you any more, now go home, you've had enough."

Again, the drunk leaves.

Fifteen minutes later the drunk comes in through another side door. The bartender says, "What's the matter with you? I keep telling you, you've had enough already, and I'm not going to serve you any more, now go home!"

The drunk looks up at the bartender and asks, "How many places do you work at?"

THE LIST 20 Strongest Beers in the World

In honor of our theme of extreme beers, we offer the list of the world's strongest beers as compiled by Beer Advocate (www.beeradvocate.com).

Beer	Brewery	ABV
1 Samuel Adams Utopias MMIII	Boston Beer Co.	25.0
2 Samuel Adams Utopias MMII	Boston Beer Co.	24.0
3 World Wide Stout 2002	Dogfish Head Craft Brewery	23.04
4T Bo's Solar Eclipse Imperial Stout	Bo's Bistro & Brewery	22.5
4T Rosies Ale	Barley John's Brewpub	22.5
6 World Wide Stout 2000	Dogfish Head Craft Brewery	22.1
7T Samuel Adams Millennium	Boston Beer Co.	21
7T World Wide Stout 2003	Dogfish Head Craft Brewery	21
9T 120 Minute IPA	Dogfish Head Craft Brewery	20
9T Raison D'Extra	Dogfish Head Craft Brewery	20
11 Bo's Vintage Ale	Bo's Bistro & Brewery	19
12 The Beast Grand Cru	Avery Brewing Co.	18.1
13T Double Ice Bock	Southampton Publick House.	18
13T Forte	Dogfish Head Craft Brewery	18
13T World Wide Stout 2001	Dogfish Head Craft Brewery	18
13T World Wide Stout 2004	Dogfish Head Craft Brewery	18
17 Samuel Adams Triple Bock	Boston Beer Co.	17.5
18 Instigator Eisoppelbock	Sly Fox Brewing	16.5
19 Deception	Du Claw Brewing	16.4
20 Maelstrom	Rome Brewing Co.	16

BREW NEWS: Game Tests Your BeerSmarts

Beer lovers love to test each other's stockpile of arcane beer trivia, and now there is a game for novices and certified geeks alike. BeerSmarts is the latest offering from Smartsco, a San Francisco-based company that has launched trivia games from WineSmarts to SexSmarts to CoffeeSmarts.

The game is simple, 15 different cards each in four different topics. Beer Basics covers brewing ingredients and terminology, Beer Culture taps into beer's history and role in society, Cheers explores beer styles and brands and Wild Card is a hodgepodge of trivia.

Each card has a question and four multiple-choice answers.

Garrett Oliver of the Brooklyn Brewery edited the set, so the accuracy is spot on. Confirmed geeks won't get stumped too often, but it will be a great learning tool for those just getting to know their beers.

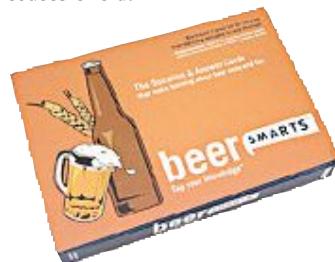
Plus, there are a couple of questions that may test even the seasoned beer drinker.

1. A beer enthusiast is known as a cerevisophile. An avid collector of beer coasters is a:

- A. Tegestologist
- B. Coasterologist
- C. Cermatophist
- D. Matalogist

2. Beer cans weren't invented until 1933. It took so long because of:

- A. Prohibition
- B. Exploding beer
- C. Sour beer
- D. Consumer resistance



BeerSmarts is available in some beer and homebrew stores. You can find a retailer near you on the Smartsco Web site, www.smartsco.com.

>> YOU GOTTA DRINK THIS

Hercules Double IPA

Great Divide Brewing, Denver, Colo.



Like a walk near the Colorado timberline on a crisp fall day, Great Divide's Hercules Double IPA's sunny orange-copper color washes over you with a wave of piney aroma. An assertive avalanche of citrus and floral notes follows, boosted by a nutty, toffee-like malt backbone, strappingly supporting a complex hop profile that just won't quit. An impressive pour in the glass, Hercules shows its strength with a rock-hard head that gives way to lots of lace. Aptly reminiscent of its namesake, Hercules Double IPA is a strong example of the growing double/imperial IPA style. If you're looking for a well balanced but powerfully hoppy beer, Hercules hits the mark.

Available in Arizona, Colorado, Florida, Georgia, Indiana, Kentucky, Massachusetts, New Mexico, New York, Ohio, Oregon, Pennsylvania, Rhode Island, Texas, Virginia, Washington and Wisconsin.

Submitted by Lisa Morrison, Portland, Ore.

If you've had a beer you just have to tell the world about, send your description, in 150 words or fewer, including where the beer is available, to jim@brewersassociation.org.



Photos courtesy of Smartsco and Great Divide Brewing. Illustration © 2005 Toons4Biz.com

>> BEER QUOTE

"Wine is used in religious ceremonies all over the world. And drinking beer can be a near religious experience, especially if it's a good Oregon microbrew."

—Paul Romain, Oregon beer and wine lobbyist, explaining his opposition to the term "sin tax."

by Our Readers

Step Away from the Mash Tun!

Dear *Zymurgy*,

Having brewed since 1998, I've had my share of mishaps: the boil-over, stuck sparges, frozen hoses, run out of propane, broken carboys, fermentation problems, infections, you name it. In fact, as a seven-year "veteran" I thought I'd seen it all...until this Independence Day.

Thus far, my brewing career has covered three states and as a new resident to Virginia I was anxious to add a fourth. My brewing apprentice, who also happens to be my dad, was in from upstate New York for the holiday and we couldn't think of a better way to celebrate the Fourth of July. I'd been nursing a starter for over a week, had built a great recipe and even purchased water—there would be no chances taken on my first VA batch!

Just as we're finishing the sparge, tires

screech across the parking lot and a Henrico County squad car parks at an angle blocking traffic. I think to myself, "Those pranksters with the fireworks are going to wish they'd been more careful." Before I know it, Barney Fife (please don't interpret any disrespect for the law, he *really* looked like Barney) and his plain clothes partner ask me, "Will you please restrain your canine and put it in the house so I may approach?" Who says that? Canine? It's the world's most lovable, tail-wagging, friendliest black lab (who is already tied up, by the way).

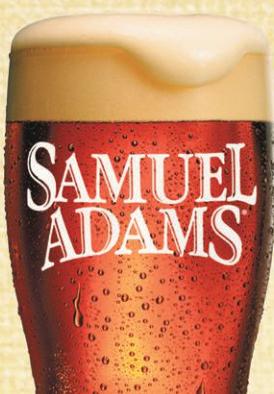
I respect the officer's wishes, he comes up into the driveway and inquires what we're doing. I proudly respond, "Making beer." His face looks as if someone had just stolen his soul. He asks for our identification and goes back to his vehicle. In no

time, another screech of tires and his backup arrives.

Now the threesome comes into the drive and we go through the same questions again ... same answers again.

During the inquisition my wort boils over and it makes me mad. All I can think is, "Look what you made me do. Now I'm going to be scrubbing pots all evening." I turn off the cooker on my three-tier giving Barney and his two partners my undivided attention. We pick up where we left off, (politely) disagreeing on the legality of brewing. They had the guns so you can guess who won.

They make me "cease all operations." Dad and I, with tails between our legs, roll the three-tier in the garage and start to put everything away. Once I dump mash into



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a trash bag both squad cars leave and the drama ends.

I learned two very important lessons that day:

1. You *can* brew inside with a garage door mostly closed if you *need* to (you didn't

think I'd let them beat us, did you?)

2. Do your homework. Know the local laws before you brew so you are more knowledgeable and can stand your ground (if you are legally in the right).

With the wonderful help of Paul Gatza and the AHA I

(continued on page 50)



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Content / Inhalt : 12 g

Best before date : see back

Mindestens haltbar bis : siehe Rückseite

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by Ray Daniels



A Visitor From Brewers Past

Alexander Bernard Scrooge. He had lived with the name all his life, but until this night the implications of it had never fully occurred to him. Now, the dream made that hard to ignore.

For A.B. (as his friends called him), the name of "Scrooge" was a minor annoyance, nothing more. But it appears that all had started to change just a few months ago. Last spring, a buddy had invited him over to participate in a homebrewing session. A.B. was introduced to the sweet glory of malt, the inscrutable pungency of hops and the timeless mystery of yeast. In just one day, he was hooked.

Over the summer he had read several good books on homebrewing and added a few additional titles like the recently published *Brew Like a Monk* to his Christmas list (wink, wink). When the weather turned cool again in the fall, A.B. started to brew. He made a few extract batches at first and then started to add some steeped and partial-mash grains. Now he was even beginning to think about tackling an all-grain brew.

That was until last night. He groaned as he thought about the dream again. It all seemed so real—and yet it must have been a dream. He thought back to the previous night. Suffering from a bit of insomnia, A.B. had heard the 12 chimes of his grandfather clock as the midnight hour arrived. But it did not come quietly, ushering in a wind that swept through his bedroom even though the doors and windows were shut tight.

When he sat up and opened his eyes in alarm, he was greeted by an ethereal guest clad in white overalls, calf-high rubber boots and what appeared to be a hairnet. A.B. might have been frightened, except

that this visitor looked damn silly in the hairnet—that, and he held a pint glass filled with amber liquid and topped with a layer of foam. A faint aroma of Cascade hops reached A.B.'s nose—the unmistakable scent of IPA.

"Got another one of those?" A.B. asked the guest, nodding toward the pint glass. "I could use some hops to help me get to sleep."

The guest nodded and smiled. "I'll give you a taste of this one, if you like," he said. "But I wager you won't like the flavor of it."

"Why not?" queried A.B. "Is it infected?"

The visitor smiled slightly, making clear that he knew something that A.B. did not. "No, not infected. Infections are something the brewer does not intend. This beer tastes quite the way that its maker anticipated."



"Great!" said A.B., "I'd love to give it a taste."

"Very well," said the visitor. He nodded and the glass floated out of his hand toward A.B. But a strange thing happened as it approached: the contents of the glass

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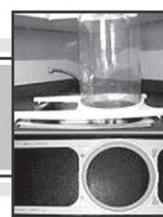
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turned from amber to black and the once plentiful foam disappeared, leaving a flat black puddle in the glass.

When A.B. apprehended the glass from its mid-air course, he checked carefully for strings, transparent shelves and the like. "Neat trick," he thought. The beer itself was neither warm nor cool, but rather something like room temperature. He sniffed at it and found not the crisp hoppiness that he had whiffed from across the room, but rather a sour, lactic tang that would better suit a lambic than an IPA.

"Hey," A.B. griped to the visitor, "What happened to that nice IPA you were holding?"

The visitor seemed more distant now, a bit paler and more indistinct than before. “IPAs come later,” he said. “What you hold now is a London Porter from 1805—a 200-year-old ale that most modern brewers would kill to taste.”

A.B. had heard about homebrewers who recreated historical brews and figured that must have been this guy's gig. With a shrug of the shoulders, he lifted the glass to his lips and took a sip.

Undetailed for more than two centuries, the flavor of that old porter remains elusive: A.B. recoiled immediately after swallowing.

"Oh, by Gambrinus, that is terrible stuff," he exclaimed, although he had no idea why he chose this moment to start swearing by an ancient brewing legend.

And he had no time to ponder just why that porter was terrible. When he looked up, his bedroom had disappeared and he stood next to the strange visitor in what was apparently a brewery—a very old brewery by the looks of it. Two men stood before a series of tankards, each apparently filled with porter.

The first man, a rather well dressed gentleman, spoke first: "How much brown malt in this brew?"

"Oh, none at all sir," said the second man. He was clearly a workingman, clad in rough clothes and well-worn boots. He was most likely a brewer as flecks of malt adhered to his shirt.

"Good," the first nodded with satisfaction, "that will lower costs, for sure." He picked up the first tankard and peered into it. "Nice dark color so that it looks as if it has a generous portion of brown malt in it. How'd you do that?"

"Yes, sir. We tried soot, but it was a bit too rough. We've settled upon burnt sugar to give the color."

"Sugar! Why, if you replace all the brown malt with sugar, it will cost just as much to make. That will never work."

"Oh, don't worry sir. It takes only a small portion of burnt sugar to provide the coloring. I wager it shall prove quite economical."

"Hmmm. I see. But what of the kick? Won't the punters complain if it hasn't the needed potency?"

"Yes sir, our competitors at Thrall had that problem when they went off brown malt, but they seem to have corrected it now."

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"Well sir, they seem to be using a bit of tobacco, although I've heard that they also tried a bit of opium as well."

"Both quite costly," he mused. "Are there other alternatives?"

"Yes, sir. We've made one batch using a substance called strychnine. At the levels we've used they say that drinking a quart of it will have the same effect as drinking twice that amount of full-strength porter."

"Twice the amount, eh? I suppose that could give us the edge we need to bring more trade to our pubs."

"Would you care to try that porter, sir?"

"No, thank you very much. I've heard of strychnine and I don't care to become a consumer myself. Are there any other alternatives?"

"Of course sir. One that appears to be gaining favor among smaller porterhouses is called coccus indicus. It is a berry from Ceylon that the natives there use to paralyze fish so they can be caught by hand."

"I see. And have you brewed a batch with it? Did you serve it to our own porters?"

"Yes sir. They seem to have found it quite agreeable."

"Good then, we'll remove the brown malt and use a bit of burnt sugar along with this coccus indicus to make the new brew. Carry on."

"Yes sir!" And as the workingman nodded, nearly took a bow and left the scene, A.B.'s mysterious visitor touched A.B.'s arm.

"Is that what I drank?" fretted A.B. "Beer made with burnt sugar and some narcotic berry?"

"Fret not my friend, you drank little of this brew—no matter what it contained. Instead of thinking of yourself, think of the people of London who consumed such brews by the quart each day. Think what it did to their health and well being."

"Ah, true!" A.B. replied, feeling somewhat

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guilty. "But I don't understand what brewer would do such a thing. Who was that gentleman and why was he dictating the contents of a beer he wouldn't drink himself?"

"That gentleman was the owner of this brewery—a brewer, after a fashion. But as you could see, his motivations involved money rather than the flavorful pleasures of beer."

"He is a brewer, but he does not love beer?" A.B. asked. "What tortured soul would find fulfillment in poisoning a generation for their own profit rather than making a wholesome, flavorful product that the people would love?"

And as he spoke those words, A.B. found himself back in bed, empty handed and alone except for the wind, which had returned to whip things around again. The words of his visitor resounded in the room.

"A.B., you have become a brewer and you inherit the lineage of the brewers who have gone before you. You can choose how you brew, what you make, how it tastes and what it contains. I have shown you the scurrilous side of brewers past, rogues who cared not for those who drank their beer.

"Let this be a lesson to you. As a brewer, you have a responsibility to those who

drink your ales and lagers. Never forget that, A.B."

"OK," said A.B., making a mental note to look up "scurrilous" next time he was near a dictionary. "But does that mean I can't experiment? That I can't try strange things in my beers?"

"No, A.B. Innovation is the brewer's birthright. But any thinking person can tell the difference between food and poison. Embrace beer as food and explore it as legions before you have done, making that which appeals to you and which you find to be flavorful and wholesome."

"Right, got it," said A.B. quietly. Sensing that this strange visit was almost over, he realized that insomnia was still upon him. "Hey, before you go—any chance you could float a nice hoppy IPA into my hand?"

Just then, the wind calmed and his room became quiet again. A.B. looked around in the gloom hoping to see an amber pint headed his way. But instead, he heard the now faint voice of the visitor, saying: "Sorry A.B. You're a brewer, you'll have to handle that one on your own."

Ray Daniels is executive editor of Zymurgy and the author of Designing Great Beers.



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by Professor Surfeit



Don't Lag Behind

Dear Professor,

I'm worried. I have been on somewhat of a quest to further understand and improve on "lag time" in my homebrewery. I've had a few worts come out slightly sour and I'm trying to eliminate the possibility of poor lag time and possible bacteria growth during the lag time as a culprit.

I know that, in general, it takes anywhere from five to 15 hours to see active fermentation begin. However, it seems that about 95 percent of the time, my worts take upwards of 17 hours-plus until I see kraeusen activity in the glass carboy. With my last experiment, I pitched two vials of White Labs yeast and shook the carboy for some extra time (mini-mash/extract brew, 2 gallons of wort to 3 gallons cold water). I assumed that this would have sufficed in providing enough oxygen for a faster start).

So what gives? My trained eye doesn't seem to know what a "raised airlock" looks like (maybe the wort is fermenting sooner and I just don't know it?). Is this another "don't worry" situation? Any further suggestions or advice in this regard? What types of bacteria could be growing during lag time in an impeccably cleaned, closed glass carboy anyways?

Thank you,
Metal Larzz

Dear Metal,

Are you really sure you are getting bacteria spoilage? If you've brewed cleanly and not introduced bacteria through carelessness, even a 24-hour lag time shouldn't hurt. Sometimes a small amount of acidity is due to other things besides microorganisms.

Your wort might be too cool. Try keeping it between 70 and 75° F for the first 12 hours or

so and that should shorten lag. At first signs of ferment, then proceed to cool.

Lactobacillus, pediococcus and wild yeasts are usually the common culprits. Evidence of their presence can actually be seen as a "ring" around the inside neck of your filled bottles after a couple of weeks in the bottle. The small amount of crud on the surface of your bottled beer would surely indicate a contamination. But even if you see the ring of crud, this still could be a microorganism that is not devastating to the flavor of your brew, at least in the short term.

Hope this helps,
The Professor, Hb.D.

Things Aren't Looking So Jolly

Dear Professor,

I have been brewing off and on now for some 20 years and have enjoyed reading your column. Now I'm posing a question, which goes to show if you live long enough you will need professional help!

I have started a brew from the book *Clone Brews* by Tess and Mark Szamatulski, a "Samiclaus." It's a Christmas beer at about 14 percent alcohol by volume upon finishing, one year later. This recipe calls for a second fermentation stage with Champagne yeast. It appears that I'm stuck at this stage, since the specific gravity has become very stubborn, continuing to hover around 1.120 from a start of 1.152 lagering (Wyeast 2308).

I have pitched a dry Champagne yeast into it and waited one month, checking the specific gravity. No change. So next I got Champagne Wyeast 3021, which swelled and definitely showed signs of life. I next boiled yeast nutrients in a small portion (about 2 cups) of wort, cooled it and combined the two into the fermenter, slightly whipping it to add a little more O₂ so that the yeast would be kind to me. Yet no continued evidence of further fermentation! The final specific gravity goal is 1.028 to 1.034. Right now it makes great alcoholic pancake syrup, but I desire the

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brandy-like Christmas beer the Swiss are famous for during the holiday season.

At this rate I will be committing brewing hari-kari by adding Everclear on Christmas to reach the ABV of 14 percent. Please advise in order to save Saint Nicholas this year!

Cheers,
Bill Brock
Killeen, Texas

Dear Bill,

Going from an original gravity of 1.150 to 1.030 comes out to be 16 percent alcohol by volume by my calculation! That is liquid rocket science! But you're stuck at 1.125. That is a problem. Seems you never got liftoff. If I were in your carboys I'd ask for dilution.

Get the gravity down to yeast friendly density. We're talking salvage at this point. I'd add a gallon of water. This should dilute the brew to about a 1.100 equivalent original gravity. Wyeast 2308 was definitely not the yeast to try using for such a high gravity. This yeast was meant for Bavarian-style lagers of much lower gravities.

They probably imploded from the osmotic pressure of the wort. May their hulls rest in wort.

You may have gotten away by using an alcohol-tolerant doppelbock type yeast, but even at 1.150 that is quite high. Try a low ester

strong alcohol yeast at 70° F. You might try a Champagne yeast if this doesn't work.

You could add some enzymes like amyloglucosidase, such as AMG3001, and an alpha amylase enzyme such as termamyl, but they

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would thin out your beer and you might not end up with any body. These enzymes I'm told are quite uncontrollable.

Other methods for making very strong beers include fermenting a batch with an original gravity between 1.090 and 1.100 (or wherever you are sure to get a good startup fermentation) and then "feeding" it with more malt, yeast, enzymes and nutrients. That's a tricky maneuver, but with try, try again tactics and some persistence you can get there.

Jingle your bells,
The Professor, Hb.D.

Kegging with Corn Sugar

Dear Professor,

I have a question concerning your suggestion in the July/August 2005 *Zymurgy* about kegging with corn sugar. Your recommendation was to use 40 percent of the amount that one would commonly use in bottling. I have quite a different approach. I have never found even an equal amount of priming sugar to suffice, so I use 10 percent *more* corn sugar when I naturally carbonate in the keg versus bottling. I find this to approximate quite well the CO₂ needed for various styles of beer, and I don't get reports

from other brewers that my kegged beers are overcarbonated.

Any idea on what might cause the discrepancy between our two viewpoints? A 20 to 30 percent difference I may write off as just personal preference, but 70 percent I just cannot grasp. In your response in the magazine, you did not go into detail about how you arrived at your 40 percent number.

Many thanks and come back and see us anytime in St. Louis.

Take care,
Sean Sweeney
St. Louis Brews

Dear Sean,
In my 35 years of brewing I've never heard that more corn sugar in the keg works well. Wow. Now then you only give me percentages and don't give me the actual amount you are using in the bottles.

My standard is 3/4 cup of corn sugar for 5 gallons of bottled beer and 1/3 cup for 5 gallons of kegged beer.

Perhaps being from St. Louis you are serving your beer at 32 degrees cold, but probably not. But if your beer is served that cold, then perhaps a little more corn sugar will suffice. If you are serving at 45 to 55° F then I would still stick to my standards.

Now then there are other factors: hose length and diameter and draft dispensing plumbing. Perhaps my system creates too much foam and I need to cut down on my sugar. Perhaps your system is technologically perfect and you find you need to add a bit more sugar.

But judging from the fact that I have never, ever had anyone write me a nasty note complaining that the 1/3 cup to 5-gallon kegged beer standard was false, I'd have to stick to my hoses for most homebrewers and their systems.

Thanks for taxing my feeble brain,
The Professor, Hb.D.

Hey homebrewers! If you have a brewing-related question for Professor Surfeit, send it to "Dear Professor," PO Box 1679, Boulder CO 80306-1679; fax 303-447-2825; or e-mail professor@brewersassociation.org.

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This Holiday, Give the Globe.

by Zymurgy staff

Baltic Porter Picking Up Steam

If stout is the potent progeny of the early porters, the Baltic porter could be called the stepson of imperial stouts.

During the czarist rule of the late 18th century, Britain did a brisk trade in extra strong imperial stouts to Russia and the Baltic states. When shipments pattered out after the Russian Revolution, the taste for big, bold, black beers remained. Local breweries from Scandinavia to Poland took up the slack, producing their own potent potables under the porter tag.

But these porters were a far cry from what the workingman was drinking in London. The Baltic porters were stronger—from 7.5- to 9.5-percent alcohol by volume. And, because the breweries producing them were mostly lager breweries, Baltics were often brewed with lager yeast strains.

During the Cold War, Baltic porters were virtually unheard of in the United States. But recent years have seen a number of the strong, bottom-fermented porters appearing on U.S. shelves. U.S. craft brewers, both amateur and professional, have taken

a shine to Baltic, or imperial, porters. The style is even included in the 2004 edition of the Beer Judge Certification Program's Style Guidelines. Baltic porter is the style for the November/December Club Only Competition.

Baltic porters are complex brews, drawing comparisons to many other classic beer styles. They are dark and strong, with smooth alcohol warming like imperial stouts. They offer big, malty sweetness with hints of raisins and molasses, like old ales. They have a

schwarzbier's light roastiness and the crispness of a lager.

The key to brewing Baltic porters is achieving a rich, malty sweetness with just the right roasty balance, while avoiding any burnt flavor or aroma. Debittered chocolate malt, black malt, brown and amber malts are all common. You may also try crystal malts or adjunct sugars such as molasses.

Hops play a minor role in Baltic porters. Any Continental or noble hops will do, but don't overdo it. There should be no hop aroma

Baltic Porter

Ingredients for 5 U.S. gallons (19 liters)



1 can	Coopers Light Malt Extract
1 can	Coopers Amber Malt Extract
1 can	Coopers Dark Malt Extract
0.5 lb	(0.23 kg) 60 L Crystal Malt
0.25 lb	(0.11 kg) CaraVienne Malt
0.25 lb	(0.11 kg) Carafa Malt
0.5 lb	molasses
3.25 oz	(92 g) Polish Lublin Hops*, 4.0% alpha acid (90 minutes)
0.5 oz	(14 g) Polish Lublin Hops*, 4.0% alpha acid (30 minutes)
	*You may substitute Saaz hops if you cannot find Lublin.
	White Labs WLP830 German Lager or Wyeast 2308 Munich Lager Yeast
1.25 C	(296 ml measure) Coopers light dry malt extract for bot- tling

CLUB ONLY COMPETITION

Category 12C Baltic Porter

Entries due October 21, 2005. Judging will be held November 5.

Shipping Address:

AHA COC, c/o Neill Acer
West End Brewery
2911 Broadway
New York, NY 10025

Hosted by Brian Lanius and the Ruffian Brewers of Suffern, N.Y. For more information, contact Brian Lanius at Brian@lanius.org.

Original Specific Gravity: 1.084

Final Specific Gravity: 1.018

IBUs: 29

ABV: 8.9%

Directions

Steep grains at 150° F in 1 gallon of water for 20 minutes. Remove grains and sparge with 1 gallon of 170° F water. Stir in extract and molasses then bring to a boil. Add first hop addition. Boil for 60 minutes then add second hop addition. Boil 30 minutes more then transfer to fermenter filled with 3 gallons of cold water (top-up to 5 gallons if necessary). When wort temperature is below 70° F, pitch yeast from starter and aerate well. Ferment at 47-52° F for two weeks. Transfer to secondary and ferment at 57-62° F for four weeks. Lager at 40° F for two months. When lagering is complete, bottle with 1.25 cups of Coopers light dry malt extract.



ON THE WEB

BJCP Style Guidelines

www.bjcp.org

Club Only Competition

www.beertown.org/homebrewing/schedule.html

and hop flavor and bitterness should be minimal, just enough to keep the sweet malt flavor from becoming cloying.

For historical accuracy, you can brew your Baltic porter with a lager yeast and lager for up to eight weeks. Or, you can take the approach of many American craft brewers and ferment with an ale yeast for an imperial porter. In either case, a prolonged period of cold conditioning will improve your beer and help round out all of the complex flavors.

Baltic porters pair well with rich desserts and full-flavored cheeses. They also complement shellfish, much like their brethren stouts.



AMERICAN HOMEBREWERS ASSOCIATION KUDOS

Sanctioned Competition Program Best of Show

July 2005

Garfield Hts. Homedays, 10 entries—*Richard Skains of Rocky River, OH.*

6th Annual Mammoth Brewing Homebrew Competition, 55 entries—*Jon Peterson of Poway, CA.*

E.T. Barnett Homebrew Competition, 66 entries—*Rob Beck of Kansas City, MO.*

Iowa State Fair, 114 entries—*Robert Dawson of Nevada, IA.*

Ohio State Fair Homebrew Competition, 126 entries—*Paul Shick of Cleveland Heights, OH.*

Orange County Fair Homemade Beer Competition, 160 entries—*Jeff Toland of San Juan Capistrano, CA.*

August 2005

Benton/Franklin Fair, 18 entries—*Perry Lamprey of Kennewick, WA.*

Grant County Fair, 22 entries—*Robert Flores of Othello, WA.*

Montgomery County Fair, 82 entries—*Ed Bielaus of Rockville, MD.*



CALENDAR

For complete homebrew event listings, see www.beertown.org/homebrewing/events.asp.

October 21–23

10th Annual Music City Brew-Off Nashville, TN. Sanctioned by: AHA/BJCP. Fee: \$6. Entry Deadline: 9/26–10/12. Contact: Tom Vista, Phone: 615-331-7567, Email: hopgod848@comcast.net Web: www.musiccitybrewers.com

October 29–November 5

Coconut Cup Miami, FL. Sanctioned by: AHA/BJCP. Fee: \$6. Entry Deadline: 10/17–26. Contact: Denise Graham, Phone: 305-227-0848, Fax: 305-221-4777, E-mail: sndg@bellsouth.net Web: <http://hbd.org/mash/coconut.html>

October 29

Oktobersbest Homebrew Competition Cincinnati, OH. Sanctioned by: AHA/BJCP. Fee: \$6 first entry, \$4 additional. Entry Deadline: 6/1–10/18. Contact: Rick Franckhauser, Phone: 513-921-4945, E-mail: franckenbrew@fuse.net Web: www.maltin-fusers.org

November 5

Franco-Belgian Challenge Madison, WI. Sanctioned by: BJCP. Fee: \$5. Entry Deadline: 10/12–11/2. Contact: Mark Schnepper, Phone: 608-821-4140, E-mail: mschnepper@yahoo.com Web: www.mhtg.org

November 5

10th Knickerbocker Battle of the Brews Albany, NY. Sanctioned by: AHA/BJCP. Fee: \$6. Entry Deadline: 10/14–28. Contact: Reed Antis, Phone: 518-796-9051, E-mail: reedmary@capital.net Web: www.moonbrew.com

November 5

2005 THIRSTY Classic Iowa City, IA. Sanctioned by: AHA/BJCP. Fee: \$6. Entry Deadline: 10/19–29. Contact: Susan Walsh, Phone: 319-337-5742, E-mail: susan-walsh@uiowa.edu Web: www.thirstyhomebrew.org

November 5

AHA Teach a Friend to Homebrew Day Contact: Gary Glass, Phone: 888-822-6273 x 121, Fax: 303-447-2825, E-mail: gary@brewersassociation.org Web: www.beertown.org/events/teach/index.html

November 12

Foam On The Range 2005 Denver, CO. Sanctioned by: AHA/BJCP. Fee: \$5. Entry Deadline: 10/25–11/5. Contact: Tom Gardner, Phone: 303-863-0209, E-mail: tomagardner@cs.com Web: www.foamontherange.org

November 12

Michigan Cherry Festival Beer Competition Columbus, MI. Sanctioned by: AHA/BJCP. Fee: \$8. Entry Deadline: 10/25–11/7. Contact: Cassandra Britt, Phone: 586-727-5803, E-mail: sandiangary@iserv.net Web: www.richmond-worthogs.org

November 12

MALT's First Annual Turkey Shoot Edgewater, MD. Sanctioned by: AHA/BJCP. Fee: \$6. Entry Deadline: 10/15–11/10. Contact: Tim Sauerwein, Phone: 443-994-1399, E-mail: sourwine@comcast.net Web: www.maltclub.org

November 19

Hogtown Brew-Off Gainesville, FL. Sanctioned by: AHA/BJCP. Fee: \$6. Entry Deadline: 10/24–11/11. Contact: Craig Birkmaier, Phone: 352-258-2543, E-mail: craig@pcube.com Web: www.hogtownbrewers.org

January 6

Big Beers, Belgians & Barleywines Festival Vail, CO. Sanctioned by: AHA/BJCP. Fee: \$5. Entry Deadline: 11/1–12/31. Contact: Laura Lodge, Phone: 970-524-1092, Fax: 970-524-1093, E-mail: BigBeersFestival@hotmail.com Web: www.BigBeersFestival.com

January 19–21

Upper Mississippi Mash-Out Minneapolis/St. Paul, MN. Sanctioned by: AHA/BJCP. Fee: \$7. Entry Deadline: 12/26–1/6. Contact: Steve Fletty, Phone: 612-625-1048, E-mail: fletty@umn.edu Web: www.mnbrewers.com/mashout

February 11

Big Beautiful Belgians AHA Club-Only Brier, WA. Sanctioned by: AHA/BJCP. Fee: \$5. Entry Deadline: 1/23–2/4. Contact: Lori Brown, Phone: 425-771-7602, E-mail: loribrown@worldnet.att.net Web: www.beertown.org/homebrewing/club.html

February 17

23rd Annual KC Biermeisters Competition Kansas City, KS. Sanctioned by: AHA/BJCP. Entry Deadline: 2/1–5. Contact: Neava Ford, Phone: 913-432-9630, E-mail: neava@sbcglobal.net Web: www.kcbiermeisters.org

February 18

War of the Worts XI Collegeville, PA. Sanctioned by: AHA/BJCP. Fee: \$6. Entry Deadline: 1/18–2/11. Contact: Vince Galet, Phone: 215-328 2584, E-mail: vince.galet@merck.com Web: www.keystonehops.org

February 24–25

BABBLE Brew-Off 2006 Lincolnshire, IL. Sanctioned by: AHA/BJCP. Fee: \$7. Entry Deadline: 2/1–18. Contact: Dan Morey, Phone: 847-837-1069, E-mail: val.dan.morey@juno.com Web: www.babblehomebrewers.com/

March 17–24

March Mashness St. Cloud, MN. Sanctioned by: AHA/BJCP. Fee: \$6. Entry Deadline: 3/1–15. Contact: Bruce LeBlanc, Phone: 320-251-0229, E-mail: brewski@astound.net Web: www.cloudytownbrewers.org/competition

by Jill Redding

Iron Hill AHA Rally a Hit

Iron Hill's Mark Edelson knows that homebrewers are some of his best customers, so hosting an AHA membership rally at one of his brewpub locations was a great way to give something back.



About 80 homebrewers converged on Iron Hill Brewery & Restaurant in Wilmington, Del. on August 23, with about 20 of them joining the American Homebrewers Association for the first time and others renewing their membership. It was the second such rally organized by the AHA after a similar successful event at Saint Arnold Brewing Company in Houston in February.

"Homebrewers are always a great group to have in the restaurant," said Edelson, who was a homebrewer before co-founding Iron Hill in 1996. "They are some of our biggest fans."

The evening was co-hosted by Iron Hill, the AHA and three other Delaware breweries—Dogfish Head Craft Brewery, Stewart's Brewing Company and Fordham Brewing Company.

"It's always a lot of fun when the professional and amateur brewing communities come together," said Dogfish Head's Sam Calagione. "The diversity of the people involved with championing the better beer movement in America is matched only by the diversity of great beers being made in kitchens, brewpubs and microbreweries throughout the country."

The event was held on the upstairs deck of the Iron Hill restaurant, situated along

a walking path by the Christina River. Iron Hill served up its house beers from the outside bar, and a "guest bar" fea-

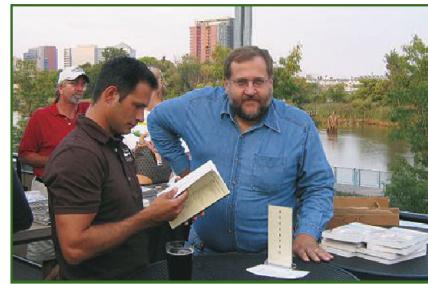
tured special beers such as 90 Minute IPA from Dogfish Head and a cask-conditioned beer from Stewart's.



The upstairs deck of the Iron Hill Brewery & Restaurant was a great party spot.



Professional and amateur brewing communities came together to talk about beer.



Lew Bryson was on hand to sign copies of his new book.



About 80 homebrewers got into the craft beer spirit on the Iron Hill deck.



Proceeds from the \$1 drafts went to two local clubs.

Homebrewers brought along several kegs to share, and plenty of appetizers were available for attendees.

Edelson said proceeds from the \$1 drafts were donated to two participating Delaware homebrew clubs, the First State Brewers and SANDALS.

"They didn't know we were going to do that until the end of the evening, so that was a nice surprise," Edelson said.

Lew Bryson was on hand to sign copies of his new book, *Virginia, Maryland and Delaware Breweries*, and several prizes donated by the participating breweries,

the Brewers Association and others were raffled off.

"I would say about 90 percent of the attendees walked away with a prize," said Edelson. "There was something for everybody."

The AHA membership rally is just gearing up, with events planned for New Belgium Brewing, Matt Brewing Company, Boston Beer, Sierra Nevada, Brooklyn Brewery, Harpoon Brewery and Deschutes Brewery in coming months. Entry into each rally is free for AHA members and \$33 for non-members, which includes a one-year membership to the AHA as well as food, beer, prizes and a copy of *Zymurgy for Beginners*. So far 76 new AHA members have signed up at the rallies with several others renewing.

Brock Wagner, who hosted the first membership rally at Saint Arnold, summed up the theme of the AHA rallies. "We talked about brewing beer. We drank beer. And we homebrewed. It was the perfect afternoon!"

Jill Redding is associate editor of Zymurgy.

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American Homebrewers Association
A Division of the Brewers Association
www.beertown.org



by Ken Schramm

Optimizing Honey Fermentation

The challenge of making mead is achieving the perfect honey fermentation—clean, with zero or absolutely minimal off flavors. It optimizes the character of a spectacular honey, yielding aromatics and flavor reflecting its finest properties.

Simply, it comes down to a series of steps: pitching a vigorous, healthy yeast population, low lag times, effortless and robust yeast reproduction, successful competition or K-factor activity, and a steady healthy ferment to completion.

Reference texts for wine production, brewing, and yeast performance and technology for the beer and wine industries number in the dozens, but at present there are none for mead. But we can begin to piece together a plan for moving mead fermentations to quality levels reserved for the finest wines and most consistent beers.

Yeast requires nutrients to grow, to metabolize sugar into ethanol and to stay healthy in the process. Everything gets into or out of the yeast cell through the cell wall, and the plasma membrane is the barrier that can disrupt fermentation or damage the cell. Membrane health is critical to maintaining healthy functions from start to finish. Keep that bugger fat and happy, and life (and your mead) is good. Fail to meet the membrane's needs, and everything deteriorates in a hurry.

Growth nutrients include carbon, nitrogen, phosphate and sulfate. Carbon is available from the sugars in the medium. Nitrogen and phosphate are problematic in mead musts.

While it has been accepted that mead musts are low in free amino nitrogen (FAN), I have been curious to know exactly "How low is low?" I set out to determine

**YEAST REQUIRES
NUTRIENTS TO GROW,
TO METABOLIZE SUGAR
INTO ETHANOL AND
TO STAY HEALTHY IN
THE PROCESS.**

the FAN content of musts from four preferred meadmaking honeys. I bought Florida Tupelo and Orange Blossom from my local farmers market, and Clover (Kroger) and Buckwheat (Private Selection) from my local grocery. I contacted Dr. Ben Gavitt at the Cornell University/New York State Agricultural Extension Service Wine Lab and arranged to have the musts analyzed as well as a sample of pure cherry juice and a finished bottle of mead.

The Procedure

To approximate a standard gravity mead must, I measured 100 milliliters of honey into a sanitized Pyrex vessel, and diluted that to 400 milliliters with steam distilled water. I dissolved the mixture by stirring with a sanitized spoon, and transferred 100 milliliters of the mixture to a sterile vial. I used the remainder of the liquid to measure and record the specific gravity of all of the samples. The samples were shipped via FedEx to NYSAES Lab.

Analyses

Sample 1, the Tupelo, received a FAN analysis along with a sterility check. The other must samples received only FAN analysis. The finished mead received residual sugar analysis, ETOH, sterility check and a microbial analysis.

Gavitt reported that all samples arrived in good condition, and showed no signs of



fermentation. He indicated that while there may be variances in FAN levels due to testing regimens, the numbers are accurately representative of FAN levels in mead musts.

Results

The Florida Tupelo must had an OG of 1.110, and contained 10 parts per million FAN. The sterility check showed $>1 \times 10^6$ yeast/100 milliliter, typical of *Saccharomyces*, but most importantly, 0 Viable Bacteria/100 milliliter. That finding indicated that the practice of preparing traditional mead musts without heat or the use of sulfites may be capable of producing a good medium for clean fermentations.

Sample 2, the Florida Orange Blossom, had an OG of 1.110, with 5 ppm FAN. The must from Pure Clover (Sample 3) also registered an OG of 1.110 and 14 ppm FAN. Sample 4, the Buckwheat, had an OG of 1.106 and 21 ppm FAN, reinforcing the widely held belief that darker

musts contain more nutrients. Still, 21 ppm is a long way from the 300 ppm most winemakers seek from a wine must destined for more than 12-percent alcohol.

Obviously, the amount of FAN in these musts is well below what is needed for a healthy fermentation. The actual FAN compounds in the honeys I had analyzed

and glutamic and aspartic acids. While the variety of amino acids is largely positive, their concentration in a must dilution is perilously low. Interestingly, the most prevalent amino acid in honey, proline, cannot be assimilated by yeast.

TARGET NITROGEN LEVELS		
Brix range of must	S. G.	Target YANC* Level
21	1.087	200 ppm
23	1.096	250 ppm
25	1.106	300 ppm
27	1.115	350 ppm

REFERENCE: Bisson and Butzke
SG Conversions: USDA Tables

*YANC is Yeast Available (assimilable) Nitrogen Content, which combines all available nitrogen from both organic (amino acids) and inorganic (ammonia or urea) sources.

Sample 5 was pasteurized cherry juice from Swanson's Juice Mill in Bear Lake, Mich. Its OG was 1.047, and it contained 262 ppm FAN, above the level of 200 ppm commercial winemakers would consider adequate for a lower gravity must. That said, most meadmakers would not use more than 1 and perhaps 2 gallons of juice in 5 gallons of must, and that dilution would leave the available nitrogen levels below the optimal range.

were not determined, but there is some information on amino acids in honey from Dr. Jonathon White's "Composition of Honey," published in "Honey, A Comprehensive Survey," edited by Eva Crane, Britain's master authority on honey.

White documents a number of important amino acids in honey, including compounds with high yeast uptake levels such as lysine, methionine, isoleucine, leucine,

Vitamins and Minerals

As the yeast population makes the transition from growth to fermentation, its needs change to include the sugar that it will gather from the must, and vitamins and minerals to conduct its metabolism. The most critical of the vitamins is biotin, but the yeast needs thiamine, niacin, pantothenate, and the minerals magnesium, calcium, manganese, potassium, zinc, iron and copper. Many of these micronutrients are utilized in the process of transamination, in which amino acids are broken down and then reassembled by the cell to build the lipid layers in the plasma membrane. Nitrogen is also a metabolic need. During the fermentation, nitrogen is used in transporters that move sugars across the plasma membrane against the concentration gradient.

"Biotin takes part in all major biochemical reactions that involve protein synthesis, in nucleic acid synthesis, in carbohydrate metabolism, and in the synthesis of fatty acids. Its deficiency is clearly shown by poor growth and damaged plasma membranes." (Yeast Technology, Reed and Nagodawithana).

Reed and Nagodawithana document biotin levels in average beer wort of .56µg/100 ml. Levels in undiluted honey are quoted by Kitzes, et al, at .066µg/100g, which would represent one-quarter to one-third of the levels found in a honey must. Thiamine (vitamin B1) is used by yeast in amino acid synthesis. It is also needed in the sugar-to-pyruvate-to-ethanol pathway. The same two sources note levels in wort of 60 µg/100 ml, and levels in honey of ~5/6 µg/100 g. Honey musts will likely be low in pantothenate, key to the production of serine and methionine—amino acids used in the plasma membrane. Pantothenate deficiency causes yeast to produce high levels of H₂S and its characteristic rotten egg smell. Lastly, riboflavin, another key vitamin, is present in wort at 33-46 µg/100 ml and in ~5/6 µg/100 g of honey.

Minerals important for growth and metabolism in a healthy yeast population include

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calcium, magnesium, potassium, phosphorus and zinc, which are present in honey in minor to absolutely negligible quantities. The exception may be potassium.

Minerals are also a large part of the buffering capacity of must. Clayton Cone notes that potassium levels above 300 ppm are critical to maintenance of pH levels. Haydak, et al, reported levels from 100 ppm in light honeys (not enough) to over 4700 ppm in darker honeys (more than enough). The average of 205 ppm for light honeys, however, would predict a substantial shortfall when diluted with water at ratios of 3:1 or 4:1. When potassium levels drop below 300 ppm, pH levels in the cell can drop below 2.7, and metabolic activity will virtually cease. Especially in the case of traditional and show meads, early monitoring of the pH is a wise preventative measure. Bisson also comments on the need to establish potassium levels early, as well as the strong possibility that potassium plays a role in strengthening the plasma membrane's resistance to ethanol toxicity.

As the fermentation progresses, environmental and metabolic stress on the plasma membrane increases. Several key functions rely heavily on good membrane health, including:

1. Transport of a declining supply of sugar from the medium into the cell.
2. Transport of ethanol and CO₂ through the membrane out of the cell.
3. Maintaining resistance to ethanol absorption into the cell through the membrane against an increasingly hostile concentration gradient.
4. Absorption of ongoing metabolic nutritional needs and survival factors.

Thus it is important to build healthy cell wall mass during lag and growth phases, and to maintain it during the entirety of the stationary phase.

Fermentation Protocols

I have been utilizing staggered additions of a combination of 1 gram diammonium phosphate (DAP) and 0.5 gram Fermaid K (Lallemand's micronutrient blend) at pitch and at 24-hour intervals for three days. Fermentation times have been reduced, and the resulting meads have been of very high

quality, requiring less aging to reach drinkable maturity.

Lallemand recommends rehydration of the yeast in water supplemented with the organic nutrient Go-Ferm. The yeast membranes are devoid of a number of micronutrients needed to develop the yeast biomass required for high gravity musts and the subsequent stress of higher alcohol levels later in the fermentation.

Cone stresses the importance of keeping the yeast in the growth phase. "Yeast produce 33 times as much alco-

hol per cell during the growth phase than it does in the stationary phase. So there is an advantage to keeping the yeast growing as long as possible. There is also an advantage to adding the DAP in as many increments as possible. This keeps the yeast growing as long as possible and also keeps a fresh supply of N available for the yeast to metabolize and build up its protein content." The yeast will also continue to absorb and utilize oxygen in the growth phase. For winemakers, the practice of pumping over would get that oxygen into the fermenting must.

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The goals are to prolong the growth phase as much as possible without overfeeding the yeast, to provide a source of micronutrients and to supplement potassium levels, in particular the lighter-colored honeys with lower mineral levels. For traditional 5-gallon mead fermentations with a gravity above 1.120, the keys are:

1. Rehydration at 104° F with Go-Ferm or other organic rehydration nutrient at a rate of 1.25 grams nutrient per gram of yeast. In all cases, addition of nutrients by weight will be more accurate than by volume. Volumes are included for the convenience of those without the benefit of gram measurement devices. This

equates to 3.0 lbs/1,000 gallons.

2. Addition of 3 grams (approximately 0.75 teaspoon) Fermaid K, plus 4 grams (1 teaspoon) DAP per 5 gallons of must with a vigorous aeration at the end of the lag phase (six to 12 hours, at the start of obvious fermentation activity). This equates to 21 ounces Fermaid K plus 28 ounces DAP per 1,000 gallons. For gravities above 1.125, increase these amounts by an additional 25 percent.
3. Addition of 1 gram (0.25 teaspoon) DAP, plus 1 gram (0.125 teaspoon) Fermaid K with a vigorous aeration at 12-hour intervals until 50 percent sugar depletion or five days, whichever occurs first (7 ounces DAP plus 3.5 ounces Fermaid K per 1,000 gallons).
4. Supplementing the potassium levels to a minimum of 300 ppm with a potassium source. Food grade potassium hydroxide is an option for commercial meadmakers, but its handling and use would be problematic on smaller scales. For home meadmakers, potassium bitartrate or potassium phosphate are viable options.

Role of pH in Better Detail

Drs. Roger Morse and Keith Steinkraus established many years ago that low pH in a fermenting mead must can lead to a slowdown in fermentative activity and a prolonged and unhealthy fermentation.

Bisson explains the phenomenon in her text on fermentation for her course at UC-Davis. Movement of amino acids across the cell membrane (by transporters, or trans-permeases) is coupled to proton movement into the cell. Those protons must then be transported out of the cell by ATPase pumps (at the expense of one ATP > ADP hydrolysis per transport). When the pH drops, additional protons enter the cell due to passive proton flux. If the number of protons inside the cell wall exceeds the capacity of the ATPase pumps in the membrane to evacuate them, amino acid uptake slows and fermentative activity is reduced.

Bisson also notes that fermentations that falter and stick can be extremely difficult to restart, making the maintenance of an appropriate pH all the more important.

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No-Heat Methods, Melomels and Metheglins, and Microorganisms

In *The Compleat Meadmaker*, I make the case for preparing mead musts without the use of any heat or must sanitation processes beyond the requisite rigorous adherence to equipment sanitation. Although traditional mead musts may be largely devoid of competitive microflora, the application of that method to melomels and metheglins creates a window of opportunity for any organisms that come to the must through fruits or spices. That fruit can bring a load of microflora is obvious; less obvious is the fact that the environs in which spices are harvested—and the processes by which they are prepared for market—are rife with poor sanitary practice and opportunity for exposure and contamination.

The threat from microflora on fruit appears to be backed up by the analysis of the finished raspberry mead I sent to the Cornell lab.

Sample 6: Raspberry Mead

15.0 lb (6.8 kg) Michigan raspberries

15.0 lb (6.8 kg) Raspberry Blossom Honey

0.5 tsp DAP

0.25 tsp Fermaid K at pitch, 24, 48 and 72 hours.

Original Gravity: Unknown

Final Gravity: 1.002 (corrected to 1.009 post lab)

Analysis Data:

ETOH: 14.1%

Residual sugar: 3.7% (w/v)

Glucose: 25.6 g/l

Fructose: 11.9 g/l

Viable yeast/100 ml: 5

Viable bacteria/100 ml: >1 x 106

Comments: "Yeast typical of *Saccharomyces* strains. Bacteria are long rods forming short chains (*Lactobacillus*)."

The bacterial population in this sample is considerable. Several possible sources of contamination include process, equipment (racking cane, bottles, cork, which receive the same sanitation practices as the "clean" sample) and the lead suspect, fruit. Possibilities are airborne and bird- or insect-carried bacteria and yeast, bug parts or

extraneous plant matter. Data aside, this mead was very tasty, and was well received by different audiences at several tastings.

Fruit and spices will add organisms that compete with your yeast population, not only for food, but also for nutrition. The growth needs of bacteria and wild yeast strains are in most cases almost identical to those of your chosen/pitched yeast strain—nitrogen, oxygen and B-vitamins. If the competing microflora are at phases that allow them to consume and utilize the available must nutrients, they will have a huge advantage in their war to dominate the environment and compromise your fermentation.

My initial conclusion from this data was that the use of sulfites might be preferred to minimize bacterial contamination. On further thought, however, the recommended procedure is to prepare and initiate fermentation in a smaller honey must. For a 5-gallon batch of a fresh fruit melomel, start with 2.5 gallons of water and 8 pounds of honey. Rehydrate yeast with Go-Ferm or equivalent and water at 104° F. Aerate the must thoroughly and pitch. When the must has moved through the lag, add 3 grams Fermaid K (1.5 tea-

spoons). When the must is fermenting vigorously (two to three days), add the fruit or pressed fruit juice and the remainder of the honey. This will create a healthy yeast population to compete with any bacteria or wild yeast present on the fruit. Continue with staggered additions of DAP at 1 gram or 0.25 teaspoon every 12 hours, plus 0.5 gram Fermaid K (0.125 teaspoon) until 50 percent sugar depletion. These numbers can be scaled to commercial volumes.

It is important to note that microflora may be present and capable of activity beyond the point at which the yeast ceases fermentation. Especially in musts that may finish with considerable residual sugar because the yeast has reached ethanol tolerance, or those that finish with low alcohol levels (below 10 percent), or both, it is critically important that the amounts of nutrient used do not exceed that which will be consumed by the yeast during growth and fermentation. Excess nutrient at that point will simply serve to nourish organisms that may harm your mead.

Ken Schramm is author of *The Compleat Meadmaker*.



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Big Beers, Small Sugars

Making Wort For Extreme Beers

Just as you can't cut a "normal" recipe in half and make a small beer, you can't simply double or triple a recipe and make a big beer. Aside from getting lots of sugars into the fermenter, you will need to make some adjustments to the recipe as well as to the process in order to make the best beer possible.

Fermentability

Big beers can be very thick, almost syrupy, if not attenuated enough. Attenuation is the amount a given yeast ferments a given wort. The composition of the wort and the yeast strain used determines the level of attenuation. This affects the residual sweetness and body. For example, if you were brewing a beer starting at 1.100 and you end up with a 1.035 finishing gravity, your beer has an apparent attenuation of 65 percent. At 1.035, a beer can be quite sweet and full-bodied. Certainly you could balance the sweetness with more bitterness, but it can end up a less drinkable, cloying beer. In general, the bigger your beer, the more fermentable the wort needs to be.

For big beers, you often need to drop your mash temperature or use a more fermentable extract to ensure your beer attenuates sufficiently. Higher mash temperatures favor alpha amylase and result in a wort with more longer-chain sugars, which most yeasts do not ferment. Beta amylase, which creates more fermentable sugars, is most active around 149° F (65° C), so a mash schedule that includes a long rest around 149° F (65° C) is usually best for really big beers.

One trick often used in brewing higher alcohol beers is the use of simple sugars such as table sugar (sucrose). While we've all heard that we should make all-malt beers to avoid a cidery, thin beer, the use of simple sugars can be a good thing in a big beer. It has very little flavor, ferments completely, boosts the alcohol content and keeps the body much lighter and more

By Jamil Zainasheff

drinkable. Belgian brewers are known for their liberal use of simple sugars like candi sugar. Some Belgian brewers use as much as 30 percent sugar to keep the attenuation high and the body restrained. Of course, too much simple sugar can result in a beer with a "hot" alcohol character, so keep it to less than 30 percent of your fermentables.

Peter Zien, owner of AleSmith Brewing Company in San Diego, Calif., uses 11 percent simple sugars (half dextrose and half candi sugar) in his award-winning Horny Devil ale. This complex Belgian

strong ale is huge, yet light to medium in mouthfeel with a dry finish. Zien says, "Sugar is the key to reaching a high gravity while maintaining the dry yet just-sweet-enough profile of a Belgian-style strong ale. A similar ale made without sugar would reach disturbing and unappealing levels of cloying sweetness."

Zien has spent extensive time in Belgium sharing beers and techniques with his peers at some of the finest Belgian breweries. "I was surprised to find that many well-respected Belgian brewers do not use the expensive and hard-to-work-with

candi sugar," Zien says. "They've opted for plain cane and corn-based sugars. The high phenol and ester levels of the Belgian yeast strains easily control and contain any cider-like aromas and flavors that may come with high amounts of sugar."

Specialty Grains

When formulating a recipe for big beers, keep in mind that specialty grains (crystal, roasted, etc.) do not scale linearly as you raise the gravity. Generally, if you're making a beer that is larger in gravity but not in batch size, keep your specialty grains close to the same levels as your normal beers and just step up the base grains or base extract.

Another issue to keep in mind is that during the boil, thicker worts result in higher kettle caramelization and melanoidin production. Long boil times can compound the problem. The caramelized sugars are not fermentable and add sweetness to your finished beer. In some styles such as English Barleywine or Scotch Wee Heavy, some kettle caramelization is an important characteristic of the beer, but if you want to minimize caramel character, reduce the use of crystal/caramel malts or boil for a shorter period. If you're working with extract, holding back the bulk of the extract until late in the boil can also minimize caramelization.

Hops

Hop flavor and bitterness can become muted under such a large load of malt and you generally need more bitterness and hop flavor to balance a bigger beer. Unfortunately, hop utilization suffers when boiling high gravity wort.

Scaling up a recipe by simple multiplication doesn't work very well for hop bitterness. As the gravity of the wort increases beyond approximately 1.050, hop utilization decreases. Boiling your hops in really thick wort makes hop utilization drop significantly. Doubling the gravity to 1.100 results in approximately 20 percent lower utilization than at 1.050. Use a software program like Promash or a tool like John Palmer's Home Brewing Recipe Calculator when designing your recipes; they make it easy to take into account the reduced utilization in higher gravity wort.

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Andy Tveekrem, brewmaster at Dogfish Head Brewing in Milton, Del., recommends carefully selecting bittering hops for big beers. "We use a mix of Simcoe, Amarillo and Warrior in our Dogfish 120 IPA," Tveekrem says. "All are lower cohumulone hop varieties, which gives a smoother bitterness. Avoid high cohumulone hops, as they can lend a harsh bitterness to highly hopped beers."

If you're brewing with extract, you have the advantage of boiling a portion of the extract to start, allowing for better hop utilization, and then adding the rest of the extract in the last 15 minutes of the boil. If you use this technique, make sure to keep the initial wort to less than 1.050 to get adequate utilization.

Increasing hop flavor and aroma for big beers is more straightforward and works the same as in normal gravity beers. Just keep in mind that you generally need to increase aroma and flavor hops a bit to balance the other flavors and aromas of a big beer.

WORKING WITH EXTRACT

Brewing with extract creates an advantage in crafting big beers. If you want more sugars in your wort, just add more extract. However, just as when brewing all-grain, fermentability is important and brewers should pay attention to the types of extract they use.

Certain extracts are more fermentable than others. In general, darker extracts have a greater proportion of non-fermentable sugars, though some lighter extracts have a very low fermentability. Briess, Coopers and Alexander's tend to have higher fermentability, while Laaglander is on the low side. Ray Daniels' book *Designing Great Beers* has a great chapter on working with malt extract and how to determine fermentability. Don't forget, if you don't have access to an extract that ferments to the degree you need, you can increase the overall fermentability of your wort by adding simple sugars.

Different extract brands also result in different amounts of sugars per pound. Some extracts have a higher moisture content and fewer sugars per pound overall. If you're working with an unfamiliar extract,

ask your homebrew shop what to expect for a given brand and check the gravity with a hydrometer or refractometer to ensure you get the right amount of sugars in the fermenter.

The lightest color extract on the market, and also one of the most fermentable, is the new Briess Pilsen Light extract. Bob Hansen, manager of technical services at Briess Malt & Ingredients Co., stressed

that it is most important to "buy fresh to avoid off flavors into your big beer." He adds, "Use as light a color and flavor extract as possible. Make sure the extract you use is unhopped. You want to control your flavors through your specialty grains and hop additions in a big beer."

Many of the highly flavored and hopped extracts are designed for use in normal gravity beers and will be overwhelming in

AleSmith Horny Devil Ale

Horny Devil is inspired by the curious beers produced by Trappist monks in monasteries across Belgium. The beer's dryness and strength are the result of a unique Trappist yeast strain in a warm fermentation. These attributes are subtly masked by the restrained use of premium low-alpha hop varieties. The malt flavors and fruity esters produced during fermentation create the initial impression, while authentic Belgian Candi sugar and fresh coriander add complexity to the palate.

Ingredients for 10 U.S. gallons (38 liters)

22.5 lb	(10.2 kg) Durst Turbo-Pils
5.0 lb	(2.27 kg) Gambrinus Pale Two-Row
2.0 lb	(0.91 kg) Durst Malted Wheat
0.75 lb	(0.34 kg) Flaked oats
2.0 lb	(0.91 kg) Belgian Candi Sugar (add at 10 minutes of boil remaining)
2.0 lb	(0.91 kg) Dextrose Sugar (add at 10 minutes of boil remaining)
1.1 oz	(31 g) crushed coriander seed (add at 1 minute of boil remaining)
0.79 oz	(22 g) Admiral whole hops, 14.3% alpha acid (60 min.) (22 IBU)
0.44 oz	(12 g) East Kent Goldings whole hops, 5.8% alpha acid (60 min.) (5 IBU)
1.30 oz.	(37 g) Styrian Goldings whole hops, 5.4% alpha acid (1 min.) (2.2 IBU)

Belgian-style yeast strain of your choice with the exception of the lambic and other souring blends. White Labs WLP530 Abbey Ale or Wyeast 1762 Belgian Abbey Yeast II are good choices. Excellent alternatives are White Labs WLP570 Belgian Golden Ale, White Labs WLP500 Trappist Ale or Wyeast 1388 Belgian Strong Ale Yeast.

Target Original Gravity: 1.098 (23.32 Plato)
Approximate Final Gravity: 1.009 (2.31 Plato)

Brewhouse Efficiency: 70 percent

Anticipated SRM: 5.3

Anticipated IBU: 29.3

Anticipated ABV: 11.8 percent

Wort Boil Time: 60 minutes

Directions

Single infusion mash at 149° F (65° C) using a ratio of 1.3 quarts water to 1 pound of grain. Add the 4 pounds of sugar near the end of the boil. Even though there is no practical difference between light candi sugar and beet or cane sugar, brewer Peter Zien says he continues to use a portion of the more expensive candi sugar because he enjoys the use of traditional ingredients in crafting AleSmith beers.

Ferment at 85° F (29.5° C) until yeast drops clear. Carbonate to 3 volumes and serve at 45 to 50° F (7.2 to 12.8° C).

Partial Mash Option: Replace Durst Turbo-Pils with 16.5 lb (7.48 kg) Briess Pilsen Light liquid malt extract. Mash the two-row, wheat and oats.

a big beer. Hansen advises, "Use dry instead of liquid extract to help keep color and flavor light and make sure the extract is highly fermentable or use sugar to keep the beer from being cloying."

Hansen, a former professional brewer who has won GABF medals for his extract-based beers, suggests adding a portion of your extract in the beginning and the rest at the end. "Add enough to

make a normal strength wort, holding back the rest to add 15 minutes before the end of the boil. This allows for better hop utilization and less caramelization."

Dogfish Head 120 Minute IPA

This extreme beer is boiled for a full two hours while being continually hopped with high alpha American hops. At 21 percent ABV and 120 IBU this is by far the biggest IPA ever brewed.

Ingredients for 5 U.S. gallons (19 liters)

16.0 lb	(7.26 kg) Pilsner Malt
0.5 lb	(0.23 kg) English Amber Malt 35L
11.0 lb	(5 kg) Dextrose Sugar (added during fermentation)
1.38 oz	(39 g) Amarillo pellet hops, 10% alpha acid (continuous hopping) (30.8 IBU)
1.38 oz	(39 g) Simcoe pellet hops, 13% alpha acid (continuous hopping) (40 IBU)
1.38 oz	(39 g) Warrior pellet hops, 16% alpha acid (continuous hopping) (49.2 IBU)

Mix the hops in a container and add about 0.1 oz (3 g) of the mixture every three minutes.

1.0 oz	(28 g) Amarillo pellet hops, 10% alpha acid (daily dry hopping)
1.0 oz	(28 g) Simcoe pellet hops, 13% alpha acid (daily dry hopping)
1.0 oz	(28 g) Warrior pellet hops, 16% alpha acid (daily dry hopping)

Mix the hops in a container and add about 0.2 oz (6 g) of the mixture to the fermenter every day.

White Labs WLP001 California Ale or Wyeast 1056 American Ale Yeast for the initial fermentation. For the following fermentation use White Labs WLP099 Super High Gravity Ale.

Target Original Gravity: 1.092 (22 Plato)

Approximate Final Gravity: 1.042 (10.48 Plato after sugar additions)

Brewhouse Efficiency: 74 percent

Anticipated SRM: 6.7

Anticipated IBU: 120

Anticipated ABV: 21%

Wort Boil Time: 120 minutes

Directions

Use a single infusion mash at 149° F (65° C) using a ratio of 1.3 quarts water to 1 pound of grain for the base malt. The sugar is added during fermentation. Brewer Andy Tveekrem says, "The key to making a copy of our 120 Minute IPA is to add hop pellets continuously throughout the two-hour boil. You will be adding more hops than you think are prudent. Start the main fermentation with the first ale yeast at 72° F (22° C). Two or three days later prepare a 2-quart starter for the high gravity ale yeast. After the main batch has fermented for several days or when about half the primary fermentation is done, combine the high gravity yeast starter into the main batch. Feed the fermenter twice daily with dextrose that has been liquefied with the fermenting beer. 35 to 40 percent of the overall fermentables should come from dextrose. Feed the sugar for approximately seven to 14 days. The length of time and the final alcohol level depends on yeast health and temperature. Add yeast nutrient every other day. Monitor the gravity before and after feeding to ensure that not too much sugar is being added. Stop feeding when the yeast can't take any more, or the beer will end up too sweet. Also add a small charge of hop pellets each day to enhance the hop aroma. This beer will require multiple rackings to clarify. Bottle conditioning is not recommended since the alcohol will inhibit further yeast activity. The final beer should be at least 18 percent ABV."

Partial Mash Option: Replace the 16 lb (7.27 kg) Pilsner malt with 11.5 lb (5.22 kg) Briess Pilsen Light or Alexander's Ultralight liquid malt extract.

Make sure you have your boil kettle burner off or extremely low before adding extract and stir thoroughly. Large amounts of extract will clump and settle to the bottom, tending to scorch or burn. Mixing thoroughly is also important before taking a gravity reading. In any case, when making a big beer, be sure to shut down the flame when adding large amounts of extract. Not doing so can scorch the extract and result in burnt flavors.

WORKING WITH GRAIN

There are significantly more issues to be aware of when brewing all-grain big beers. The first issue most brewers run into is in fitting twice as much grain as normal into their mash tun. Most brew systems are designed around making "normal" gravity beers, and commercial brewery mash tuns are especially notorious for this. Morgan Cox, head brewer at E.J. Phair Brewing in Concord, Calif. offers this advice on big mashes: "When I'm making a beer that pushes the limit of our mash tun, one trick I use is to dough in a portion of the grain until the mash tun is nearly full, then recirculate the mash for a few minutes to help it settle and compact slightly. This makes more room in the mash tun and lets me sneak quite a bit more grain in there than normal."

Some brewers recommend mashing thick to get more grain into the tun, but a thick mash affects the fermentability of the wort. A thin mash generally results in a more fermentable wort, because the enzymes are not inhibited by a high sugar concentration. In any case, don't go below one quart of mash water per pound of grain.

Rather than trying to cram too much grain into your mash tun, you can do two mashes with half as much grain. You can do the two mashes back to back, filling your brew kettle only halfway with each runoff. Or, if you have a brewing friend, you might borrow their mash tun and do two mashes at the same time.

A better option is the partial mash. Make up the remaining malt sugars with a high quality extract or by adding simple sugar to your wort. In a big beer, even a large percentage of a high quality malt extract is unnoticeable. In any case, keep some DME or table sugar on hand for adjusting your wort if your mashing regimen fails to produce as much sugar as you planned for.

As a last resort, you can make a half size batch of big beer, but most big beers improve with significant aging. If you brew only a half batch and try a glass every so often, you'll never find out how the beer matured three or more years down the road.

Sparging can be difficult with a lot of grain in the mash tun. Many homebrew systems have mash tuns that are taller than they are wide. A tall mash tun tends to result in stuck mashes more than a shallow one when making big beers. One common trick for a stuck mash is underletting the grain bed by pumping liquid up through the bottom of the mash. This works well on shallower grain beds, but is less effective on really deep beds as might be found on a typical homebrew system. Another trick is to cut the mash. Using a long handle spoon or a yardstick, slice through the mash, making a grid pattern. The more cuts you make, the faster the runoff. However, leave the bottom couple of

Bob Hansen's Dunkle Weizen Wine

Hansen says, "This warm, complex beer does well with at least two to three months of aging to help combine the flavors and tone down the alcohol. It will continue to do well with age, unusual for a weiss beer. The sweetness of the caramel malt and subtle flavors of chocolate combine with the banana aromatics to make a delicious dessert beer with a kick. You may substitute base malt for the light extract if you choose. The wheat extract helps to boost the gravity without having a huge grain bill and long runoff."

Ingredients for 5 U.S. gallons (19 liters)

6.6 lb	(3 kg) Light Malt Extract (Briess Pilsen or Alexander's Ultralight)
6.6 lb	(3 kg) Wheat Malt Extract (Briess Weizen or Alexander's Wheat)
1.0 lb	(0.45 kg) Munich Malt 10L
0.5 lb	(0.23 kg) Caramel Malt 60L
0.25 lb	(0.11 kg) Chocolate Malt 350L
1.4 oz	(40 g) Hallertau pellet hops, 6% alpha acid (60 min.) (40.3 IBU, only when boiled with half of the extract.)

Target Original Gravity: 1.100 (23.76 Plato)

Approximate Final Gravity: 1.025 (6.32 Plato)

Brewhouse Efficiency: 70 percent

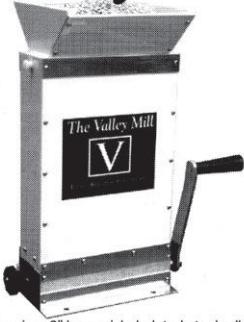
Anticipated SRM: 16.7

Anticipated IBU: 40.3

Anticipated ABV: 10 %

Wort Boil Time: 60 minutes

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inches of mash intact to continue filtering the runoff.

Directions

Use only half of the extract at the beginning of the boil, adding the remaining extract in the last 10 minutes. If you do not do this you will need to increase the hops to 1.75 oz (50 g) to get the same bitterness.

It is important to have sufficient yeast cells for this big beer, so use two pitchable size packages or a large 2-quart starter of Wyeast 3068 Weihenstephan Weizen Yeast or White Labs WLP300 Hefeweizen Ale. Ferment at 68 to 72° F (20 to 22.2° C).

Partial Mash Option: Replace the light malt extract with 9 lb (4 kg) German Pilsner malt. Mash the grains at 149° F (65° C).

Cox uses an interesting technique when running off a batch. He creates a swan-neck in his mash/lauter outlet hose, raising it up over the highest point of the mash while keeping the end of the hose lower than the bottom of the mash. This creates a smooth flowing siphon, which he says allows the liquid to run off at a more consistent flow rate. "I found this trick while doing some research," he says. "It makes a significant difference in maintaining a steady runoff, which helps prevent a stuck mash. Surges in flow from the mash/lauter tun can easily compact a large mash to the point where it becomes impossibly stuck. Begin sparging slowly and keep it steady. Avoid the urge to rush it, as trying to save time through a fast runoff will generally cost you more time and frustration in a stuck mash."

When you're ready for runoff, raise the mash temperature to 168° F (76° C) to thin the viscosity of the mash, which eases recirculation and runoff. If you don't have a

(continued on page 51)



YEAST FOR YOUR BEAST

BY
DR. CHRIS WHITE

Really big beers need two things: a lot of very healthy yeast and a high percentage of fermentable sugar.

Yeast need to be in good health because high gravity fermentations are hard on yeast, due to high ethanol concentration and high osmotic pressure of the wort. Most yeast have a hard time surviving in beer with over 10 percent ethanol. If the beer's final ethanol concentration is 10 percent, the yeast will be spent by the end of fermentation, but they can complete it. If the desired ethanol concentration is 15 percent, for example, they still need to be able to consume sugars to create another 5 percent. That means you will need more yeast to complete fermentation. ➔

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More yeast is necessary for a high gravity fermentation. There is more sugar to consume, and when yeast are stressed, more yeast will help. It is necessary to pitch three to four times as much yeast, higher than most people would expect.

If yeast health is compromised, it will be harder for the culture to finish out the fermentation. Yeast health can be improved with increased aeration and nutrient levels.

Aerate very heavily, four times as much as with a normal gravity beer. Less oxygen dissolves into solution at high gravity. Aerate twice more after pitching, during the first eight hours. Aerate for 30 seconds each time if using pure oxygen in 5 gallons, or five minutes if using air.

Higher nutrient levels can allow yeast to tolerate higher alcohol levels. Use two times the normal nutrient level. Use a complex yeast nutrient, one that has minerals and amino acids. Zinc is the most important mineral for brewing high gravity beers. Nutrients can be added during the fermentation. This can be done when adding more sugar, which is explained later in this article.

Fermentable sugar is the next important step when making high-gravity beers. In normal all-malt brewing, a portion of the sugars is unfermentable. When you make a high-gravity beer, if you want to do all malt, you will end up with a lot of unfermentable sugar. To make it fermentable, you can use enzymes in the mash or later in the fermenter.

Enzymes are proteins that catalyze chemical reactions. Yeast do not have some key enzymes, which is why the mash is so important. Addition of some enzymes that have been purified from other sources, usually fungal, can be helpful. Two types of brewing enzymes that are useful for high-gravity brewing are alpha-amylase and glucoamylase enzymes, sold under a variety of brand names. These enzymes break down sugars that are unfermentable to yeast. Glucoamylases have a broader spectrum of sugars that are broken down, but alpha-amylases work well enough and are easier to obtain.

Attention AHA MEMBERS

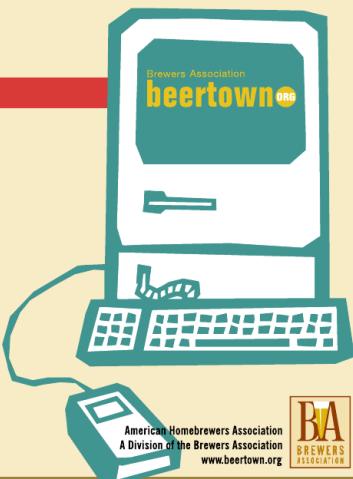
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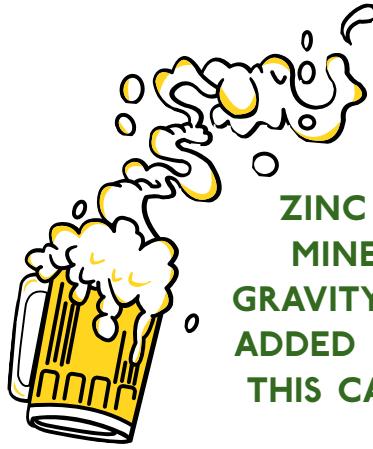
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Brewing enzymes generally are designed to be used in the mash. In the following boil they will be denatured (unfolded) and will discontinue working. Using enzymes in the fermenter is usually discouraged because if the beer is not pasteurized, the enzymes will not be denatured and will continue to modify the residual sugars and affect the body. But this is not as much of a problem with high-gravity beers, because the beers are so complex and the yeast rarely can do much more due to the high alcohol levels. Plus, many times you don't know if you will need enzymes until the fermentation stalls.

Use a liquid preparation and drop in the required amount, usually a few milliliters. Shake the fermenter to mix, and watch the effect. If the yeast are still active, the gravity should drop quickly within the first 48 hours of addition. Do not boil the enzyme mixture before addition, as this will also denature the enzymes. Contamination is not a big concern with big beers after fermentation starts.

You can also affect the sugar profile by using adjuncts. Other types of sugar, even corn sugar, will make the wort more fermentable. It is helpful to not start with the all of the sugar at the beginning, but to add gradually over the first few days. This gives less stress to the yeast. Begin fermentation with a wort that would produce a 6- to 8-percent ABV beer, and add wort (it can be concentrated) each day during the first five days. This can be done together with aeration. This is mandatory if you desire alcohol concentrations near 25 percent ABV. It is more difficult to calculate the final alcohol concentration, but you can calculate a "theoretical" starting gravity.

The higher the gravity, the more wine-like the beer will taste. Beers over 15 percent ABV begin to taste less like beer and more like fortified wines. But they are a fun challenge for brewers of all skill levels.

Chris White, Ph.D., is founder of White Labs in San Diego, Calif. He began homebrewing while receiving an undergraduate degree in biochemistry at UC-Davis.

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- 4) Add yeast to fermenter. Stir for 3 hours or more at 70° F (21° C).
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FOR BIG BEERS HOP TO IT

By
Tom
Nickel

As manager of Home Brew Mart in San Diego for two years I had a lot of first-time brewers walk in and tell me they wanted to brew something simple, like a Pilsener. I would invariably steer them toward some amber malt to mix in with their light malt extract and a solid helping of hops to make a nice pale ale. There is truly nothing easy about brewing very light beers. The flavors are so subtle that the beers become unforgiving to minor mistakes and off flavors.



In keeping with this train of thought, it would seem that big beers would be easy to make since the abundance of flavors would cover up all but the most egregious mistakes. However, this is not true. More is not always better and simply doubling your ingredients does not make a double version of a particular style. As it is with lighter beers, big beers require finesse and fine tuning to avoid unharmonious flavors and a harsh finish. No matter what the color, size or style, you ultimately want all of your brews to be drinkable and enjoyable, leaving you wanting just a little bit more.

So if hopping a really big wort for a really big beer isn't just a matter of more hops, what do you need to do? The answer is to change the ways and places in which you use hops. To avoid the pitfalls associated with hopping huge worts, you'll need to know what the issues are and how to resolve them. We'll look at some unique ways to use hops before and after the boil as well as some alternative ways to obtain bitterness in your beers.

Hidden Ways of Hopping

The number one issue with high gravity worts is the decreased utilization of hops

in the kettle. The massive amounts of sugar retard the isomerization of the alpha acids from the hops, leaving you with decreased bitterness. In addition, the alcohol of the finished product will work against you. Alcohol is an excellent flavor carrier for malt, but not for hops. So the higher the alcohol of your beer, the more malt flavor that will be carried forward.

The problem can't be solved simply by adding more hops, because the increased amount of plant material leads to an off flavor that tastes like chlorophyll. Russian River Brewing Co. owner and brewmaster Vinnie Cilurzo has fought against this flavor in his triple IPA Pliny the Younger. "The enormous hopload in Pliny the Younger was giving off a real plant-like vegetal flavor that was unpleasant and harsh," laments Cilurzo.

Technique, not just quantity, is the solution to hopping high-gravity worts. When I wrote the recipe for my first double IPA I was trying to think of every way possible to squeeze in more hop flavor without adding to the already considerable trub pile in the bottom of my kettle. I put hops in with the mash, I put hops in my sparge water, I used my mash tun as a glorified hop back and I put sacks of flower hops in the kettle during my runoff. I think I might have been the first brewer to hop his sparge water, but other brewers had already used all of the other techniques.

Adding hops in with the mash is one of my favorites. It combines the incredible smell of freshly mashed malt with the wonderfully spicy aroma of hops. And the wort runoff is unmistakably hoppy. To do this, simply start mashing in and about one-third of the way through start mixing flower hops into the mash. From experience and in talking to other brewers, flower hops work best and provide a bit of buoyancy to the mash. If you add them last, they tend to simply float on top. One to 3 ounces of flower hops will make a big impact on a 5-gallon batch. I have never calculated any bittering units from the hops added in the mash.

As for kettle hops in big beers, I try to use as few as possible. It is hard enough to fill your kettle with a very high-gravity wort.

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The last thing you want is to waste it with a large trub pile at the bottom of your kettle or fermenter. Kettle hops must provide bitterness and flavor. A hop back or dry hopping can provide fresh aromatics later on in the process. A good boil of 90 minutes will also ensure good hop utilization. Matt Brynildson at Firestone Walker suggests that any boil time over 90 minutes will start to extract harsh flavors from the hops without increasing utilization. Still, many brewers will use two- or even three-hour hop boiling times to gain extract.

A hop back is almost a necessity when making high-gravity beers with lots of hop flavor. Many brewers simply use their mash tun as a huge hop back allowing a final dose of flower hops to stew in the sub-boil beer during the run off and cooling into the fermenter. This 20- to 40-minute hop soaking gives great flavor and aromatics while wasting minimal amounts of sweet sugary wort. If you don't have a mash tun that you can use as a hop back, there are plenty of ways to make it work. If you use an immersion chiller, just whirlpool the beer in your kettle and rack it into a bucket. Add the hops loose or in hop sacks and chill the beer.

Dry hopping in the fermenter and in secondary will ensure big hop aromas in even the strongest of beers. One to two weeks contact time is fine at room temperature. If you are dry hopping at colder temperatures, contact times of up to three or four weeks are OK. Pellets are fine in the primary and either pellets or flowers will work in the secondary.

Brewer Jeff Bagby from Ogg's Pizza and Brewing Company in Vista, Calif. notes that low alpha acid flower hops are prone to giving off a tea-like flavor when used in large amounts for dry hopping. He routinely uses pellets in hop bags in his serving tanks and says that he likes "the round, even aroma from flowers and the more striking, aggressive bite that hop pellets add."

In addition to all of these techniques, there is one final way to add hops that will not appeal to purists. You can simply boil hops in water, strain them and add the water to your

(continued on page 51)

Ding Ding Double IPA

Brewed by Jeff Bagby at Ogg's Pizza and Brewing Co., Vista, Calif.

Conversion for homebrewing by Tom Nickel

This is a monster beer. It has a 1.090 O.G. and more than 10 percent alcohol, yet loads of hop flavor. Adding hops in different places is the key to achieving an awesome hop flavor, while avoiding the negative flavors associated with over hopping. This beer is only 50 percent higher in alcohol than the Ogg's Vista Torrey Pines IPA, but it uses more than three times the hops. This is the glory of the West Coast double IPA.

Malt Bill – Given in Percentages for all grain. Sugar for 5 gallons (19L)

93%	American 2-Row Malt
approx. 17L (2%)	British Lt. Crystal Malt
1%	British 75L Crystal Malt
2%	Red Wheat
approx 14L (2%)	Toasted Wheat

Also added during boil:

1.0 lb	(.9 kg) Brown Sugar
0.75 lb	(.34 kg) Clear Candi Sugar

A small amount of wheat malt with light malt extract and steeping grains can also be used. If using steeping grains, use 0.25 lb (112 g) light British crystal malt and 0.25 lb (56 g) 75L British crystal malt. Add mash hops even with steeping grains.

For full mash, rest at 150° F (66° C) for 45 minutes.

Hop Schedule

Hops are used in the mash with the grains, in the kettle and in a hop back for which the mash tun is used. The beer is dry hopped in the fermentation tank and the serving tank (secondary).

Mash Hops

Use only flowers in the mash and mash in about 1/3 of the grain total before beginning to add hops.

Use 1 oz (28 g) each – Amarillo, Cascade, Centennial. If Amarillo is unavailable then just double the usage of Centennial.

Kettle Hops

All kettle hops are pellets, though flowers are fine if you adjust for their usage

2.25 oz	(63 g) Centennial hops, 8.4% Alpha Acid (FWH about 0.25 full kettle)
1.25 oz	(35 g) Simcoe hops, 12.8% Alpha Acid (120 minutes)
1.0 oz	(28 g) Columbus hops 15.6% Alpha Acid (120 minutes)
0.5 oz	(14 g) Cascade hops, 6% Alpha Acid (90 minutes)
0.5 oz	(14 g) Amarillo hops, 8.5% Alpha Acid (90 minutes)
0.5 oz	(14 g) Centennial hops 8.4% Alpha Acid (60 minutes)
0.5 oz	(14 g) Liberty hops 3.4% Alpha Acid (60 minutes)
1.0 oz	(28 g) Simcoe hops 12.8% Alpha Acid (30 minutes)

Mash Back Hops

Again these are all flowers put on top of the screens or straining device in your mash tun

Amarillo	1.5 oz (42 g)
Simcoe	2.5 oz (70 g)
Centennial	3.0 oz (84 g)
Cascade	1.0 oz (28 g)

Fermenter Hops

These are pellets added directly into the fermenter after primary fermentation has subsided.

0.75 oz	(21 g) each – Amarillo, Simcoe and Centennial
----------------	-----------------------------------------------

Serving Tank or Secondary Hops

These are flowers and pellets added into secondary in hop sacks.

1.5 oz	(42 g) each Simcoe and Centennial Flowers
1.0 oz	Amarillo Pellets
0.75 oz	(21 g) Centennial Pellets

O.G. 1.090

Target F.G. 1.012

Approx. ABV 10.3%

American Yeast – Nutrient and starter recommended. Ferment at 67-69° F (19-21° C). One week primary fermentation. Add fermenter hops and let sit 10 days and cool down. Rack into secondary and add serving tank hops. Let sit 10 days cool then rack into keg or bottle and carbonate.

Beyond Barleywine



Thinking Big
About
Wheat, Rye and Oats

By Daniel Morey

Enchanting, alluring barleywine

is a perennial favorite among homebrewers.

Take a look back at *Zymurgy's* "Best Beers in America" poll and you'll find names like Bigfoot, Old Foghorn, Double Bastard and Old Horizontal.

Barleywine amplifies the very essence of all its ingredients. Rich malt flavor from barley, exhibiting caramel sweetness and biscuit or toast-like dryness, forms the canvas. Like the brush strokes of an artist, layers of hop flavor and aroma mingle with esters from fermentation. Then a perfect balance is achieved by the bittering quality of hops. In short, it's a masterpiece of brewing.

Conventional wisdom says barleywine begins with malted barley, but have you thought about creating your masterpiece using wheat? How about rye or oats? Time to get adventurous and brew *big* with alternative kinds of malt.

I brewed a series of strong ales with wheat, rye and oats as the primary grain and entered them in competitions. A discussion of each grain follows.

Wheat

Wheat is no stranger to brewing and is probably the second most commonly used malted grain. You can even find it in caramel and roasted forms these days.

With wheat beers, you often hear aroma descriptors like grainy, tangy and spicy. A more accurate description, in my opinion, is bread-like. Since wheat is a more delicate malt than barley, fruity esters and hop aroma tend to stand out.

Wheat malt typically has a Lovibond rating around 2, between Pilsener and pale malt, giving the beer a pleasant, light golden color. Depending on your mash schedule, the beer can be either clear or cloudy. The head is firm, white and long lasting.

Much like the aroma, the flavor of wheat is milder than barley. It is soft, fresh and bready. Its gentle nature lets the characteristics of the hops and fermentation take center stage. I believe the "tang" often associated with wheat comes from the natural acidity of the beer being more prominent because the malt character is subdued. Esters and phenols from the yeast freely impart fruit and spice notes that do not compete with overly sweet malt.

Higher levels of protein and beta glucan give wheat beers a fuller body than beers made

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with barley. In fact, you may notice a slight stickiness on your tongue from the higher viscosity of these beers.

Overall, wheat produces a simple, clean and enjoyable beer. Due to the milder flavor, lower bitterness levels should be employed for better balance. Increased late hop additions enhance hop flavor and aroma. Wheat is a good candidate for distinctive yeasts such as an English ale yeast.

Rye

Rye has gained popularity among home-brewers and commercial brewers alike, prompting the Beer Judge Certification Program to add guidelines for rye beers in 2004. The increased demand has made rye malt a fairly common commodity. Like barley, it is available in crystal and roast forms.

Rye's bready aroma, with hints of caramel, is reminiscent of barley. However, the dry, fennel-like spiciness in its finish sets it apart. It exhibits a brown sugar-like sweetness with dried fruit notes similar to raisins.

The Lovibond rating of rye is virtually the same as pale ale barley malt so it unsurprisingly gives a copperish color with ruby highlights. Rye beers pour noticeably thick, almost like maple syrup. Large bubbles slowly rise through the beer, giving a long lasting, thick, light tan head, truly amazing in its presentation.

Like barley, the flavor is malty and sweet with toasty and bready qualities. Caramel character intermixes with the primary toasty flavors. The difference is in the aftertaste—dry and slightly pungent, reminiscent of fusels. Hop bitterness is suppressed by the substantial sweetness of the malt. The viscosity of the beer may mask many flavors by affecting the receptiveness of taste buds. In general, the flavors of the rye beers evaluated for this article were milder than expected.

The mouthfeel is very thick, just like the appearance. Judges who evaluated this beer found the viscosity unpleasant. Because it is so thick, the carbonation escapes slowly and has more bite. The beer finishes dry and is slightly astringent.



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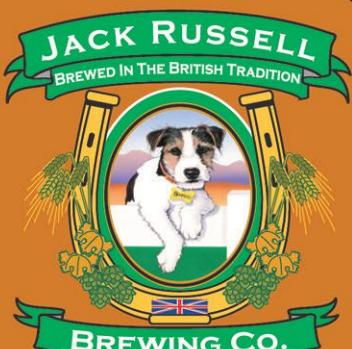
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Overall, rye is very similar to barley but with a dry, pungent finish. Its qualities are not unlike a medium rye bread. I find the faint fennel notes interesting and a welcome addition for complexity. The thickness, however, is a major distraction, and strategies to control this should be used when brewing with high proportions of rye.

Oats

Typically, the use of oats has been limited to oatmeal stouts, witbiers and farmhouse ales. The most common form in homebrewing is flaked or raw oats. Malted oats, while less common, are available in pale and crystal form. I chose pale oat malt for this brewing experiment.

The aroma of oats is unique. During the mash it has a grainy sweet smell, similar to fresh sweet corn, that seems to carry over into the finished beer. The judges described it as "grainy with oat cereal fringes." Hints of acidity can also be identified. Like the wheat, fruity esters from yeast and spiciness from hops thrive.

Oats are relatively high in oil content compared to other brewing grains, so don't be surprised if you see "ring around the collar." The color is fascinating: hazy, yellow and almost wit-like, but with a green hue rather than red. A big, almost meringue-like head rises but falls quickly. Again, the higher oil content may come into play.

The flavor is grainy with a pleasant earthiness. It starts surprisingly sweet yet finishes quite dry. Similar to wheat, the subtle nature of the oats allows the natural acidity of the beer to be more apparent. Spiciness from fermentation and hops are also accentuated.

Body is relatively light compared to wheat or rye. The beer is very refreshing yet filling. Interestingly, no judges detected any slickness that might be expected from the higher oil content.

Of the three beers in this experiment, the oat beer was by far my favorite. It was clearly beer, yet distinctly different. It was an eclectic combination: grainy, earthy, spicy, acidic, with the intriguing green tint.

ALTERNATIVE MALT SUPPLIERS

Malt Type	Wheat	Rye	Oats
Pale	Many	Briess, Fawcetts, Weyermann, Great Western	Fawcetts
Crystal/Caramel	Weyermann, Fawcetts, Franco-Belges	Fawcetts	Simpsons
Roasted	Weyermann, Fawcetts, Franco-Belges, Dingemans	Weyermann	None

Cold Fusion Rye Wine

Ingredients for 3 U.S. gallons (11.3 liters)

12.5 lb	(5.7 kg) rye malt
2.0 lb	(0.9 kg) Pilsner malt
1.6 oz	(45 g) whole Horizon hops
	11.3% alpha acid (75 min)
3.3 oz	(92 g) whole Golding hops
	4.1% alpha acid (1 min)
	DCL Safale S-04

Original Specific Gravity: 1.087
Final Specific Gravity: 1.018

Directions

Mash in with 2.09 gallons cold water; hold for 25 minutes. Bring 1.35 gallons to a boil and add to the mash to raise the temperature to 110° F (43° C) and rest for 30 minutes. Add 0.67 gallons of boiling water to mash to bring the temperature to 122° F (50° C) and hold for 35 minutes. Raise the mash to 149° F (65° C) by adding 2.25 gallons of boiling water and hold for 65 minutes. Infuse 1.36 gallons boiling water and rest at 158° F (70° C) for 35 minutes. Using direct heat increase the temperature to 168° F (76° C) for a 10-minute mash out. Boil for 90 minutes and add hops as specified. Cool, oxygenate and pitch yeast.

Judges' Comments

"Very special/interesting. Bury it for a year!"
 "Good flavor."



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Challenges and Tips

While both wheat and rye tend to be harder than barley, they don't pose any particular challenges with milling. Oats are fairly soft and have a significant variation in grain size. If you have an adjustable mill, narrow your gap to keep the efficiency up. If you don't have an adjustable mill, you will need to increase your grain bill to make up for lower efficiency due to an under-crushed grist.

Wheat, rye and naked oats are huskless malts. If using high proportions of these grains consider using rice or oat hulls to serve as a filter bed to reduce the chances of a stuck sparge. Additional hulls are not required when using standard oat malt.

All these malts have a higher beta glucan content than barley malt. Beta glucans are complex chains of glucose that become soluble in water around 170° F (77° C). Beta glucans cause the wort to become thick and viscous. A beta glucan rest at 95 to 110° F (35 to 43° C) can be helpful in thinning the wort, but is limited in effectiveness. Doughing-in cold and using a decoction to raise the mash temperature to the beta glucan rest will increase the effectiveness of this step. Rye is significantly higher than either wheat or oats in beta glucans and I would recommend limiting rye to no more than 50 percent of the grist in high gravity brews. Wheat and rye are also high in soluble protein; thus a protein rest at 122 to 128° F (50 to 53° C) can

help improve clarity. You can skip a protein rest with oat malt. It is the higher beta glucan and protein content of these malts that increases the mouthfeel of these beers.

Wheat malt has sufficient enzymes to convert itself in the mash. It is questionable if rye or oats have sufficient enzymes to convert. If you are using 100 percent rye or oats it is best to add some amylase enzyme. The mash will need a bit longer to convert. Try to use thin mashes to promote enzyme activity. Expect higher final gravities since there is limited beta amylase available.

You will likely experience greater shrink due to water absorbed by the grain. Oats seem to retain a higher portion of water than either rye or wheat. Have extra sparge water available to collect enough wort for your boil. There is a lot of fine matter in the oats so expect greater losses to trub. Likewise, both wheat and rye have larger hot break, which also leads to larger kettle losses.

Boiling can be very tricky with rye. When the beta glucan becomes soluble, the wort takes on a molten agar or gelatin-like consistency. If your boil kettle has a false bottom, the thick wort can become trapped and easily burn. Similarly, hot break from wheat can also become trapped and burn. Bring your wort up to a boil slowly, keeping your nose alert for the first hint of scorching. All my attempts at rye wine experienced some scorching. I had no issues with boiling the oat-based wort.

The Eccentric Strong Oat Ale

(3rd place Specialty Beers, NHC 2005
(Great Lakes Region)

Ingredients for 5 U.S. gallons (19 liters)

24.0 lb	(11 kg) oat malt
4 tsp	amylase enzyme powder
2.7 oz	(48 g) whole Horizon hops 11.3% AA (75 min)
4.7 oz	(132 g) whole Mt. Hood hops 4.5% AA (1 min) Wyeast London Ale III #1318

Original Specific Gravity: 1.069
Final Specific Gravity: 1.017

Directions

Mash in with 1.99 gallons cold water; hold for 90 minutes. Bring 4.54 gallons to a boil and add to the mash to raise the temperature to 149° F (65° C) and rest for 48 minutes. Add 1.87 gallons of boiling water to mash to bring the temperature to 158° F (70° C) and hold for 80 minutes. Using direct heat increase the temperature to 168° F (76° C) for a 10-minute mash out. Boil for 90 minutes and add hops as specified. Cool, oxygenate and pitch yeast.

Judges' Comments

"Interesting concept! Thank you for trying it."

"Experiments like this are why people should homebrew. Really nice effort."

I did not notice any quirks associated with either chilling or fermentation. Standard procedures should work well.

Suppliers

Suppliers for these grains are listed on page 43. While the list is not comprehensive, it is a good starting point, especially if you are looking for crystal and roasted forms of these malts.

Daniel Morey is a project engineer for Case New Holland working in Ag Tractor Development. He has been brewing since 1992, switching to all-grain on his second batch. He is a member of Club BABBLE in Lake County, Ill.



I Stone 7 Wheat Wine

(1st in Flight Specialty Beer 2005
BOSS Challenge)

Ingredients for 5 U.S. gallons (19 liters)

21.0 lb	(9.5 kg) wheat malt
1.0 lb	(0.45 kg) rice hulls
2.5 oz	(70 g) whole Horizon hops, 12.1% alpha acid (75 min)
3.0 oz	(84 g) whole Cascade hops, 7.1% AA (1 min)
	White Labs East Coast Ale WLP008

Original Specific Gravity: 1.090
Final Specific Gravity: 1.026

Directions

Mash in with 1.7 gallons cold water; hold for 25 minutes. Add 1.84 gallons boiling water to raise the mash to 122° F (50° C) and rest for 20 minutes. Bring 2.11 gallons of water to a boil and add to mash, bringing the temperature to 149° F (65°C) and hold for 45 minutes. Increase mash temperature to 158° F (70° C) by adding 1.70 gallons of boiling water for a 10-minute rest. Using direct heat increase the temperature to 168° F (76° C) for a 10-minute mash out. Boil for 90 minutes, and add hops as specified. Cool, oxygenate and pitch yeast.

Judges' Comments

"Need less oppressive bitterness to allow the sweetness normally associated with a wheat wine to come through."

"This is nice, a bit of aroma balance is needed which may help on the flavor balance...Very tasty still!"

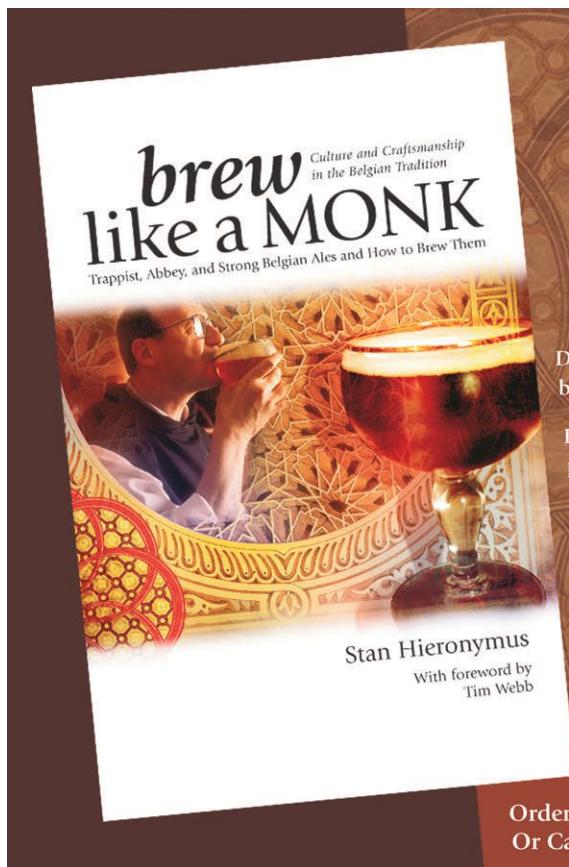
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Craft Brewed in the USA: Brewers Tout American Beer Month

By Zymurgy Staff



Craft brewers large and small found ways to celebrate the fifth American Beer Month in July. From special beers to sponsoring a roller derby team, brewers touted the quality and diversity of American-brewed craft beer.

The American Beer Month promotion grew out of a meeting of brewers at the 2000 Great American Beer Festival about ways the industry could promote itself.

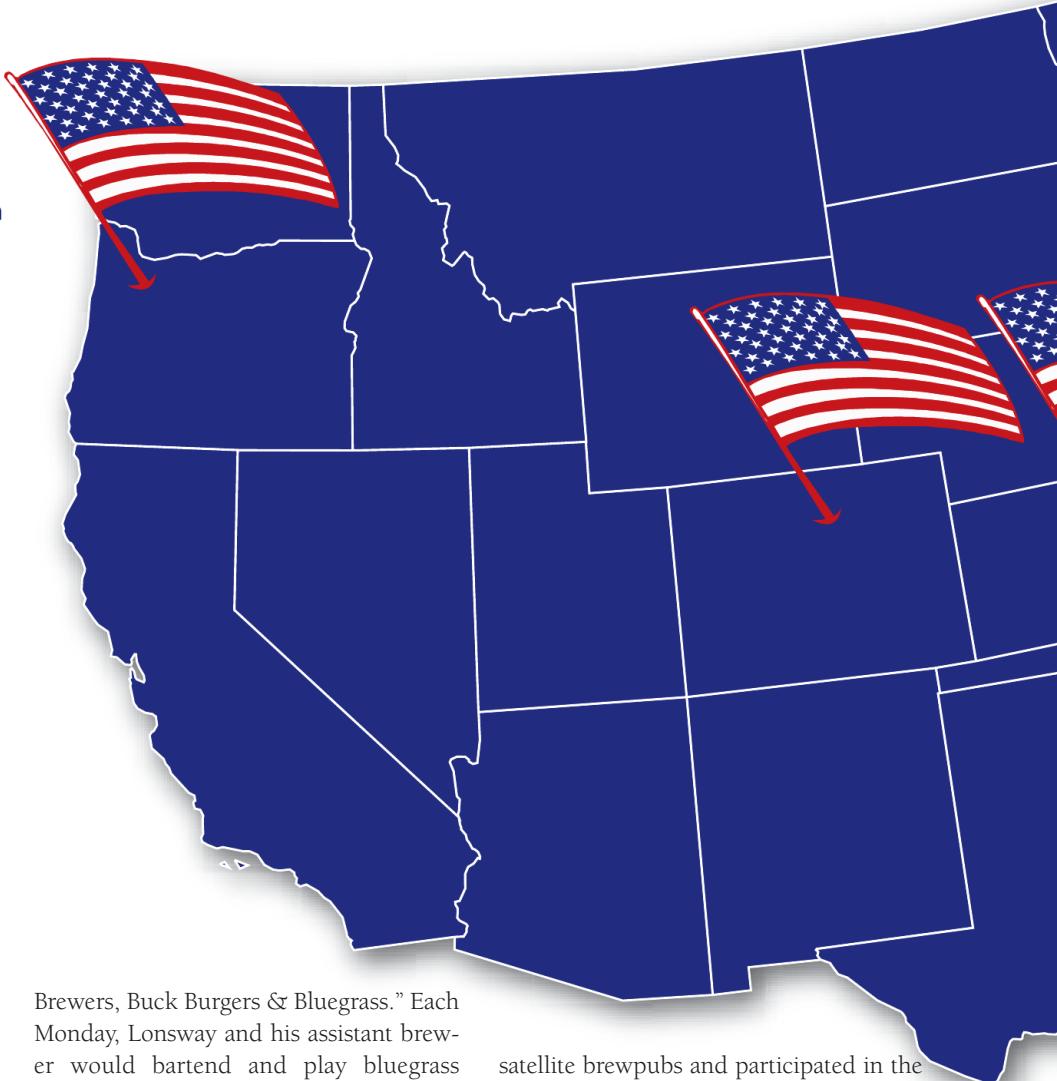
The Brewers Association has taken the lead in helping promote the American Beer Month campaign, designing a logo and maintaining a Web site (www.americanbeermouth.com) with information for beer lovers.

But it is the individual brewers who showcase their grassroots marketing skills each July to draw attention to locally brewed beers.

Here is a sampling of some of the ideas from brewers coast to coast.

Brian Buckowski of Terrapin Beer Company of Athens, Ga. brewed All American Imperial Pilsner. "What I did was brew a traditional Pilsener in a sense that the mashing schedule, fermentation temperature and aging process all mimicked traditional Pilsener/lager brewing," he says. "The American twist came when I used all American malt, hops, yeast and water."

At Stone Cellar Brewpub in Appleton, Wis. owner/brewer Steve Lonsway started a weekly promotion called "Bartending

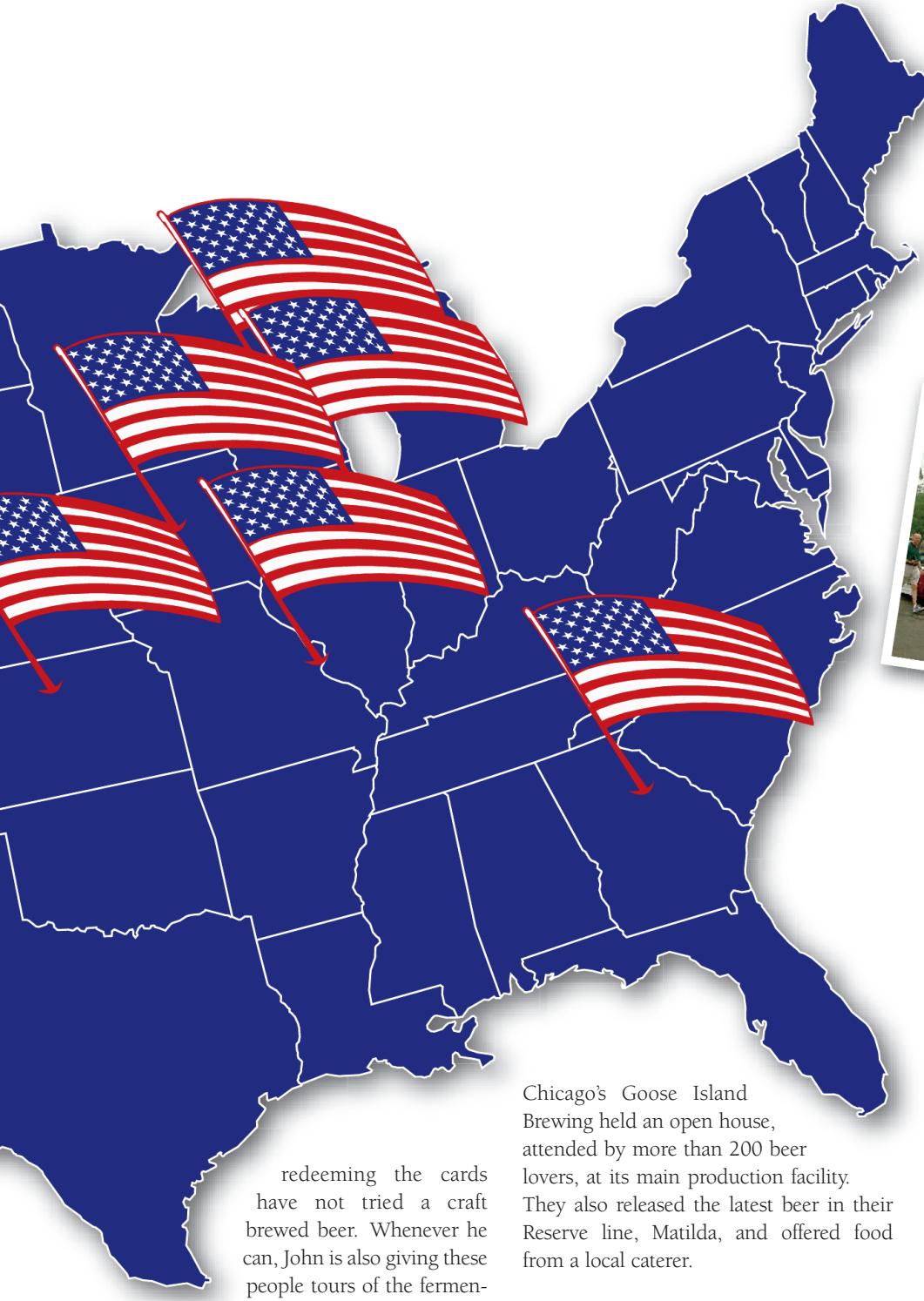


Brewers, Buck Burgers & Bluegrass." Each Monday, Lonsway and his assistant brewer would bartend and play bluegrass music from their personal CD collections while patrons enjoyed \$1 burgers with a two-beer minimum. Each week the sales doubled. "We get a lot of people who want that one-on-one with the brewers to talk beer and discuss new brews on the horizon. We also get a lot of homebrewers with questions on their own stuff," Lonsway says. "A great way to take the slowest day and bring in customers."

Granite City Brewery of Iowa decorated its wort truck that it uses to ship fresh wort from its "mother ship" brewery to its

satellite brewpubs and participated in the Ames, Iowa Fourth of July parade. "A number of us walked the parade route handing out free beer sample cards that could be redeemed in our brewpubs. The card also carried the American Beer Month logo. When talking to people we encouraged them to drink fresh American craft brewed beer," says Granite City's Larry Chase.

It seems to have worked, with a number of cards being redeemed at the group's Clive, Iowa location. "John, our managing brewer, tells me that a lot of the people who are

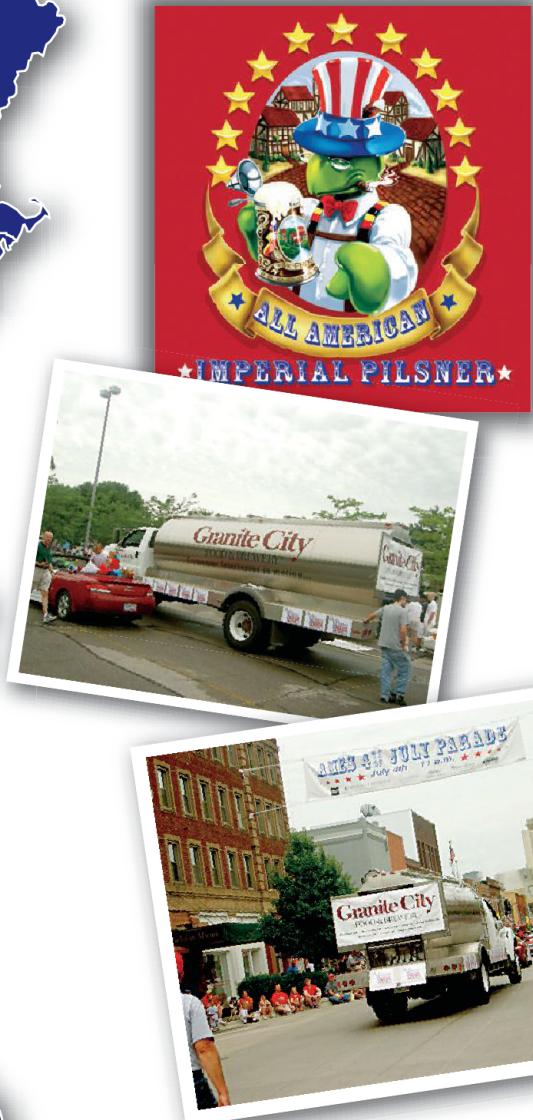


redeeming the cards have not tried a craft brewed beer. Whenever he can, John is also giving these people tours of the fermentation room and conditioning cooler at the restaurant. They get a real kick out of it," Chase said.

Saint Louis Brewery passed out special samplers of their American Pale Ale, American Lager and American Brown Ale and featured home-style fried chicken dinners on Thursdays during the month of July.

Chicago's Goose Island Brewing held an open house, attended by more than 200 beer lovers, at its main production facility. They also released the latest beer in their Reserve line, Matilda, and offered food from a local caterer.

The Oregon Brewers Guild's new executive director, Brian Butenschoen, teamed with Chris Crabb of the Oregon Brewers Festival to persuade Oregon's governor and Portland's mayor each to sign official proclamations designating the last week of July Oregon Beer Week. Venerable publican Don Younger of the Horse Brass Pub organized an On the Edge Tour featuring more than 30 pubs pouring Oregon beers



not found at the Oregon Brewers Festival. Pubs and breweries throughout Portland held special events such as beer and cheese tastings, open houses and beer and sausage parties.

And, never at a loss for finding new ways to promote craft beer, the folks at Oskar Blues in Lyons, Colo. sponsored a local roller derby team, the Rocky Mountain Rollergirls, in their debut bout at the Bladium in Denver.

"We sold loads and loads of beer at the event, while presenting a unique, highly entertaining event like none of us had ever seen," says Oskar Blues' Marty Jones.

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Dear Zymurgy (*continued from 8*)

now know what I wish I'd known then—brewing in Virginia is legal. Luckily those 12 gallons didn't go to waste.

Let freedom reign!
Bryan Richardson

Dear Bryan,

Perhaps it would be bad form to print out the section of Virginia state code that permits homebrewing and use it on a label for a bottle of homebrew to deliver to Barney and friends. But it might not be a bad idea to keep the document handy in case of a repeat performance. For anyone in Virginia, the pertinent law can be found online at <http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+4.1-200>. In a list of those excluded from needing a license for alcoholic beverages, it reads: "Any person who manufactures at his residence or at a gourmet brewing shop for domestic consumption at his residence, but not to be sold, dispensed or given away, except as hereinafter provided, wine or beer or both, in an amount not to exceed the limits permitted by federal law."

Brew on!
—Ed.

A Pub with (Almost) No Beer

Dear Zymurgy,

We just got back from an Alaskan cruise. The trip planning included reading up on brewpubs, breweries and available beers. We were eager for new experiences. It was very enjoyable with one big disappointment.

We found mainly well-stocked bars and restaurants, eager to promote local and other fine beers.

We especially had a great time at the Alaskan Brewing Co. The staff was as good as the beer. Many varieties were on tap for tasting. I heartily recommend their beers and encourage people to make the trip out to the brewery.

We (and 2,000 shipmates) left Alaska from Anchorage. The Glacier Brewhouse had fine beers, very good food and excellent service. It was a wonderful experience! The 45-minute wait to get a table is a testimony to how good they are.

[Another] brewery was a major disappointment. They've won medals for two beers—their pale ale and porter. Neither one was available while we were there. Walk in the door and you see a big advertisement on cask-conditioned ales they sell—none were available while we were in town. Our choices were an uninspiring golden ale (the light beer for the masses) and two wheat beers (with or without raspberry). I mentioned I thought it was odd to a couple staff members. I got the impression it happens often. I guess the good news is that better beers are getting more popular. And maybe word is getting around; there were plenty of empty tables. The lack of business might remedy the situation over time.

The experience really irked me, though. This was more than just an annoying restaurant experience to me (I would have written the restaurant). It gives the brewpub industry a bad reputation. A brewpub that runs out of their flagship products hurts the whole industry. Why go to a brewpub for middle-of-the-road brews? I know more than one beer enthusiast friend that has given up on brewpubs. They prefer the consistent fine quality of microbreweries and imports.

Should a brewpub be excused for running out of their main products? Am I overreacting?

Ken H.
Minnesota

Ken,

I took the liberty of passing your e-mail to the brewery itself. Here is their reply:

This summer we have two co-head brewers... brewing and transferring every day. Not a single day without a brewer. We are quite proud that this summer we did not run out of any of our beers. If a brew wasn't available it was only because we were transferring that beer to a bright tank. Meaning there is a short window when particular beers are not available. Unfortunately, Ken the brewpub enthusiast did not ask for a manager, brewer or a brew tour. Most likely Ken could have enjoyed a fresh pale ale, porter or an exciting new brew that hasn't been released yet. As for cask-conditioned brews, we celebrate a new

brew every Friday night with complimentary live music. When the cask runs out... it's out. Like all specials... they are limited.

Yes, we do have two wheat brews available: one being a Bavarian style hefeweizen brewed true to the German wheat beer tradition. The other wheat brew is for the summer only, a nice traditional American wheat with raspberries. The two brews are quite different. We are 5 and 10 barrel systems, quite different from the Alaska Brewing Company. A lot of tourists visiting Alaska do come up the Inside Passage via a luxury cruise and stop in Juneau. Most are exposed to Alaskan Amber then compare all the other in-state microbreweries and brewpubs to the Alaskan regional brewery. Our goal and commitment is to make sure all guests are 100 percent satisfied with their dining experience. I wish Ken would have asked for a manager or brewer because I'm confident we could have met his expectation and made sure he was 100 percent satisfied instead of leaving "irked."

Please let Ken know that he has our sincere apologies and the next time he and friends are visiting Anchorage to stop by. Ask for any manager at the front desk and we'll make sure that he and company have a great brewpub experience. I too enjoy traveling to breweries around the U.S. and tasting exciting fresh brews. I know the disappointment when the brew you want is not available. But I understand, as a traveler I'm making short visits and moving on to the next stop, not having the luxury of a local to come back the following day or week.

Sincerely,
Daniel Raymer
Operations Manager
Snow Goose Restaurant & Sleeping Lady Brewing Company

Cheers,
—Ed.

Send your letters to Dear Zymurgy, PO Box 1069, Gresham, OR 97030 or e-mail jim@brewersassociation.org. Hey homebrewers! If you have a homebrew label that you could like to see in our magazine, send it to Kelli Gomez, Magazine Art Director, Brewers Association, PO Box 1679, Boulder CO 80306 or e-mail it to kelli@brewersassociation.org.

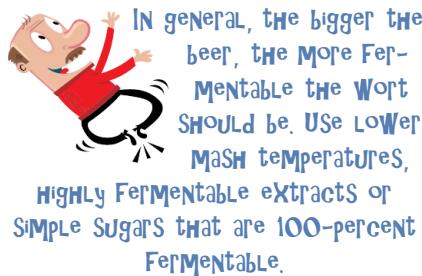
Big Beers, Small Sugars (continued from 31) brew system capable of heating the mash once conversion is complete, there are a couple of alternatives. If you have enough room left in your mash tun and it won't thin the wort too much, you can add boiling water to raise the mash temperature. If you don't have the room or are worried about thinning out the wort, pull some liquid from the mash, gently heat it in a separate pot while stirring to avoid caramelization and then add it back to the mash to raise the temperature.

THE BOIL

If things didn't go exactly as planned during the mash and sparge, the boil is your opportunity to adjust the wort. This is where a refractometer is priceless, as it takes only a few drops of wort to get a reading instead of having to cool enough to float a hydrometer.

While you can use an extended boil to reach your intended starting gravity, it is usually better to add extract to make

up the missing sugar. Extended boils result in increased melanoidin formation and greater caramelization. This can be great for some styles, but not so great in others. If you've overshot your target, you can adjust by adding back some water.



A partial boil, where you boil a highly concentrated wort and then add water in the fermenter, isn't recommended when making big beers. The very high sugar concentration for a big beer can result in huge amounts of caramelization, some scorching and very low hop utilization.

SUMMARY

Making wort for big beers requires special focus in a few different areas.

- In general, the bigger the beer, the more fermentable the wort should be. Use lower mash temperatures, highly fermentable extracts or simple sugars that are 100-percent fermentable.
- Keep in mind that there is going to be an increase in caramelization and melanoidin production, but a decrease in hop utilization.
- If you're brewing an extract-based batch, hold back a large percentage of the extract for the end of the boil.
- If you're going all-grain, use a slow, steady runoff.
- In the end, check your results before the end of the boil and adjust with extract or sugar if things didn't go as planned.

Jamil Zainasheff is a former Ninkasi award winner at the National Homebrew Competition. A member of the Quality Ale and Fermentation Fraternity, he lives in Elk Grove, Calif.



For Big Beers Hop to it (continued from 39) beer pre- or post-fermentation. This is a way of making your own hop extract. As the double IPAs have become a hot beer across the nation, brewers are looking for ways to make these beers easier to handle in a production setting. Hop extracts are used increasingly to provide up to 80 percent of the bitterness in some double IPAs. These extracts are not available on the homebrew level, but you can nonetheless juice up your own beer with hop tonic water.

As always, fresh ingredients will make a big difference. Inspect your hops and make sure they look and smell the way you want them to. If they don't smell right before you add them, they are not going to contribute the flavors you want into your beer.

Alternative Methods

Hops are not the only way to get bitterness in your beer. In Scotland, where it is too cold to grow hops, brewers of the Middle Ages used wormwood to bitter their beers. This practice continued even after hops became the primary bittering

source for beer since their English neighbors controlled the hop growing areas. A wide variety of herbs will give bitterness to beer but not all of them pleasant. Wormwood can easily overpower a beer with a mouth-numbing bitterness. Consult *Sacred and Herbal Healing Beers: The Secrets of Ancient Fermentation* by Stephen Harrod Buhner for a complete look at brewing with herbs.

To avoid the pitfalls associated with hopping huge worts, you'll need to know what the issues are and how to resolve them.

AleSmith Brewing Company also uses a novel ingredient to help achieve bitterness without hops—coffee. Speedway Stout is a 12-percent alcohol coffee-infused imperial stout. The beer has huge bitterness, some of which is definitely coming from the coffee. Owner and brewer Peter Zien says he uses coffee to help balance the immense sweetness of the 1.111 original

gravity wort. AleSmith adds 15.5 gallons of concentrated fresh-brewed coffee (Indonesian Sumatra Blue and Estate Mexican) per batch "to contribute additional layers of roasted flavors plus dimensions of bitterness, not necessarily akin to hop-type bitterness, but balancing bitterness nonetheless."

Big beers are a means to expand your creativity. They are a puzzle to be solved through technique and finesse. Hop additions don't just come in times related to your boil. Add some hops where you never have before and you will notice a new depth of hop flavor.

Tom Nickel owns O'Brien's Pub, the hoppiest place on earth, in San Diego with his wife, Lindsey. He was formerly the head brewer for the Oggi's Pizza and Brewing Company chain and was named the 2004 World Beer Cup Small Brewing Company Brewmaster of the Year. His favorite beer is 95 percent of the time the one in front of him and his favorite brewery that no one has heard of is Alpine Beer Co.





Not-So Pilsener

One would think after making beer for more than 35 years that brewing would get old and boring. Not so. In the July/August *Zymurgy* I wrote about my discovery of organic malt and the unique cabernet sauvignon-like character of New Zealand grown Nelson Sauvin hops. In September/October I recounted my pilgrimage to Prague's lonely outpost and mecca of dark beer at U Flecku, the oldest operating brewpub in the world; a discovery of pleasure and subtleties and a rejuvenated respect for fine tuning the art of brewing.

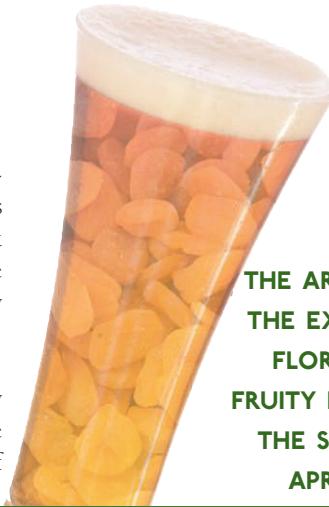
I paged through all my recipe notes of the past six months; what else have I discovered here in my brewery worth sharing? Aha! I almost forgot the successful and experimental batch of Not-So Pilsener. It was so enjoyable and the keg blew in such a short period the beer became a deliciously distant memory.

Not-So Pilsener was a memorable discovery of the unique character that late hopping with French Strisselspalt hops brought to my brew. Not a traditional Pilsener, this 20-percent rice lager is a variation on a theme, such was the desire to lighten up the body without compromising malt and hop character. I've brewed a similar recipe in years past with great success, but this time I bumped up the rice from 10 to 20 percent and played around with the delicate nature of American Mt. Hood and French Strisselspalt hops.

What is the uniqueness of this lager? At first tasting I noted the clarity, the lightness, the refreshing bitterness, the foundation of malt overtones and a unique floral nature of hop aroma. But I couldn't quite pin it down. It was my wife, Sandra, who at first sip of my proudly proclaimed rice Pilsener asked me, "Did you put apricots in this beer?"

"Wha...?" I replied, and inhaled as I drafted another mouthful of the Pils. She was absolutely right on the mark. No, I hadn't put in any apricots in the beer, but the aroma had the exuberant floral and fruity nature of the sweetest apricots.

"How did that happen?" I immediately asked myself as I reviewed my recipe notes. Perhaps the increased amount of



THE AROMA HAD
THE EXUBERANT
FLORAL AND
FRUITY NATURE OF
THE SWEETEST
APRICOTS.

Not-So Pilsener

Malt Extract Recipe

Ingredients for 6 U.S. gallons (23 liters)

8.0 lb	(3.6 kg) very light malt extract syrup or 6.4 lb (2.9 kg) very light dried malt extract
1.5 lb	(680 g) rice extract syrup
1.5 oz	(42 g) Mt. Hood hops 6% alpha (6 HBU/168 MBU) 60 minutes boiling
1.5 oz	(42 g) French Strisselspalt hop pellets 2% alpha (3 HBU/84 MBU) 60 minutes boiling
1.0 oz	(28 g) Mt. Hood hops 6% alpha (6 HBU/168 MBU) 20 minutes boiling
0.5 oz	(14 g) Mt. Hood hops, 10 minutes boiling
1.25 oz	(35 g) French Strisselspalt hop pellets 2% alpha, 2 minutes boiling
0.43 oz	(12 g) French Strisselspalt hop pellets 2% alpha, dry hopping
0.25 tsp	(1 g) powdered Irish moss
0.75 cup	Pilsener or German type lager yeast (175 ml measure) corn sugar (priming bottles) or 0.33 cup (80 ml) corn sugar for kegging

Directions

Add malt extract and rice syrup to 2.5 gallons (9.5 liters) hot water and dissolve well. Add 60-minute hops and bring to a boil.

The total boil time will be 60 minutes. When 20 minutes remain add the 20-minute hops. When 10 minutes remain add 10-minute hops and Irish moss. When 2 minutes remain add the 2-minute hops. After a total wort boil of 60 minutes turn off the heat and place the pot (with cover on) in a running cold-water bath for 30 minutes.

Strain out and sparge hops and direct the hot wort into a sanitized fermenter to which 2.5 gallons (9.5 liters) of cold water has been added. If necessary add cold water to achieve a 6-gallon (23-liter) batch size. Aerate the wort very well.

Pitch the yeast when temperature of wort is about 70° F (21° C). Once visible signs of fermentation are evident ferment at temperatures of about 55° F (12.5° C) for about one week or when fermentation shows signs of calm and stopping. Rack from your primary to a secondary and add the hop pellets for dry hopping. "Lager" the beer at temperatures between 35 and 45° F (1.5-7° C) for four to six weeks.

Prime with sugar and bottle or keg when complete.

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Not-So Pilsener

All-Grain Recipe

Ingredients

for 6 U.S. gallons (23 liters)

8.0 lb	(3.6 kg) German Pilsener malt
8.0 oz	(225 g) Belgian or other aromatic malt
2.0 lb	(908 g) Briess rice flakes
1.0 oz	(28 g) Mt. Hood hops 6% alpha (6 HBU/168 MBU) 60 minutes boiling
1.5 oz	(42 g) French Strisselspalt hop pellets 2% alpha (3 HBU/84 MBU) 60 minutes boiling
1.0 oz	(28 g) Mt. Hood hops 6% alpha (6 HBU/168 MBU) 20 minutes boiling
0.25 oz	(7 g) Mt. Hood hops, 10 minutes boiling
1.25 oz	(35 g) French Strisselspalt hop pellets 2% alpha, 2 minutes boiling
0.43 oz	(12 g) French Strisselspalt hop pellets 2% alpha, dry hopping
0.25 tsp	(1 g) powdered Irish moss
	Pilsener or German type lager yeast
0.75 cup	(175 ml measure) corn sugar (priming bottles) or 0.33 cup (80 ml) corn sugar for kegging

Target Original Gravity: 1.057 (14.5 B)

Approximate Final Gravity: 1.021 (5 B)

IBUs: about 40

Approximate Color: 5 SRM (10 EBC)

Alcohol: 4.7% by volume

Directions

A step infusion mash is employed to mash the grains. Add 11 quarts (10.5 liters) of 140° F (60° C) water to the crushed grain, stir, stabilize and hold the temperature at 132° F (53° C) for 30 minutes. Add 5 quarts (4.75 liters) of boiling water and add heat to bring temperature up to 155° F (68° C) and hold for about 30 minutes. Raise temperature to 167° F (75° C), lauter and sparge with 3.5 gallons (13.5 liters) of 170° F (77° C) water. Collect about 6 gallons (23 liters) of runoff. Add 60-minute hops and bring to a full and vigorous boil.

The total boil time will be 60 minutes. When 20 minutes remain add the 20-minute hops. When 10 minutes remain add 10-minute hops and Irish moss. When 2 minutes remain add the 2-minute hops. After a total wort boil of 60 minutes turn off the heat and place the pot (with cover on) in a running cold-water bath for 30 minutes. Continue to chill in the immersion or use other methods to chill your wort. Strain and sparge the wort into a sanitized fermenter. Bring the total volume to 6 gallons (23 liters) with additional cold water if necessary. Aerate the wort very well.

Pitch the yeast when temperature of wort is about 70° F (21° C). Once visible signs of fermentation are evident ferment at temperatures of about 55° F (12.5° C) for about one week or when fermentation shows signs of calm and stopping. Rack from your primary to a secondary and add the hop pellets for dry hopping. "Lager" the beer at temperatures between 35 and 45° F (1.5-7°C) for four to six weeks.

Prime with sugar and bottle or keg when complete.

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rice created some fruity esters, but I quickly ignored that hunch as I recalled the late hopping of French Strisselspalt. I had been sent a sample of this very low alpha hop and have come to attribute apricot aromas and to a lesser degree a hint of apricot flavor with these hops. Apricot character without the acidity. Unique. And as the beer was consumed over a period of time, the intensity did not diminish. Always there to awaken the floral fruity joy of sweet apricot, quickly to recede, giving way to noble hop flavor and pleasant bitterness of Mt. Hood hops and a Not-so Pilsener enjoyed in the hot months of summer or the crisp air of winter.

If you are intrigued, try your hand at special ordering French Strisselspalt hops (not to be confused with French Strisselbract) through your homebrew supply shop.

So let's cut the shuck and jive and get on with the recipe.

Charlie Papazian is president of the Brewers Association.

Reader Advisory: Warning!

These pages are rated XG (eXtra Geeky) by the Bureau of Magazine Muckymucks. Items in this section may contain raw data, graphic functions, full statistics and undiluted biochemistry. Keep away from poets, squeamish novices and others who may find the joyously technical nature of this prose to be mindbendingly conceptual or socially offensive. Also, because of the complex nature of brewing science, there is no guarantee that you will live longer, brew better or win any awards in the next homebrew competition based upon the conclusions presented here.

Beer Carbonation Levels

By Chris Bible

The amount of carbon dioxide within a finished beer is important for several reasons¹. The carbon dioxide level directly impacts the ability of a beer to form and retain a head of foam. It also contributes to perception of body within a beer and acts as a flavor enhancer by influencing the delivery of volatile odor and flavor compounds into the headspace of beers and into the olfactory area within our bodies².

Dissolved carbon dioxide also contributes to the acidic pH of a finished beer. This acidity is perceived as tartness on the tongue and as a “prickly” sensation perceived by the trigeminal nerve as a pleasure/pain sensation². Acidic pH also plays a role in extending the shelf life of finished beer.

Carbonation levels within beer are usually described in terms of “volumes” of CO₂. What is really being stated is the ratio of the volume of CO₂ (at standard temperature and pressure) per volume of beer in

which it is dissolved. For example, a beer carbonated to “2.3 volumes CO₂” would have 2.3 liters of CO₂ dissolved within every liter of beer; the ratio would be 2.3/1.

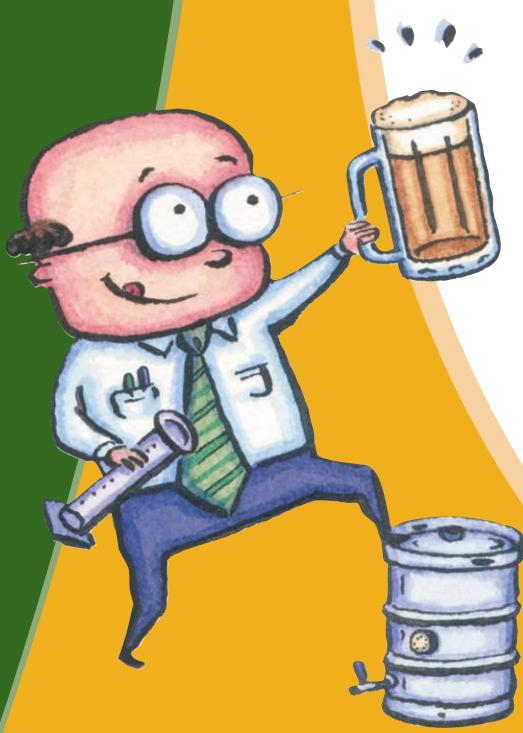
Beers have carbonation level ranges specific to the style of beer in question. Stylistic guidelines for carbonation levels within a given beer style from two different sources^{3,4} are given in Tables 1 and 2.

Beer that is ready to be carbonated has already undergone primary fermentation. Within a batch of fermented beer, yeast cells have enzymatically hydrolyzed maltose and maltotriose to glucose and the glucose has been converted into ethanol, carbon dioxide and energy.

Beer that has undergone primary fermentation has had CO₂ bubbling through it more or less continuously for several days (or weeks for a lager) and will be “saturated” with CO₂. The word “saturated” means that

TABLE I: CARBONATION LEVELS FOR VARIOUS BEER STYLES

Beer Style	Volumes CO ₂
British-style ales	1.5 – 2.0
Porters, Stouts	1.7 – 2.3
Belgian ales	1.9 – 2.4
European lagers	2.2 – 2.7
American ales & lagers	2.2 – 2.7
Lambic	2.4 – 2.8
Fruit Lambic	3.0 – 4.5
German Wheat beer	3.3 – 4.5



**TABLE 2: CARBONATION LEVELS FOR VARIOUS BEER STYLES⁴**

Beer Style	Volumes CO ₂	Beer Style	Volumes CO ₂
American Amber Ale	.2.2-2.8	English Dark Mild	.1.3-2.0
American Brown	.1.5-2.5	English Light Mild	.1.3-2.0
American Dark Lager	.2.5-2.7	English Old/Strong Ale	.1.5-2.3
American Lager	.2.6-2.7	English Ordinary Bitter	.0.75-1.3
American Light Lager	.2.6	English Pale Ale	.1.5-2.3
American Pale Ale	.2.2-2.8	English Strong (Extra Special) Bitter	.0.75-1.3
American Pilsener	.2.6-2.7	Flanders Brown	.1.9-2.5
American Premium Lager	.2.6-2.7	Foreign-Style Stout	.2.3-2.6
American Wheat	.2.3-2.6	German Pilsener	.2.5
Bamberg Rauchbier	.2.2-2.6	Helles Bock	.2.2-2.7
Barley Wine	.1.3-2.3	Imperial Stout	.1.5-2.3
Belgian Dubbel	.1.9-2.4	India Pale Ale	.1.5-2.3
Belgian Fruit Lambic	.2.6-4.5	Irish Dry Stout	.1.6-2.0
Belgian Gueuze Lambic	.3.0-4.5	Kölsch	.2.4-2.7
Belgian Lambic	.3.0-4.5	Maibock	.2.2-2.7
Belgian Pale Ale	.1.9-2.5	Märzen/Oktoberfest	.2.6-2.7
Belgian Strong Ale	.1.9-2.4	Münchner Helles	.2.3-2.7
Belgian Tripel	.1.9-2.4	Munich Dunkel	.2.2-2.7
Belgian White (Wit)	.2.1-2.6	North German Altbier	.2.2-3.1
Berliner Weisse	.3.5	Oatmeal Stout	.2.0-2.4
Bock	.2.2-2.7	Oud Bruin	.1.9-2.5
Bohemian Pilsener	.2.3-2.5	Robust Porter	.1.8-2.5
Brown Porter	.1.7-2.5	Schwarzbier	.2.2-2.6
California Common	.2.4-2.8	Scottish Export Ale	.0.75-1.3
Cream Ale	.2.6-2.7	Scottish Heavy Ale	.0.75-1.3
Doppelbock	.2.3-2.6	Scottish Light Ale	.0.75-1.3
Dortmunder/European Export	.2.6	Strong Scotch Ale	.1.5-2.3
Dunkelweizen	.3.6-4.5	Sweet Stout	.2.0-2.4
Düsseldorf Altbier	.2.2-3.1	Traditional Bock	.2.2-2.7
Eisbock	.2.4	Vienna	.2.4-2.6
English Best (Special) Bitter	.0.75-1.3	Weizen/Weissbier	.3.6-4.5
English Brown	.1.5-2.3	Weizenbock	.3.7-4.7

THE OVERALL FERMENTATION PROCESS CAN BE DESCRIBED⁵ AS:

the CO₂/beer solution has achieved a stable equilibrium with respect to the amount of CO₂ entering and leaving solution. Said another way, at saturation-equilibrium conditions, there is the same amount of CO₂ dissolving into the beer from the atmosphere above the beer as there is CO₂ escaping from the solution into the atmosphere above the beer. At saturation equilibrium

conditions, the amount going into solution equals the amount going out of solution.

The amount of CO₂ that is dissolved within beer at saturation equilibrium conditions is a function of the temperature and pressure of the beer. Lower temperature and higher pressures allow beer to dissolve more CO₂ per unit volume of beer. The amount of CO₂

that is dissolved in a water solution at saturated equilibrium conditions at atmospheric pressure is shown⁶ in Figure 1. (see page 56)

The effects of both temperature and pressure on this saturation equilibrium are shown⁷ in Figure 2. (see page 56)

A more familiar presentation of the effect of temperature and pressure on beer's ability to hold CO₂ is given⁸ in Table 3. (see page 56)

The amount of CO₂ that can be dissolved at saturation equilibrium in a solution of beer is slightly different than the values presented in Figures 1 and 2. Beer can hold slight-

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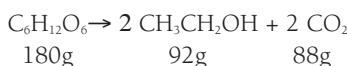
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ly less CO₂ per unit volume than water due to the fact that the other dissolved species within beer "get in the way" of the CO₂ that is trying to dissolve.

There are two ways that homebrewers typically achieve desired carbonation levels within their beer: secondary fermentation within a closed container (a bottle or keg), or force-carbonation.

If the homebrewer chooses to use secondary fermentation within a closed container to carbonate the beer, additional fermentable sugars must be provided to the yeast. If corn sugar (also known as glucose or dextrose) is used, then the reaction³ that produces CO₂ during carbonation is one in which one mole of glucose, C₆H₁₂O₆, creates 2 moles of ethanol, CH₃CH₂OH, and 2 moles of CO₂. Succinctly stated:



With a little stoichiometric algebra it can be shown that approximately 1 volume of CO₂ will be added to the beer for every 3.7 grams/liter of glucose that is dissolved

TABLE 3: COMBINED EFFECTS OF TEMPERATURE AND PRESSURE ON CO₂ CONTENT OF BEER

Temperature, °F	5 psi	10 psi	15 psi	20 psi	25 psi	30 psi
30	2.23	2.82				
35	2.02	2.52	3.02			
40	1.83	2.30	2.75	3.19		
45	1.66	2.08	2.51	2.94		
50	1.50	1.90	2.30	2.70	3.10	
55		1.75	2.12	2.47	2.83	3.18
60		1.62	1.95	2.27	2.60	2.92

*Values in table are volume CO₂/volume beer

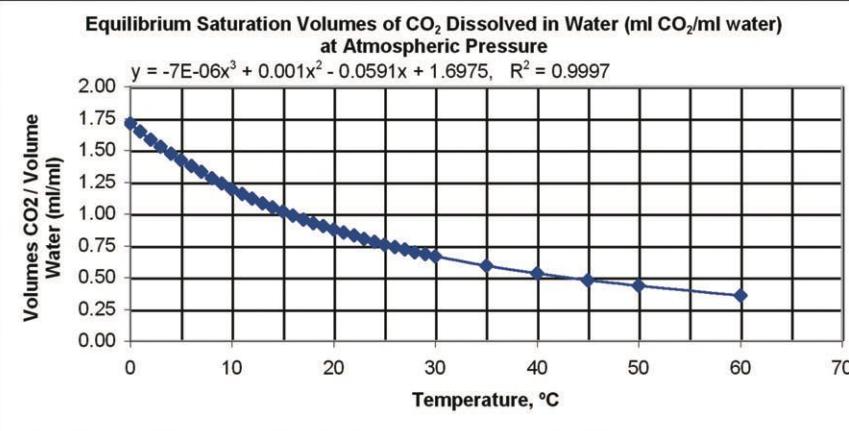


Figure 1: Saturation Equilibrium Concentration of CO₂ in Water at Atmospheric Pressure

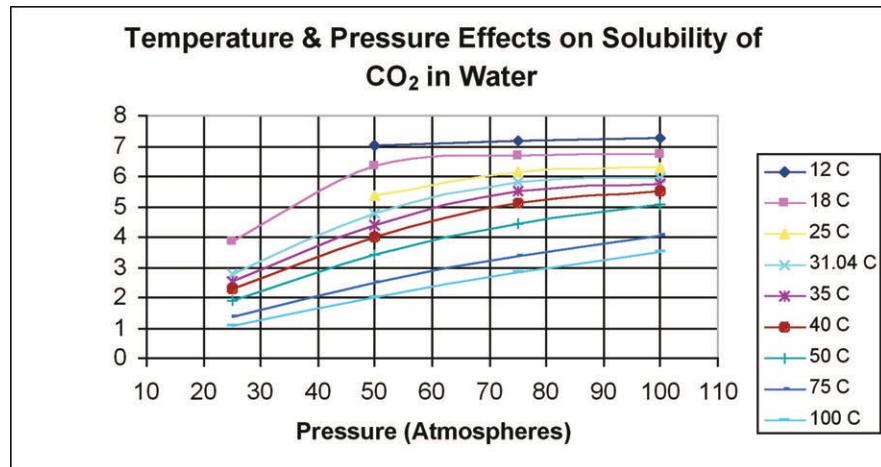


Figure 2: Effect of Temperature and Pressure on the Solubility of CO₂ in Water (1 atmosphere = 14.7 psi)

into the beer and allowed to undergo a secondary fermentation.

As an example, let's say that you've fermented a 5-gallon (18.9-liter) batch of beer and are ready to prime. Assuming that the

beer is at 25° C and atmospheric pressure, it will already contain about 0.75 volumes of dissolved CO₂ (see Figure 1). Let's further assume that we want to take the total carbonation level up to about 2.4 volumes of dissolved CO₂ at that same temperature.

Then:

$$2.4 \text{ volumes} - 0.75 \text{ volumes} = 1.65 \text{ additional volumes required}$$

$$(1.65 \text{ volumes needed}) \times [(3.7 \text{ g glucose/liter beer}) / (1 \text{ volume CO}_2 \text{ generated})] = 6.1 \text{ g glucose/liter beer required.}$$

$$(6.1 \text{ g glucose/liter beer}) \times (18.9 \text{ liters of beer}) = 115.3 \text{ g glucose required for priming}$$

This calculation assumes that we are carbonating water, not beer, so our assumption about the amount of CO₂ initially in the beer after primary fermentation is incorrect; in reality slightly more glucose will be required in order to achieve the desired carbonation level in beer. About 125 grams of glucose will actually⁹ be required to achieve the desired level of carbonation in this example.

If a homebrewer chooses to force-carbonate the beer, achieving correct carbonation levels in the finished beer is much more straightforward. All that is required is to hold the beer under pressure with CO₂ for a sufficient time such that the correct level (see Table 3) of carbonation is achieved for a given temperature. A force-carbonation hold time of three days has been suggested¹⁰, but holding the beer for an even longer time would certainly be appropriate.

Conclusions

1. Carbonation level is critical to the overall quality of the finished beer and impacts the flavor characteristics and mouthfeel of the finished beer.
2. Carbonation level within a beer can be easily controlled either by adding appropriate amounts of fermentable priming sugars during a secondary fermentation or by carefully controlling the temperature and pressure of the carbon dioxide while force-carbonating.
3. By carefully controlling the carbonation level in the finished beer, homebrewers can greatly enhance the taster's overall enjoyment of the beer and bring a bit of much needed, sparkling pleasure into the world!

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Corporation. He lives in Knoxville, Tenn. with his wife and son and has been homebrewing for more than seven years. Chris especially enjoys making and drinking stouts and porters.

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To Brew or Not to Brew? Silly Question

I recently had the “so you brew your own” conversation with my neighbor. Usually these discussions happen when I meet someone new. Typically, the new guy will tell me a story about how he made a couple of batches in college, but never pursued it any further. Sometimes I get the story about so-and-so’s grandfather, who made his own beer back in the Prohibition days until the bottles exploded all over the basement and so-and-so’s grandmother enacted her own version of the 18th Amendment.

My neighbor didn’t give me one of those stories. He just asked, “Why make beer?”

As opposed to what? Lemonade? Transmission fluid? Plutonium?

I just stared at him for a few seconds, cocking my head to the side as if that would help make sense of his question. It’s not that he was opposed to drinking beer; he readily accepted a six-pack of my amber to take home. But the notion of actually making the stuff was as confounding to him as performing his own appendectomy.

There are a number of responses for such a question.

There is the “Smokey and the Bandit” answer: “Because I’m thirsty, dummy.”

There is the sarcastic teenager response: “Duh.” (Most effective when accompanied by a rolling of the eyes.)

Fiscal responsibility is another justification for making your own. For the cost of a few bottles of Chimay, you can make 5 gallons of your own Belgian beauty. The notion of “good beer cheap” has universal appeal.

Patriotism. Many of the founding fathers (and mothers) of this country were beer makers. In fact, the original logo for the United States was an eagle with a bundle of barley in one talon and a hop vine in the other. (OK, I made that part up.)

Selection is a great advantage of homebrewing. I am not hamstrung by the finite and untested palates of the locals, or the bottom-line orientation of the distributors. I can make any kind of beer I want. An IPA made with peated malt, German hops and Australian yeast? A peach Pilsener? A lavender barleywine? No problem. I might be ostracized by the BJCP, but pushing the boundaries is part of the fun.



I could have told my neighbor about the philosophical and spiritual nature of brewing. Any hacker with a can of malt extract and a packet of Coopers yeast can make a quaffable ale. But to consistently generate first-rate beer, one must boldly confront one’s own flaws and continuously seek opportunities to improve—tweaking amounts and adjusting temperatures, watching over the brew pot like the mother of a newborn baby.

Indeed, the Zen of the brewing experience is that one can become proficient only after recognizing one’s weaknesses. (This seems rather high-minded coming from a guy standing in a cluttered garage with hops in his hair and a barley-encrusted wooden spoon in his back pocket.)

I considered detailing for him the political statement that one makes by homebrewing. Homebrewers are not content to swallow the quotidian swill foisted upon them by heartless, insipid corporations. No amount of slick and smarmy advertising will coerce them to forsake their palates; their taste buds refuse to be swayed by the condescending sneers of the trendy and tasteless. By choosing to make your own beer, you are choosing your own destiny.

Instead, I just said, “It’s a lot of fun. And it tastes good, too.” Both of which are also very good reasons for making your own beer.

Dave Hayes and his wife, Mandy, live in Forest Grove, Ore., where their bubbling kettle often attracts the attention of neighbors. They are members of the Oregon Brew Crew and have been fermenting their own destiny for seven years.

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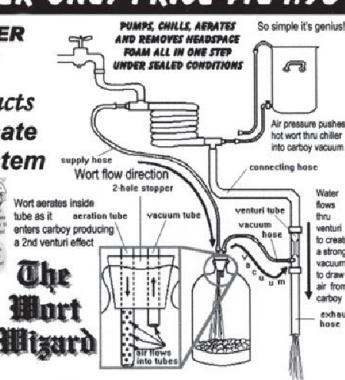


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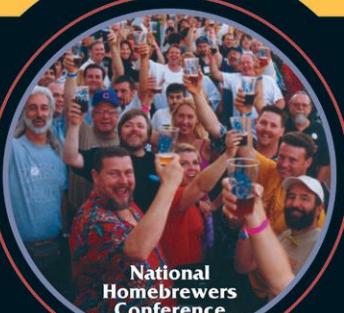


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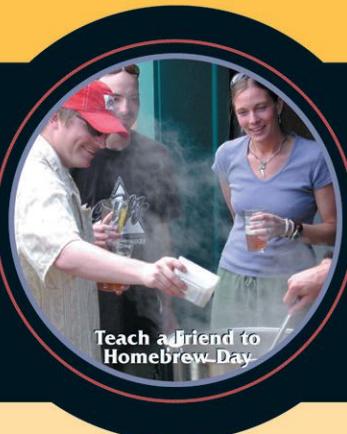


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