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THE HOW-TO HOMEBREW BEER MAGAZINE

MARCH-APRIL 2008, VOL.14, NO.2

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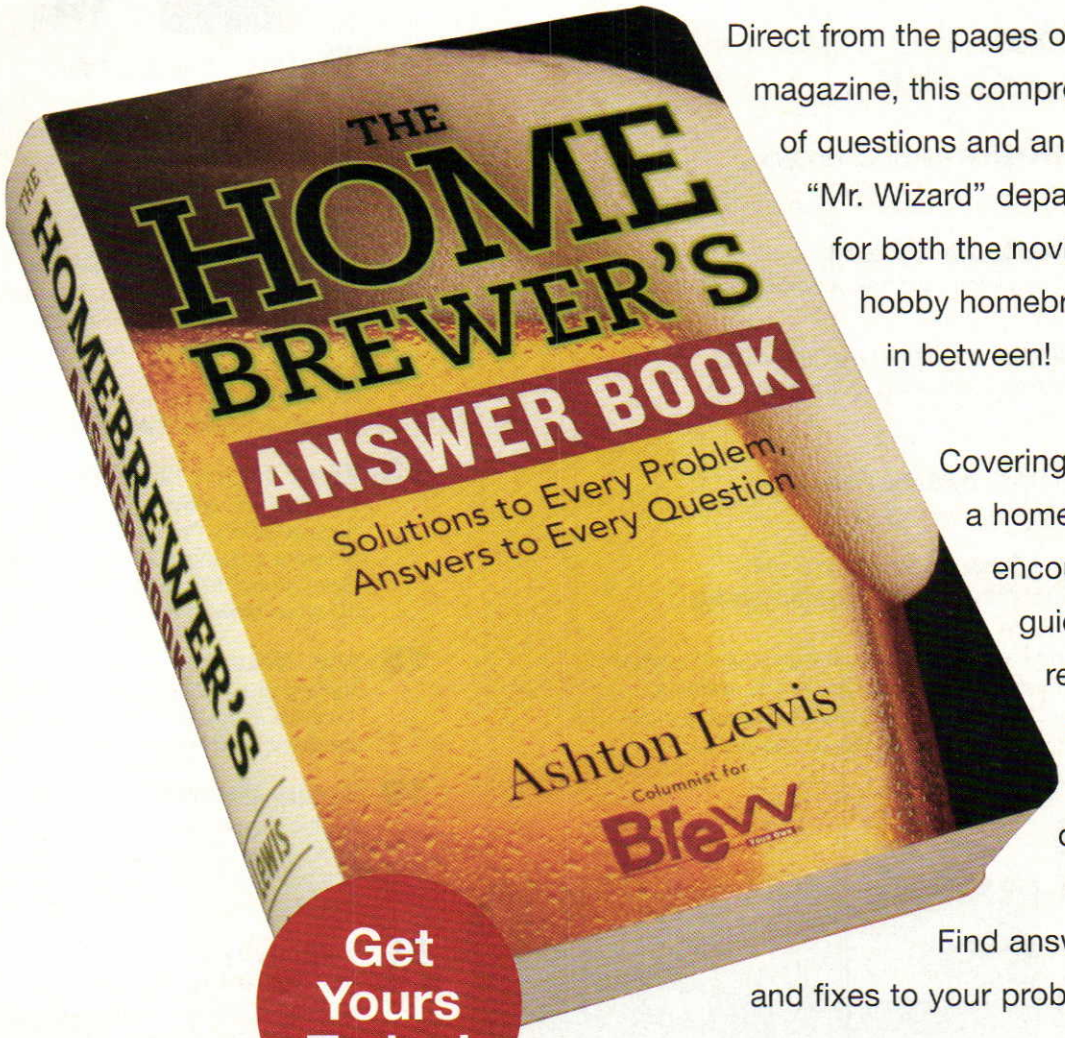

Direct from the pages of *Brew Your Own* magazine, this comprehensive collection of questions and answers from our popular "Mr. Wizard" department offers advice for both the novice and the advanced hobby homebrewer – and everyone in between!

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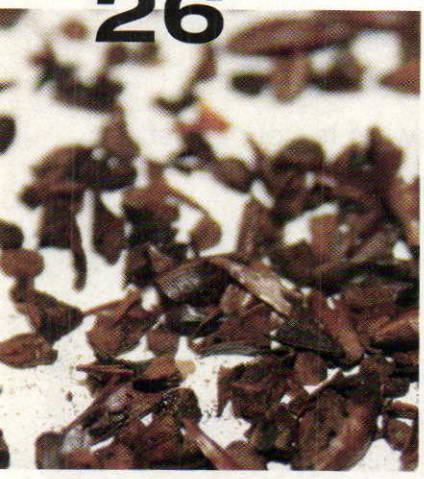
Volume 14 Number 2

Features



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RECIPE INDEX

BYO RECIPE STANDARDIZATION

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

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

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

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

Brew Your Own
THE HOW-TO HOMEBREW BEER MAGAZINE

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Cover Photo: Charles A. Parker

MaiL

Dragon's Milk Malt

In the January-February 2008 Replicator column, the amount of pale malt listed in the all-grain option for Dragon's Milk is incorrect. The correct amount of pale malt for the recipe should be 13 lbs. (5.9 kg). Correspondingly, you will need 21 qts. (20 L) of water for the mash. Sorry for any inconvenience this caused.

Revisiting Reiterated Mashing

We've received a lot of letters about the reiterated mashing technique presented in the December 2007 issue of BYO, and the topic has sparked some discussion on homebrewing forums on the internet. Here, story author (and BYO Editor) Chris Colby responds to the most-asked questions:

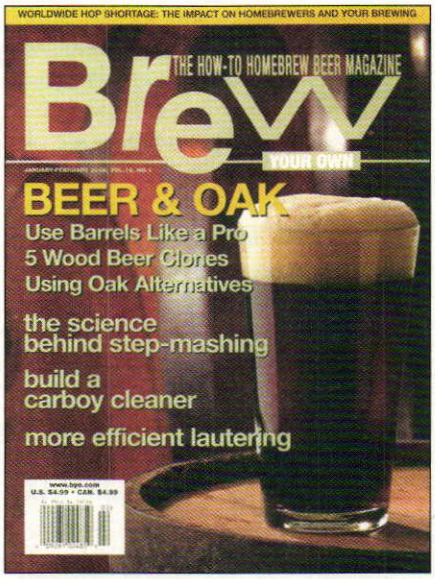
"The basic idea behind reiterated mashing is to produce high-gravity wort from an all-grain grist. This is accomplished by performing two or three mashes, each mashed in the wort from the previous mash. Because better extract efficiency would lead to higher-gravity brews, most of the questions I received dealt with extract efficiency — what should brewers expect and how could they improve it.

"For your first mash, your extract efficiency can be whatever you want it to be, up to your own usual efficiency. If you mash and lauter as you normally do, your extract efficiency should be normal. However, in my recipes, I give the procedure for a somewhat rushed mash and lauter, because a two or three mash brewday is already going to be long. Using the rushed procedure, my efficiency drops a little compared to my usual extract efficiency. But, you can decide for yourself how to collect your first wort.

"In the second mash, the grains are mashed with wort, the first wort is run off and a small amount of sparge water is added. The amount of sparge water in the second and third mashes is equal to the amount of water the grains absorb. (This allows you to keep the volumes of second and third worts equal.)

"Your efficiency will increase with mashing time, and you can monitor the increasing density of your wort with a refractometer. Likewise, your efficiency will increase the slower you run off the wort once the sparge water has been added. And of course, if you kept sparging, your efficiency would increase further — however, this would also dilute your wort and work against your goal of concentrating the wort in your mash tun.

"So, in the second mash, more time (and more stirring) is going to increase your extract efficiency. However, it is unavoidable that some wort sugars will be left behind. In practice, the efficiencies I've gotten in my second mash were not much lower than in the first — around 5–10% lower in most cases. However, this needs to be interpreted in the light of the fact that my first mash efficiency is usually lower than my regular efficiency due to the quick wort collection.



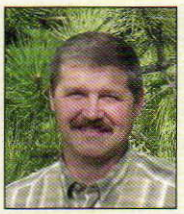
"In the third mash, the dropoff in efficiency is more pronounced. On average, my efficiency for the third mash dropped about 15–20% compared to my first mash (based on my second and third tries at the three-mash procedure.)

"Among the letters I got from brewers who tried reiterated mashing, some were bummed that their extract efficiency was low compared to their expectations and others were psyched that their extract efficiency was so high compared to their expectations. Ironically, the reported efficiencies in these two groups were basically the same. If you're going to be disappointed in getting an extract efficiency lower than your usual single mash efficiency, then this method is not for you. On the other hand, if you think the process is going to be wildly inefficient, you will likely be surprised at how well the technique works. With practice, your extract efficiency will rise. And, if efficiency is really a priority, you can extend your brewday to allow for longer rests, more thorough stirring and slower wort collection.

"Just today I received a PM (personal message) from someone on the MoreBeer forum who hit on one way of boosting his efficiency slightly. When lautering the second mash, he kept collecting wort after cutting off the wort running to the kettle (for the third mash). He then used this wort in place of the sparge water for the third mash. Hey, why didn't I think of that?

Contributors

Kristen England (right) wrestles in Mexico under the stage name "el BJCP Continuing Education Directoro." He has won numerous NHC and MCAB gold medals in addition to being named the 2005 Midwest Home Brewer of the Year and 2005 High Plains Brewer of the Year. He is a member of the St. Paul Home Brewers Club and a BJCP judge. In his spare time, Kristen recently received his PhD in Pharmacology from the University of Minnesota. He currently lives in St. Paul with his wife (left), daughter and a one-eyed dog. In this issue he body slams roasted barley on page 26.



Jon Stika writes our "Techniques" department in every issue of *BYO*. When Jon says he brews his own, he really means it. Jon grows his own hops and has grown and malted his own barley. Jon grew up in Milwaukee, Wisconsin, within sight of the Miller brewery and is now a member of the Heart River Homebrewers Club, of Dickinson, North Dakota. On page 55, he writes about the importance of quickly getting your hot wort down to yeast pitching temperatures and the different wort chilling methods you can use at your home brewery.

Ralph Olson is the general manager and owner of Hopunion CBS LLC. This hop expert has been buying, selling, handling, storing and processing hops for more than 25 years. He loves to brew his own beer, work in the garden and go jeeping (as pictured here with his 1968 Landcruiser which has been with him for more than 20 years). He also contributes to *Brew Your Own* as a member of our Editorial Review Board. In this issue, he helped us pull together our "Hop Survival Guide" package.

"For any big, very big or huge beer, you end up paying for your extract somehow. You either pay the price of malt extract, the price of propane and the time of boiling your wort for an extended period or the price of a gross excess of grains (in beers where only the first wort is collected). In reiterated mashing, the price is mainly the time spent mashing and and a slight-to-moderate decrease in extract efficiency compared to a single mash brew. The payoff is a normal-length boil (and the associated decrease in color pickup) and relatively cheap ingredient costs. Reiterated mashing can also be used to make very big or huge beers in smaller mash/lauter and boiling vessels compared to other all-grain methods.

"I also received some letters inquiring about the grist in the Mjollnir and Ragnarok recipes. I received questions on why I used flaked maize and 6-row malt in the formulations and why I included Vienna malt as this is a darker base malt and the beer was supposed to be light in color.

"My idea in formulating the recipes was to make a 'super-Octoberfest,' a beer that looked and tasted — to the extent that this was possible —like a regular Octoberfest, but much higher in gravity. Normally, I would go with an all Vienna malt grist, but I wanted to lighten it up a bit, so I added some Pilsner malt. I wasn't shooting for the absolute lightest-colored beer I could make (and, Vienna malt is only about 4 °L anyway; just one degree Lovibond darker than a typical pale ale malt). The flaked maize is just there to add some completely fermentable extract. The beers were going to be high in gravity, so adding some flaked maize would allow the beer to ferment to a lower final gravity and not be cloying. I added the 6-row malt for some added enzymatic power.

"In the Mjollnir recipe (the two mash brew), the amount of malt in the recipe is in the ballpark of a regular Octoberfest, with the flaked maize added 'on top' for more fermentables. In the Ragnarok recipe, the amount of malt is in the ballpark of a doppelbock, with the maize added to boost the specific gravity.

"Adding the flaked maize also reduced the amount of husk-derived materials in the beer. When mashing and lautering, compounds from the husk of the barley malt enter your wort. Some of these compounds produce the nice, malty flavors of a good beer. Others, such as tannins and silicates, produce less desirable attributes. As you increase the amount of malt in a recipe, you increase the amount of both the desirable and undesirable husk compounds in your beer. Also, in my experience, when all-malt beers exceed a certain gravity, they start tasting less like beer and more like wine. And, I like beer. So, my formulations were aimed at brewing very big beers with only an average level of 'husk stuff.'

NEW YEAR, NEW OFFICE

Brew Your Own's editorial and advertising office has moved.

Effective with this issue, the new mailing address for Brew Your Own's editorial and advertising departments is:

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Our phone and fax numbers remain the same. Our Escondido, California subscription department address also remains the same.

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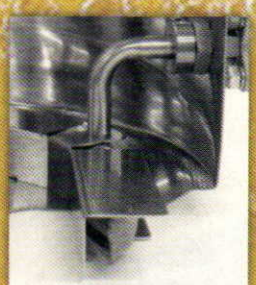

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homebrew NATION

BYO

reader RECIPE
Tom Seigler • Centralia, Illinois

This is basically a red ale, but with some added rye for complexity. The yeast made this beer clear as a bell, and after one month in the bottle I think it is out of this world.

Tom's Red
(5 gallons/ 19 L, all-grain)

OG = 1.045 FG = 1.014
IBU = 27 SRM = 15
ABV = 4.1%

Ingredients

8 lbs. (3.6 kg) pale 2- row malt
0.75 lbs. (340 g) flaked rye
0.18 lbs. (82 g) roasted barley
0.18 lbs. (82 g) biscuit malt
0.18 lbs. (82 g) crystal malt (20 °L)
5.25 AAU Styrian Goldings hops (1 oz./28 g of 5.25% alpha acids) (60 m.)
5.25 AAU Styrian Goldings hops (1 oz./28 g of 5.25% alpha acids) (10 m.)
White Labs WLP004 (Irish Ale) yeast (from a starter)

Step by Step

Mash at a ratio of 1.3 qt/lb for 60 minutes at 152 °F (67 °C) and sparge at 170 °F (77 °C).

byo.com BREW POLL

How will the hop shortage affect your homebrewing?

Exploring new hop varieties: 40%
Growing my own hops: 25%
Trying hop substitutions: 21%
Less brewing: 5%
Waiting for favorite varieties to return: 4%
Making gruits (using ingredients other than hops): 3%
Brewing unhopped beer: 3%

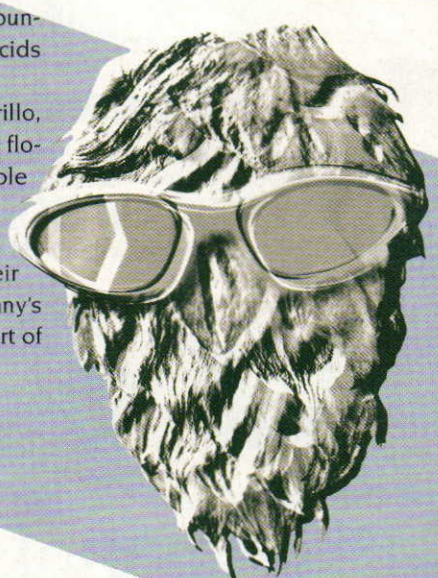
Check out the latest poll question and vote today at byo.com

hop PROFILE Ahtanum

Ahtanum is an American hop variety bred by Yakima Chief Ranches, named for the town of Ahtanum in the Yakima county of Washington state. It has a range of 5.7 to 6.3% alpha acids and 5 to 6.5% beta acids.

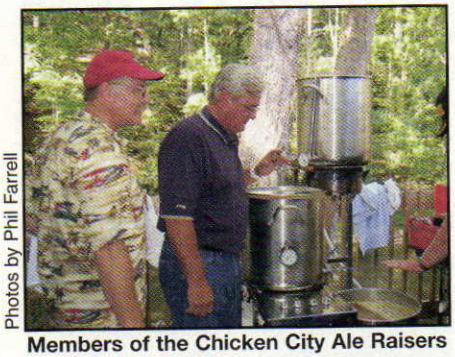
Often used as a substitute for Cascade or Amarillo, Ahtanum is most often used as an aromatic variety. It has floral and citrus aromas, very similar to Cascade, and is suitable for lagers and American ales.

Commercial examples of beers hopped with Ahtanum include Brooklyn Brewing's Brooklyn Scorcher, from their Brewmaster's Reserve series and Sly Fox Brewing Company's Ahtanum IPA, which they brewed in 2004 and 2005 as a part of a project series of varietal IPAs.



club PROFILE
The Chicken City Ale Raisers

Cumming, Georgia



Photos by Phil Farrell

Members of the Chicken City Ale Raisers at 2007's Octoberfest in Helen, Georgia

Jimmy Carter may have legalized homebrewing in the nation, but in the early days, we in North Georgia had to keep a low profile lest we wind up cooling our heels in the County jail. We Chicken City Ale Raisers (CCAR) were hardened criminals in those days. Us stock brokers, government administrators, dentists and blue-collar guys had to pop a gentle cap. Our name reflects the feeling of the day, in that we needed to "raise a little ale" to get the state of Georgia to legalize such a worthwhile and noble pursuit that was practiced so freely by the founders of our country.

Some members are welders and machinists. We have manufactured nine 3-tier systems over the years, complete with all kinds of vessels, burner manifolds, pumps, chillers and hopbacks. We religiously brew together for National Homebrew Day and Teach a Friend to Brew. We also have several cooks and two sausage presses. This evolved into an annual club Oktoberfest with homebrew, homemade sausage, beer tent, and an annual club homebrew challenge.

The CCAR chicken gets inducted into the Rogue Nation with Sebbie Buhler.

The CCAR won the Peach State Open three times in the last five years. We were the top club in the Mid South two years ago. Not just a regional aberration, we have three BJCP judges among us, including a Master and a National and three CCAR members who have won multiple AHA National medals. Phil Farrell was also one of the three finalists for 2007's Beer Drinker of the Year Award. The CCAR are small but mighty, always choosing quality over quantity.

Not content to have a simple mascot, the CCAR Chicken brews, drinks, and travels with us. The Chicken was originally a beer talisman that was waved over the mash, boil, and fermentation for good luck. In order to keep the beer gods smiling upon us, we are now trying to share our good fortune and channel as much of the brewing mojo in the known universe through our chicken. The chicken so markedly improved our brewing, we decided to share him with the rest of the beer world. The Chicken's first function was the 2005 AHA National Convention. He now visits breweries, brewpubs, beer bars, homebrew shops, contests, festivals and beer events everywhere. He is officially a citizen of Rogue Nation and your favorite brewer or beer celebrity has probably had their picture taken with him. Last year, the chicken visited every Beer Hall in Munich for Oktoberfest. Take that Spuds McKenzie! For more information about the club (and a gallery of Chicken pictures) visit us at www.ccarhomebrewclub.com.

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Do you have a system or a homemade gadget that will make our readers drool? How about a killer recipe or tip? Want to profile your club? Email a description and photos to **edit@byo.com** and experience fame among 100,000+ homebrewers!

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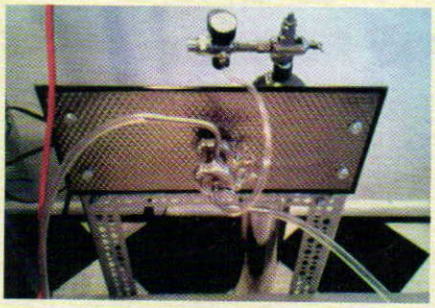
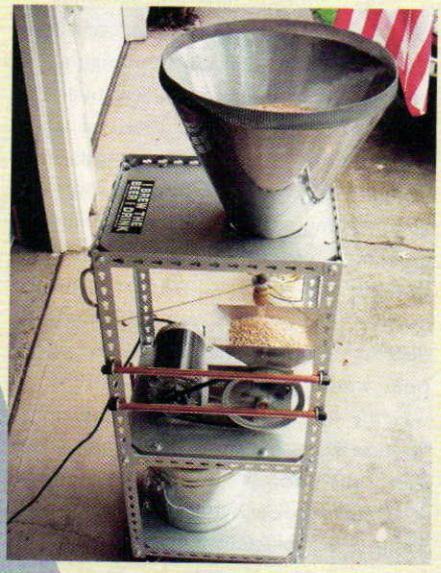
homebrew systems that make you DROOL

Don Darst
Salem, Oregon

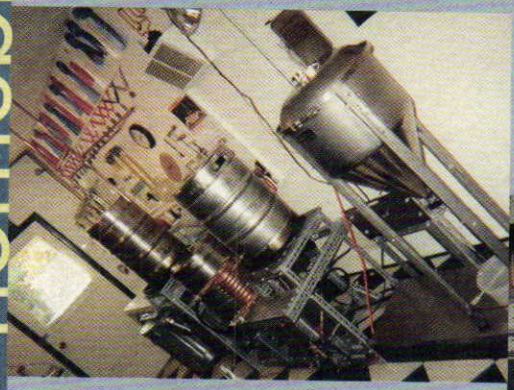
WELCOME to Don's Neighborhood Pub. There's no Bud here, just the best homebrew! I couldn't have done it alone, though. I've got to thank Ron Thomas for the tile flooring and ideas for my brewery, Kevin Ladue for the stainless work on my oxygenator, Evan Mackie for the stainless kettle and grinder lids of my design, Saffrons Supply for the plumbing supplies and last but not least my beautiful wife Nancy, because you have to have an understanding wife to allow a designated brew shop in your home!



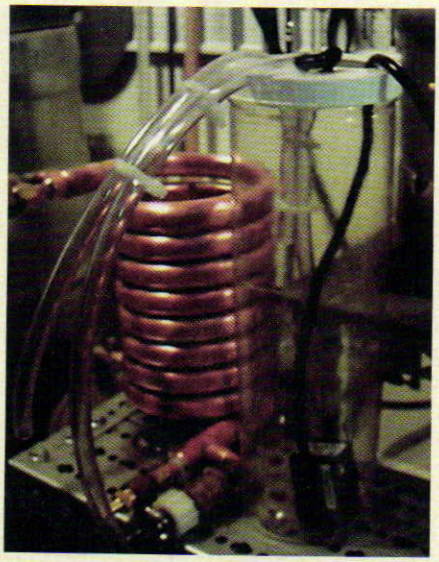
OXYGENATION STATION: Made from stainless steel, a small drum houses an oxygen stone. It is sealed with o-rings and uses 2-piece sanitary clamps to connect leading and trailing ⅜" stainless tubing. I found that while transferring wort, dialing in ½ pound of oxygen keeps foam manageable with quick ferment.



GRAIN GRINDER: The core of the grinding stand is my Glatt grinder. An eight-to-one pulley reduction keeps it spinning at around 200 rpm. I built the framework from scrap angle iron and bolted it together like an erector set, adding ¾" plywood for the bases. The hopper, actually an inverted stainless exhaust stack found at a salvage yard, holds over 30 pounds of grain. I soldered the ball valve on so I could regulate the flow.



LAZER BLUE WATER: I added drama to filling my hot liquor tank by installing a lazer blue light to the flow. It doesn't make the beer taste better, but impresses the hell out of my brew buddies.



BREWERY CHILLER:
The ½" copper pipe end of my counterflow chiller returns to the sink to fill either a bucket for Powdered Brewery Wash or sanitizer. Water boiled in PBW is gravity-fed from the brew kettle through the chiller, followed by Iodophor or Star San sanitizer. To sanitize before use, I made what looks like a new car fuel pump cartridge. I drop an aquarium pump in a tall tubular container (I think it had Cheerios in it) with precut clear tubing. It slips into the center of the chiller perfectly, holding it securely. I circulate for 30 minutes before hooking my beer lines to it. I can submerge the entire container in my sink of sanitizer to get the right proportions.

KEG WASHER: Another idea from the microbrewery I worked at was having my own keg washer. For the bigger cleaning jobs, I fabricated this table with locking wheels and a power head made of ½" copper tubing. One hacksaw cut made at about a 45-degree angle makes city water pressure work really well! The added spray nozzle on the hose shoots externally on a keg or bucket. The water is directed away, with an automotive drip pan. This setup makes cleaning almost fun.

replicator
by **Marc Martin**

Dear Replicator,

On a recent trip to Vermont I stopped by Harpoon's smaller brewery in Windsor. I really liked the beer and was looking forward to trying one of the limited 100 Barrel Series. Harpoon had English-style Old Ale at the time, and as soon as I tried it I fell in love. I bought a case on my way out and it didn't last long. I can't locate this beer where I live and it is only made in small batches once a year. If you could help me out with a recipe that is close I would appreciate it very much.

Thomas Belanger
Gorham, New Hampshire

Thirty years ago, when only mega-breweries ruled America, several styles of beer were almost lost in obscurity. Even with the emergence of microbreweries, some styles were still very slow to reappear. One of these, Porter, is now brewed by most craft brewers. Old ale, however, is still often overlooked. Fortunately, some of the more adventurous brewers are reviving the style and offering it at least once a year.

Harpoon has long been known as a brewery on the leading edge and willing to offer this type of unique beer to its patrons. Two college friends who had traveled through Europe decided in 1986 that Boston was ready for beer with real flavor.

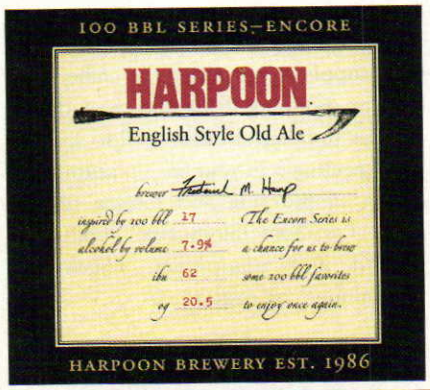
By 2000, high demand had pushed the capacity of Harpoon's Boston brewery to its limit. Rather than expand further in Boston, Harpoon purchased the former Catamount Brewery in Windsor, Vermont, which provided for an additional 30,000 barrel capacity. In the winter of 2005, more tanks were added for a boost to 55,000 barrels. The Windsor brewery brews the regular Harpoon lineup plus Vermont Draft Soda. Additionally, the "100 Barrel" limited edition beers are brewed here.

Fred Hamp is the brewer responsible for the Old Ale. His mother gave him a homebrewing kit for his 21st birthday and he has been at it ever since. In 2002 he attended UC-Davis and graduated from its Master Brewers program. He has been with Harpoon for five years.

Fred developed the recipe for the Old Ale and brewed the first batch in the winter of 2006/07. Because of its popularity, Harpoon is planning a "100 Barrel Encore." Fred said that he tried to stay as close as possible to the traditional English style by starting with a solid malt backbone and adding just enough specialty malts to develop the color and complexity needed for this big beer. English hop varieties were used because of their earthy profile and their tendency to not overpower the dark malts. He suggests to pitch plenty of yeast and to age the brew well to bring out its flavor.

Now Thomas, you too can revive this style and "Brew Your Own."

For more information about Harpoon, visit them at www.harpoonbrewery.com or call 1-888-HARPOON (427-7666).



Harpoon Brewery English Style Old Ale

(5 gallons/19L, extract with grains)

OG = 1.082 FG = 1.020
IBU = 62 SRM = 19 ABV = 7.9 %

Ingredients

9.9 lbs. (4.5 kg) Muntons Light, unhopped, malt extract
10 oz. (0.3 kg.) light dried malt extract
7 oz. (0.2 kg) biscuit malt
7 oz. (0.2 kg) crystal malt (30 °L)
6 oz. (0.17 kg) aromatic malt
2 oz. (57 g) chocolate malt
2 oz. (57 g) black malt
16.5 AAU Challenger pellet hops (15 min. into the boil) (2 oz./56 g of 8.25% alpha acids)
1.25 AAU Fuggle pellet hops (60 min. into the boil) (0.25 oz./7 g of 5% alpha acids)
2.4 AAU East Kent Goldings pellet hops (at shutdown) (0.5 oz./ 14 g of 4.8% alpha acids)
½ tsp. yeast nutrient (15 min. before shutdown)
White Labs WLP 007 (Dry English Ale) or Wyeast 1028 (London Ale) yeast
¾ cup (150g) of corn sugar for priming

Step by Step

Steep the crushed grain in 2 gallons (7.6 L) of water at 155 °F (68 °C) for 30 minutes. Remove grains from the wort and rinse with 2 quarts (1.9 L) of hot water. Add the liquid and dry malt extracts and bring to a boil. While boiling, add the hops and yeast nutrient as per the schedule. Add the wort to 2 gallons (7.6 L) of cold water in the sanitized fermenter and top off with cold water up to 5 gallons (19 L).

Cool the wort to 75 °F (24 °C). Pitch your yeast and aerate the wort heavily. Allow the beer to cool to 68 °F (20 °C). Hold at that temperature until fermentation is complete. Transfer to a carboy, avoiding any splashing to prevent aerating the beer. Let the beer condition for one week and then bottle or keg. Allow to carbonate and age for four weeks and enjoy your English Style Old Ale.

All-grain option:

This is a single step infusion mash. Replace the malt syrup and dry extract with 16 pounds (7.25 kg) 2-row pale malt. Mix the crushed grain with 3.5 gallons (13 L) of 172 °F (78 °C) water to stabilize at 155 °F (68 °C) for 60 minutes. Sparge slowly with 175 °F (79 °C) water. Collect approximately 6 gallons (23 L) of wort runoff to boil for 60 minutes. Reduce the 60 minute hop addition to 1.75 oz. (50 g) to allow for the higher utilization factor of a full wort boil. The remainder of this recipe and procedures are the same as the extract with grains recipe.

Homebrew CALENDAR

March 15–16
Buckeye, Arizona
Great Arizona Homebrew Competition
Sponsored by the Brewmeisters Anonymous homebrew club. BJCP/AHA rules apply, $6 per entry. All entries must be received by March 11. Printable entry forms, labels, dropoff locations and information are available at www.brewarizona.org.

March 28–29
Dallas/Ft. Worth, Texas
Bluebonnet Brew-off
The annual event featuring a homebrew contest, which is the first leg of the Lone Star Circuit, kicks off once again. Entries will be accepted from February 18 until February 29. Judging will occur March 8, 9, 15 and 16. Registration information, rules and more available at www.bluebonnetbrewoff.com.

March 29
Blue Island, Illinois
Chicago Cup Challenge Homebrew Contest
The 18th annual event featuring the Chicago Beer Cup, which is awarded to the homebrew club whose members accumulate the most points. Part of the Midwest Homebrewer of the Year Competition. Entries will be accepted from March 10 until March 22. More information at www.bossbeer.org.

April 19
Bend, Oregon
COHO Spring Fling Homebrew Competition
The first annual homebrew competition of Central Oregon. This will be an AHA/BJCP event, hosted by the Central Oregon Homebrewers Organization. Entries must be received by April 14. Complete event details are available online at www.cohomebrewers.org.

BEGINNER'S block

Wort Chilling For Stovetop

by Betsy Parks

Before investing in homebrewing equipment, many new brewers boil concentrated wort on a stovetop with the intent to add cold water to bring the volume up to a full batch. Once the boil is complete, however, the wort needs to be cooled quickly to proper pitching temperature just like any other batch. This issue, we learn the basics of why rapid cooling is important and gain a few tips for cooling your stovetop wort.

You must chill

The primary purpose for chilling is to achieve the right temperature for your yeast to properly thrive. Pitch when the wort is too hot and your yeast will die; too cold and the yeast won't thrive. But you can't simply take your pot off the stove and wait, because one of the most important purposes of wort chilling is preventing contamination. Once the wort dips in the range of 80 to 130 °F (27 to 54 °C), beer is at a high risk of contamination from bacteria and microorganisms. Wort left to cool without your help (or longer than an hour) will also develop unwanted levels of dimethyl sulfide, which imparts off flavors.

Cool it down

To get your pot of concentrated wort to the right temperature, choose one of the following methods that work for you.

The first approach is the tried-and-true sink-based ice bath. Fill a sink (or similar vessel) with cold water and enough ice so that the bath will come up the sides of your brewpot without overflowing into the pot or out of the sink. Transfer your pot of hot wort to the sink with the lid on and immerse it in the bath. At this point you can either leave your pot untouched in the bath, adding ice and cold water when the icebath starts to warm up, or you can stir the wort. Stirring is not necessary and can be an added risk because you're removing the lid of the pot, introducing a spoon or other stirring device and potentially aerating the wort. It can also speed up the cooling, however, so if you want to stir, sanitize whatever you use to stir the wort (a stainless steel spoon is best). Stir slowly to prevent aerating and make sure nothing gets into the wort, including water from the sink or your hands.

Another method is to add ice to the heated wort, which can both chill as well as bring the volume up. Any old ice won't do for this task, however. To prevent contamination, you'll have to make your own ice from boiled water in an airtight container. This is good, however, because it gives you an opportunity to premeasure a quantity of water, saving a step during the crucial cooling window. If you decide to add ice to your wort, be sure whatever you make your ice in (like a 1-gallon or 1-liter plastic bottle), is sanitized inside before you add your boiled water. After the boil, sanitize the outside of the container, cut it open and add the ice to the wort. Stir the ice slowly, just as you would for the ice bath, until the wort is at your recipe's pitching temperature. If you have one gallon (3.8 L) of wort at 200 °F (93 °C) and add 0.75 gallons (2.8 L) of frozen water, the resultant temperature is about 70 °F (21 °C), assuming that the pot is not super heavy, which adds thermal mass.

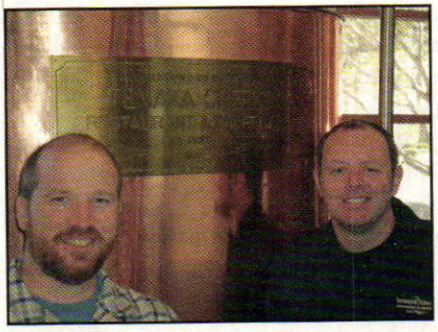
A third possibility is using an immersion chiller. A basic immersion chiller can be made at home with 15 to 20 feet (5 to 6 m) of soft copper tubing, some food-grade, heavy plastic tubing and some hose clamps and fittings, all of which you can find at regular hardware and homebrew supply stores. Using the chiller is as easy as dropping it into the wort during the last 10 minutes of the boil to sanitize it, connecting it to your faucet, putting the output in the sink and turning on the water. For more information about wort chilling and equipment, check out "Techniques" on page 55.

Brewing Kölsch

How to make the beer of Cologne

by Betsy Parks

As winter eases its grip, one of the best ways to usher in the warmer months is to brew something a little lighter. This issue, four US brewers kickstart the season with some advice for making the best Kölsch. Break out the stange glasses!



TIM ETTER AND ANTHONY GIBSON, Master Brewer and Head Brewer at Tenaya Creek Restaurant and Brewery in Las Vegas. Tim established Uinta Brewing Company in Salt Lake City before developing the Tenaya Creek Restaurant & Brewery concept with his family in 1999.

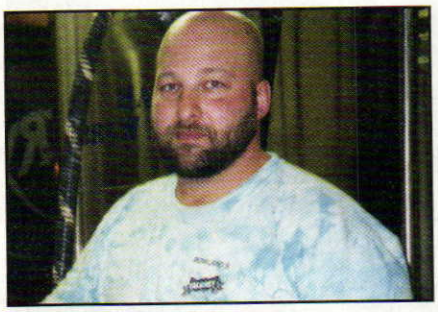
When we formulated our Tenaya Creek Kölsch, we were definitely going for the traditional style. We toyed around with different variations but always found ourselves coming back to the traditional Kölsch flavor.

For us to brew a traditional Kölsch, the two main areas we focused on were the yeast, including temperature, and the malts. We use an American Ale yeast that we find gives us excellent results for attenuation and a slight fruitiness that rounds out the palate and gives our Kölsch wonderful balance. We also use all German malts to keep with the traditional theme, which include Pils, Munich and wheat malts.

There are lots of ways for both home and commercial brewers to use ingredients and techniques to make a Kölsch stand out. For example, the strain of yeast we use allows us the ability to ferment at a lower temperature to give us a crisp but balanced mouthfeel. It is not a Kölsch strain, but we still achieve the results we want and do not encounter any clarity problems that sometimes come along with Kölsch strains.

An individual brewer's take on styles can be very different and also what they wish to achieve can also be very different, so it's tough to give specific advice for making your own Kölsch. In our experience, however, the two most important factors to keep in mind are getting to know the yeast strain you are using and trying to use authentic high quality German malts.

Photo by Jim Witmer



PATRICK ROWLAND is the main brewer at Rowland's Calumet Brewery. He learned to brew from his father Robert, who founded the brewery in 1990 with his wife Bonita at their North Madison Street bar in Chilton, Wisconsin, which opened in 1983. When it opened, Rowland's Calumet was one of the smallest commercial breweries in the US. Patrick started working full time for the brewery in 2002 and took over as the brewer last year following his father's passing.

The recipe for Calumet Kölsch was formulated by my father, and I would consider it to be a classic and true to the original German style.

For the base malt, we use equal parts of wheat, 2-row and 6-row barley malt, plus some Briess Carapils (Chilton is the home of Briess Malt & Ingredients Co.).

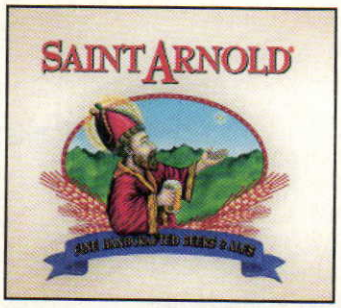
At one point, we had a brewer from Germany call the brewery to ask how we made our Kölsch, because in Germany you can't brew the style and call it Kölsch unless it is from Köln. After we explained to him how we brewed it, and what malt and hops we used, the brewer told us that we had his permission to call it Kölsch — that yes, what we were brewing was the same as the beer of Köln.

Brewing this style most definitely relies on yeast and temperature. What you're looking for is a yeast with medium flocculation. At the brewery, we actually use a lager yeast that we ferment at ale temperatures.

I would say that Kölsch is really the perfect lawnmower beer, and the late winter is really the best time of year to brew it because of incoming water temperatures, through your heat exhanger are colder.

My advice for homebrewers who want to brew a good Kölsch, based on what we do at the brewery, is to read first about the style. If you want to know what the traditional style is like, try looking in the Classic Beer Style series.

As for brewing techniques, transfer the wort to the fermenter when it is as cold as possible and let the temperature free rise. This process will help the beer develop a crisp, clean taste and brings out a mustiness from the wheat malt.



BROCK WAGNER co-founded the Saint Arnold Brewing Company with his friend Kevin Bartol in Houston, Texas in 1994. As a student at Rice University, Brock started homebrewing before graduating with a BA in economics and managerial studies in 1987. He worked in investment banking for six years before opening the brewery.

Effectively brewing light, delicate beers like Kölsch is so different from making much bigger ales. Our lightest beers took many test brews to perfect the recipes. A good base malt is important because you're not using any specialty malts and the base malt needs to shine through.

At Saint Arnold, we use a blend of Durst Pils and domestic 2-row for our Fancy Lawnmower. A good hop balance is also important. In ours, we use Hallertau throughout, heavier on the finish. Finally, the yeast is critical. We use White Labs WLP029 (German Ale/Kölsch) yeast, but we run it well below their recommended temperature range. With this method, we still get the fruitiness of the yeast but the end result is a much cleaner, crisper beer.

People forget about yeast for the most part, other than following recipes, and when using the more flavorful Belgian and hefeweizen yeasts. As an experiment, try taking one wort and splitting it into two carboys, pitching each with a different yeast and enjoy the results. With Kölsch and steam-type beers you can play with the yeasts at the extremes of their recommended fermentation temperatures. This is a good way to come up with your own signature beer.

Fancy Lawnmower, like all Saint Arnold beers, wasn't developed to try to replicate an existing beer. Usually the genesis of our beers comes from enjoying other good beers and then thinking, "how do we improve on these to make something even better?" With Fancy Lawnmower, we really wanted the floral hops to be the focus point of the beer.

If you want to formulate a good Kölsch recipe, first you have to have temperature control for your fermentation. Don't be afraid of going below the recommended range, but pitch lots of healthy yeast. As a rule of thumb, I tell homebrewers to use at least double what they normally pitch. Make sure the wort is well aerated too. Second, always use a good pale malt — a high quality Pils is best. Finally, choose a hop to showcase and go with it. But don't be too heavy-handed. This style is supposed to be a delicate, quaffable beer.

This is definitely a beer where bigger is not better. I have yet to see an imperial Kölsch, thank goodness, although I'm sure somebody has tried it. Keep this beer light. It is best when it is a flavorful session beer.

Preferred Specialty

Choosing malts and a pale ale problem

"Help Me, Mr. Wizard"

by Ashton Lewis

Specific specialty grains

There seems to be a lot of different specialty grains that folks add to their recipes for things like head retention, creaminess, mouthfeel, etc. Crystal, Carapils, Caravienne, Caramunich, Carafoam, flaked barley and the list goes on. Why are there so many and does one really stand out for you when you are brewing a beer?

Ed Krach
Austin, Texas

I have enough years in my rearview mirror that claiming part of my anonymous past is probably OK. When I was in graduate school at the University of California, Davis, I was one of a handful of participants in a taste panel for a major magazine that rates products and publishes the reviews. Our task was to flavor profile a fairly wide range of beers available in the United States. The methodology used in this panel is called Quantitative Descriptive Analysis (QDA for short) and the objective is to evaluate a food product using an agreed upon lexicon of flavor descriptors using a point scale. For example, a descriptor for beer is "bitter" and in a QDA panel this descriptor is given a numerical value depending on its intensity. If you are wondering if we mixed up an answer and question, we didn't. I'll get to malt in a bit.

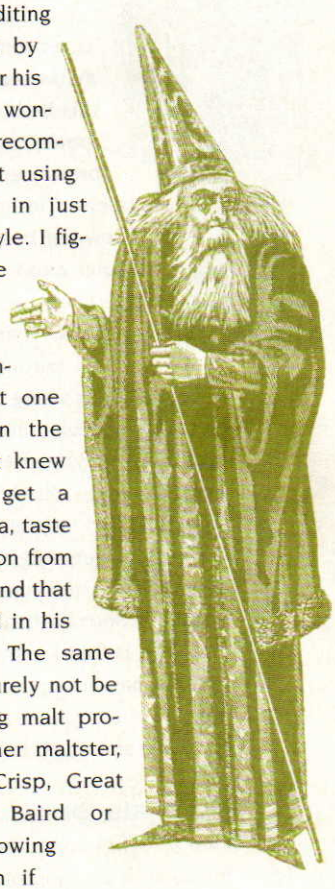
The QDA panel I was on had over 40 descriptors in our vocabulary. Over the course of several months we were presented nameless samples of beer to evaluate. The panel leader was Dr. Jean-Xavier "JX" Guinard. JX is a really cool guy from France who has a varied background in beer, food and wine research and wrote the Classic Beer Styles "Lambic" book for Brewers Publications. When I was entering Davis in 1991, JX was leaving for Penn State and later returned as I was completing my degree. Luckily for me and the other graduate students, JX left some of his experimental Lambics in the lab beer refrigerator (cold room) and we tasted some of these gems when time permitted. In any case, JX insisted on conducting this panel in a very rigid and non-biased way (which is the best way to conduct a sensory panel). We tasted the same beers randomly during the study and JX monitored the consistency of the panel; we were a very well-trained group of "expert" judges and our consistency was excellent.

This magazine wanted us to rank the beers in addition to simply describing them because descriptions do not sell magazines. JX was extremely hesitant to allow his expert panel to commit the ultimate sensory crime, which is intermingling a QDA (read "expert") panel with a preference (read "consumer") panel. At the end of the day, we were persuaded to wear both hats and I think we did a pretty good job at separating our dual roles.

Your question beckons me to walk that path once again, but age and experience has given me the wisdom not to take the bait! There are indeed many, many different malts available to brewers. And many of these malts have very similar (if not the same) names. Chocolate malt, black malt, wheat malt, crystal 60, and all of the names you listed in your question. Many beers also have the same names. Pale ale, stout, doppelbock, hefeweizen; just stick a brewery name in front of any of these styles and I am sure most homebrewers can create a list of at least 30 different beers. And all 30 of these beers are truly different beers brewed by different brewers with different ideas about what and why they do what they do. The selection of malt available to brewers is really no different than the selection of beers available to the beer consumer.

Part of my job includes going to annual brewing meetings that feature trade shows. I love walking around the tradeshow floor, checking out the various tools of the trade. Part of this journey includes chewing malt samples and reading the specs accompanying them. I evaluate the flavor, look at the size of the grain, read the specs that detail color, enzyme content, viscosity, protein content, degree of modification, etc. and imagine how the malt (or other grain) may fit into my ideas for future brews.

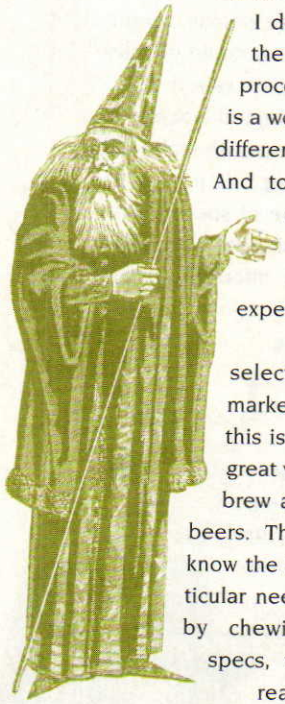
Walking into a grocery store offers the same abstract trip as walking a trade show floor. Look at the selection, read the labels, evaluate the firmness, color and overall appearance of the various ingredients and imagine how they could be married into dinner. Without a varied selection we would have limited variety in food. And the same is true with malt (and hop) selection in brewing. I do not have a favorite maltster or type of special malt. Rather I seek the malt that I believe, based upon available information, will serve my brewing needs.



I remember editing articles submitted by Horst Dornbusch for his style column and wondering about his recommendations about using Weyermann malt in just about any beer style. I figured since there are many great malts out on the market, why limit the recommendation to just one company? But on the other hand, Horst knew that he could get a certain color, aroma, taste or foam contribution from Weyermann malt and that was what he used in his brewing recipes. The same outcome would surely not be achieved by using malt produced from another maltster, such as Briess, Crisp, Great Western, Hugh Baird or Dingemans. Knowing ingredients, even if you have detailed knowledge of only a handful, is extremely important when selecting a particular grain to perform a certain task.

I know that I must bring this answer to a close for fear of standing on my soapbox for too long. The answer to your question "does one [malt] really stand out" above

others is a resounding NO! It depends on what you wish to accomplish in the brewhouse. The malt requirements for Budweiser are most certainly different than those for Andechser Doppelbock Dunkel. I encourage all brewers to read recipes as a general guide. When it comes to malt selection, I certainly heed the advice of others but also follow my own path. If I read a recipe and envision a variation with a change in malts, I do not hesitate to make the alternation. What this process requires, however, is a working knowledge of the different malts on the market. And to reiterate one of my common themes, I offer my opinion that knowledge requires experimentation.



There is a really wide selection of malts on the market and the reason for this is that brewers require a great variety of great malts to brew a great variety of great beers. The only way to really know the best malt for your particular need is do your research by chewing, reading malting specs, trying different malts, reading about different malts and then using this body of knowledge (or speculation) to make a choice that hopefully makes your abstracted beer a reality. By the way, our panel selected Old Milwaukee as the best domestic lager and that beer has won more than a few medals at the Great American Beer Festival. I'm not sure what my point is, but I know that every expert opinion has an equally persuasive alternate opinion. Use the malt that makes your face smile and taste buds tingle!

Pale ale predicament

I am an avid homebrewer, and have been for about a decade, off and on. I'm quite confident that I have a pretty good grip on the fundamentals of brewing both ales and lagers, from extract to all-grain, even decoction mashing, which I do a lot. But I'm stuck at a dead end when it comes to brewing pale ales. I've had great success (here and there, anyway) with dark ales and lagers and even pale lagers, but I cannot make a decent pale ale to save my life. I have experimented with absolutely every conceivable parameter of recipe design; mash temperature, water chemistry, hopping level, yeast type, malt bill — you name it, I've tried it. Not only do I not get a decent beer, I get exactly the same result every time, which is a weird, citric, vaguely yeasty-tasting liquid which doesn't really resemble pale ale at all. I'm at my wit's end and have sworn off ever attempting to brew a pale ale again unless I can get some kind of expert advice on what I'm doing wrong. I've read every article, and even whole books, on the subject of brewing pale ales, that I can get my hands on, and I can't seem to find any answers anywhere. You're my last hope. Is there anything you can tell me which you think I might not know already that might help me brew a good pale ale?

R. Hawthorne
via email

Unfortunately I don't have much information to digest from your question. All I know is that you have no luck brewing pale ales and I seem to be your last resort. The name of my column may imply that I am sort of psychic, but to be honest I am just an ordinary person . . . who happens to have a particularly simple view of brewing.

I feel compelled to use a little tough love here to help you with your problem. Either you are really, really unlucky when it comes to brewing pale ales, or the other beers you brew have not been as successful as you let on. Style aside, brewing styles that are expected to be clean and balanced, such as pale lagers, pale ales, dark lagers, etc, requires good brewing technique. Consistent and "proper" brewing techniques (whatever the heck that really means) are required to brew good beer, no matter the style.

I suggest having some homebrewing friends give critical feedback to a variety of your beers. It would help if you could present them in a blind fashion, mixed in with some other homebrews, to help eliminate bias. If you are a taster, you could recruit a non-taster to present the samples. Or you could solicit feedback by entering your beer into competitions. Personally, though, I have never been overly impressed with judges' comments on competition sheets. A good tasting where flavors are discussed by the judges is usually more revealing; however that's just my opinion.

"Consistent and 'proper' brewing techniques (whatever the heck that really means) are required to brew good beer, no matter the style."

There may be something in all of your beers that could be the culprit and it just happens to be more obvious to you in your pale ales. Pale ale is not a style that easily hides flaws. Some homebreweries, just like commercial breweries, have a "house character" common to all beers. If this house character is caused by a flaw in technique it can be eliminated by identifying the problem.

The techniques that I encourage all brewers to really focus their attention on are cleaning (and yes there is a technique associated with cleaning), wort aeration, pitching rate and fermentation temperature control. If you mash, you need to understand how mash thickness and temperature can be used to affect wort fermentability and of course how water chemistry affects enzymes and beer flavor. Whatever tact you choose to take, you should have a method that makes sense. In other words, everything you do should have a reason that you more-or-less understand. Mashing for two hours because that's what the recipe said to do is not a very good reason in my book.

If you have good brewing technique then you should be able to execute the details of a recipe and brew beer like a technician. A good technician brewer can follow any recipe presented to them and follow the process through to its intended outcome. If a technician brewer starts off with a bad recipe and methodically follows its course the outcome is most likely going to be bad. I am going to assume that you are just using problem recipes. In all

reality, most brewers are not perfect when it comes to technique and you should critically evaluate your methods and look for things that can be improved.

It's pretty easy to spot a really lame recipe once you go through the brewing process and taste the disappointing outcome. A good technical brewer can confidently blame the recipe for a bad brew just like an excellent group of musicians can blame the notes of the score for a less than harmonious tune. The ideal approach is not to brew a beer according to a bad recipe and avoid the disappointment that surely will follow.

I try to compose recipes that have a decent chance of success (at least that's what I tell myself). When coming up with a new recipe, I use past successes to help guide my new recipe. When in doubt, I subscribe to the "less is more" philosophy of brewing. I would much rather brew a beer that clearly lacks something. I believe it is easier to pick out what is missing from a beer than identifying flavors that need to be removed. If a flavor is missing I try to identify ways to add that component to the beer the next time I brew it. Simplistically, one can argue that if a beer is way too bitter, it's pretty obvious that the flavor that needs to be partially removed is bitterness. But if you are brewing one of those "everything, but the kitchen sink" kind of recipes, the task of identifying what doesn't belong is a bit more complex.

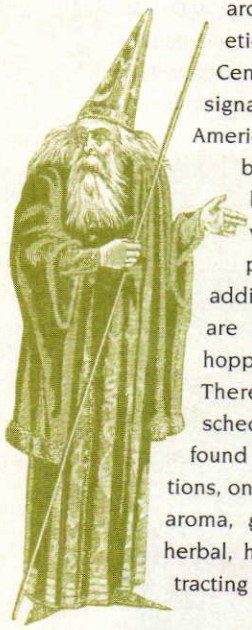
To me, pale ale is a style that is best approached with a very simple recipe. This opinion is true of both American and British-style pale ales. You do not need a laundry list of malts; usually pale malt, some crystal malt and the odd "toasty malt" for added flavor, or roasted malt for a touch of extra color is all you really need or want. In my opinion, more than three malts in a pale ale recipe is excessive unless you are fine-tuning a recipe and adding some missing flavor note.

Mashing should also be simple because the base malts used for pale ales usually require nothing more than a single-temperature infusion mash. Use a water-to-malt weight ratio somewhere in the neighborhood of 3:1 (0.36 gallons of water/pound malt or 3 liters/kg) and do not go crazy with adding Burton salts to your water unless you have a good reason for doing it. Remember that all pale ales are not brewed in the Burton style, one that is noted for its pronounced mineral palate, and that not all brewing water needs to be enhanced by adding minerals. If you don't know much about your local water, I recommend using distilled or reverse osmosis treated water and adding minerals to create the water you want. I like to use a mix of calcium sulfate and calcium chloride and target around 100 ppm of calcium in my water.

The next major part of a pale ale recipe is the hopping schedule. When you say your pale ales have a "citric" flavor, two things come to mind. The first is a citrus-like aroma and the second is sourness. While sourness usually comes from acid production from bacteria, such as *Lactobacillus*, the citrus aroma usually comes from hops. And if you have enough of the hops to make the beer smell like

citrus fruit, it can sometimes taste, at least in my opinion, that the beer has a lemonade-like zing.

The hops most commonly used in American-style pale ales are the "C" varieties. Cascade, Centennial, Columbus and Chinook, and all have this citrus-like aroma. Although these varieties, especially Cascade and Centennial, have become the signature aroma hop for the American style pale ale, they can be overbearing. Large mid-boil additions can add a flavor that is part bitter and part piney/citrus. Large late additions mainly add aroma and are responsible for the big, hoppy nose of many pale ales. There is no correct hopping schedule to follow, but I have found that using only two additions, one for bitterness and one for aroma, gets rid of a mid-palate, herbal, hop flavor that can be distracting in some hoppy ales. Try backing off on the hops if the recipes you have previously used have been aggressive in the hop department.



Finally there is yeast. If you are brewing American-style pale ales, use a nice, neutral yeast strain. My old standby when it comes to clean ale yeast is White Labs WLP001 (California Ale) or Wyeast 1056 (American Ale). I like to ferment this strain between 64 and 68 °F (18 and 20 °C) to produce very clean beers with minimal aroma from the yeast. If you are brewing British style pale ales you should use a different strain since a lot of the flavor in British ales results from the yeast strain. In my opinion, the American pale ales tend to be more malt and hop accented. British ale yeast strains used in pale ales, for example Wyeast 1968 (London ESB Ale) and White Labs WLP002 (English Ale), are much more flocculent than a strain like 1056 or WLP001. If you don't allow these yeast strains to settle with time or use a fining aid like isinglass, you may have beers that are a bit yeasty.

These are the big recipe topics I would focus on. If you have sound brewing technique it may be just finding the right recipe to suit your taste. And if you buy into the "less is more" philosophy, seek out recipes that look simple and tweak them over time to come up with a house pale ale recipe that you are pleased to drink. Good luck!

Brew Your Own Technical Editor Ashton Lewis has been answering homebrew questions as his alter ego Mr. Wizard for the last 12 years. A selection of his Wizard columns have been collected in "The Homebrewer's Answer Book," just released, available online at brewyourownstore.com.
Do you have a homebrewing question for Ashton? Send inquiries to *Brew Your Own*, 5515 Main Street, Manchester Center, VT 05255 or send your e-mail to wiz@byo.com. If you submit your question by e-mail, please include your full name and hometown. In every issue, the Wizard will select a few questions for publication. Unfortunately, he can't respond personally. Sorry!

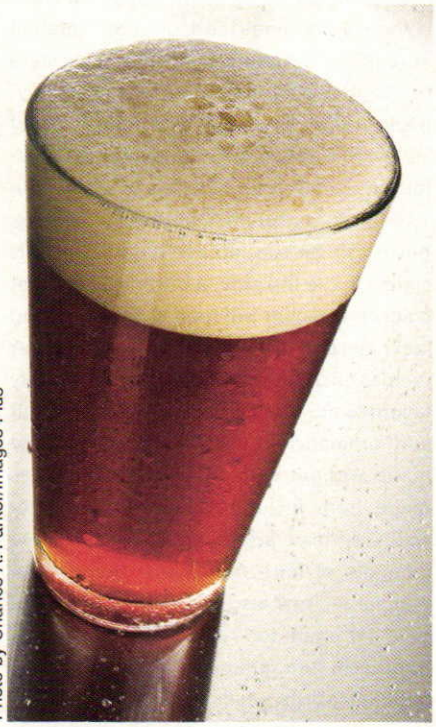
Extra Special Bitter

(a.k.a. English Pale Ale)

by Jamil Zainasheff

I was an undergraduate at the University of California, Davis when I had my first English bitter. A friend's roommate from London couldn't abide by the American lager beers we all drank back then. He ranted about how important it was for a beer to have flavor. I remember thinking how silly that was, as beer tasted like beer of course. Yet I listened to him, and upon tasting the beer he offered I realized it was different from the mass-market lagers I was used to drinking. It was quite bitter to my inexperienced palate, with more flavor from fermentation and malt than I was used to.

Strong bitter, often referred to as English pale ale or Extra Special Bitter (ESB is the name of a beer from Fuller's, not really a style name) is an average to moderate strength English ale. A strong bitter should be firmly bitter by taste (often falling in the range of 30 to 50 IBUs), but the bitterness should not overpower the malt. Balance is important and most examples range from balanced to moderately bitter. While many commercial examples can be described as "hoppy," do not confuse this style with American pale ale. Strong bitter has more fermentation and malt character than American pale ale and the hop character is nothing like the big, bold hop character you find in many American-type pale ales. Moderate is the key word here and the hop character should be somewhat restrained and balanced, never overshadowing the fermentation and malt character.



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ESB by the numbers

OG:	1.048–1.060 (11.9–14.7 °P)
FG:	1.010–1.016 (2.6–4.1 °P)
SRM:	6–18
IBU:	30–50
ABV:	4.6–6.2%

This is the highest gravity version of the bitter family, which results in a few noticeable differences from its kin. Strong bitter tends to have a slightly fuller malt backbone than special/best bitter and the appropriate bitterness to balance the additional malt. The additional malt creates a little more alcohol, a bit more body and a touch more flavor. Some examples will express a touch of alcohol flavor and aroma, although I prefer examples that are more subtle. Strong bitter ranges in color from golden to deep copper. These beers are also very clear, due to the highly flocculent yeast and the head is usually minimal, due to low carbonation.

British pale ale malt is a key component of any bitter recipe. It provides a background biscuit-like malt character that many people associate with fine British beers. British pale ale malt is kilned a bit darker (2.5 to 3.5 °L) than the average American two-row or pale malt (1.5 to 2.5 °L) and this higher level of kilning brings out the malt's biscuity flavors. A few malt companies (Crisp Malting is one) still produce British pale ale malt from cultivars such as Maris Otter using a traditional floor malting method. The result is malt with a slightly darker color (3.5 to 4.0 °L) and more flavor than other pale ale malts. It is the malt of choice for many English beer fanatics. British pale ale malt is highly modified and well suited to sin-

RECIPE

Strong Bitter
(5 gallons/19 L, all-grain)

OG =1.056 (13.9 °P)
FG = 1.016 (4.1 °P)
IBU = 41 SRM = 9 ABV = 5.3%

Ingredients

10.75 lb. (4.9 kg) Crisp Pale Ale malt or similar British pale ale malt
0.5 lb. (227 g) Great Western crystal malt 15 °L
0.25 lb. (113 g) Great Western crystal malt 120 °L
8.5 AAU East Kent Goldings hops (1.7 oz./48 g at 5% alpha acids (60 min.)
5 AAU East Kent Goldings hops (1.0 oz./28 g at 5% alpha acids (0 min.)
White Labs WLP002 (English Ale) or Wyeast 1968 (London ESB Ale) yeast

Step by Step

Mill the grains and dough-in targeting a mash of around 1.5 quarts of water to 1 pound of grain (a liquor-to-grist ratio of about 3:1 by weight) and a temperature of 152 °F (67 °C). Hold the mash at 152 °F (67 °C) until enzymatic conversion is complete. Infuse the mash with near boiling water while stirring or raise the temperature with a recirculating mash system to mash out at 168 °F (76 °C). Sparge slowly with 170 °F (77 °C) water, collecting wort until the pre-boil kettle volume is around 5.9 gallons (22.3 L) and the gravity is 1.048 (11.9 °P).

Once the wort is boiling, add the bittering hops. The total wort boil time is one hour after adding the bittering hops. During that time add any other kettle finings with 15 minutes left in the boil and the last hop addition at flame out. Chill the wort to 68 °F (20 °C) and aerate

recipe continued from page 19

thoroughly. The proper pitch rate is 11 grams (0.4 oz.) of properly rehydrated dry yeast, 2 packages of liquid yeast, or 1 package of liquid yeast in a 2-liter starter.

Ferment around 68 °F (20 °C) until the yeast drops clear. With healthy yeast, fermentation should be complete in a week or less. Allow the lees to settle and the brew to mature without pressure for another two days after fermentation appears finished. Rack to a keg and force carbonate or rack to a bottling bucket, add priming sugar and bottle. Target a carbonation level of 1 to 2 volumes depending on your packaging.

If you're cask conditioning the beer, add priming sugar, any cask finings (gelatin or isinglass) and dry hop with ¼ to ½ oz. (7 to 14 g) of whole East Kent Goldings hops. Allow the beer to condition in the cask for several days and serve via a beer engine or by gravity feed at 50 to 55 °F (10 to 13 °C).

Strong Bitter
(5 gallons/19 L, extract plus grains)

OG = 1.055 (13.6 °P)
FG = 1.016 (4.1 °P)
IBU = 41 SRM = 9 ABV = 5.2%

Ingredients

7 lb. (3.18 kg) John Bull Maris Otter or Edme Maris Otter English pale liquid malt extract (If you can't get fresh liquid malt extract, it is better to use 5.5 lb (2.5 kg) English dried malt extract)
0.5 lb. (227 g) Great Western crystal malt 15 °L
0.25 lb. (113 g) Great Western crystal malt 120 °L
8.5 AAU East Kent Goldings hops (1.7 oz./48 g at 5% alpha acids (60 min.)
5 AAU East Kent Goldings hops (1.0 oz./28 g at 5% alpha acids (0 min.)
White Labs WLP002 (English Ale) or Wyeast 1968 (London ESB Ale) Yeast

Step by Step

Mill or coarsely crack the specialty malt and place loosely in a grain bag. Avoid packing the grains too tightly in the bag, using more bags if needed. Steep the bag in about 1 gallon (~4 liters) of water at roughly 170 °F (77 °C) for about 30 minutes.

Lift the grain bag out of the steeping liquid and rinse with warm water. Allow the bags to drip into the kettle for a few minutes while you add the malt extract. Do not squeeze the bags. Add enough water to the steeping liquor and malt extract to make a pre-boil volume of 5.9 gallons (22.3 liters) and a gravity of 1.047 (11.6 °P). Stir thoroughly to help dissolve the extract and bring the wort to a boil.

Once the wort is boiling, add the bittering hops. The total wort boil time is one hour after adding the bittering hops. During that time add any other kettle finings with 15 minutes left in the boil and the last hop addition at flame out.

Chill the wort to 68 °F (20 °C) and aerate thoroughly. The proper pitch rate is 11 grams (0.4 oz.) of properly rehydrated dry yeast, 2 packages of liquid yeast, or 1 package of liquid yeast in a 2-liter starter.

Ferment around 68 °F (20 °C) until the yeast drops clear. With healthy yeast, fermentation should be complete in a week or less. Allow the lees to settle and the brew to mature without pressure for another two days after fermentation appears finished. Rack to a keg and force carbonate or rack to a bottling bucket, add priming sugar and bottle. Target a carbonation level of 1 to 2 volumes depending on your packaging.

If you're cask conditioning the beer, add priming sugar, any cask finings (gelatin or isinglass) and dry hop with ¼ to ½ oz. (7 to 14 g) of whole East Kent Goldings hops. Allow the beer to condition in the cask for several days and serve via a beer engine or by gravity feed at 50 to 55 °F (10 to 13 °C).

gle infusion mashes and a moderate mash temperature around 152 °F (67 °C) is a good target for this style.

If you're brewing with extract, your best choice is an extract made from British pale ale malt. There are some British style malt extracts currently on the market made from 100% Maris Otter malt and they are an excellent choice for English beers. If you end up using domestic two-row malt or extract made from it, you'll need to compensate with some additional specialty malts such as Munich, biscuit or Victory, but use restraint. For a 5-gallon (19-L) batch, add no more than ¾ pound (0.34 kg).

While there are some modern examples of strong bitter, called summer bitter, brewed with pale malt only, my feeling is that a proper English bitter must have at least a touch of caramel character. Even a small dose of crystal malt adds caramel notes, body, and helps fill out the malt flavors. The type of crystal malt also makes a difference. Darker color crystal malts add richer colors, as well as some dark caramel, toasty, roasted and raisin flavors. Lighter color crystal malts add sweeter caramel notes. The maximum crystal malt this style can handle without getting heavy and cloying is around 8 to 10% with a color range of 10 to 150 °L. However, the darker the crystal, the less you should use. A bitter with 10% 150 °L crystal malt may not be cloying, but it can be too intense a flavor for this style. On the flip side, a bitter with all light color crystal malt will tend to be sweet and lack depth of character. Some bitter recipes include other specialty malts. My favorites are Special Roast, Victory, biscuit and aromatic, but a fine bitter can be made without them. Commercial recipes range from including minimal, low-color specialty malt additions to considerable amounts of mid-color malts. Some commercial recipes also use a little chocolate or black malt for color. If you take this approach, the amount of highly kilned malt should be small enough that the flavor is not apparent in the finished beer. Use an ounce or two (28–57 g) at most in a 5-gallon (19-L) batch. Specialty malts are a big part of what differentiates one brewer's bitter from another, so feel free to experiment. If you do want to brew a summer bitter, just replace any specialty malts with more British pale ale malt.

While corn, cane sugar and other adjuncts are traditional in brewing many English beers, I usually omit them unless I'm crafting a big beer and I need to increase wort fermentability, I'm trying to thin the body, or I'm trying to reduce the intensity of the base malt flavors. If you're using a less attenuative yeast and don't have the ability to control the wort fermentability through mash temperature, then replacing some base malt in your recipe with simple sugar can help. Simple sugars ferment fully, thin the beer, and provide very little in the way of flavor contributions. I've seen recipes that use brown sugar, but don't count on it to add much in the way of flavor. Use it only for thinning the beer. If you want to add brown sugar/caramel-type flavors, use caramel malts. Corn and other non-barley adjuncts reduce the overall malt flavors, when used in place of the base malted barley. I prefer a bold base malt flavor, so I don't use adjuncts in my strong bitter.

Bitters are best brewed with English hops, such as East Kent Goldings, Fuggles, Target, Northdown or Challenger. The bittering level for strong bitter is in the range of 30 to 50 IBU. What you're targeting is noticeable hop bitterness without overwhelming the malt background. Keep in mind that there are many factors at play in the final impression of bitterness for the drinker. The starting and final gravities, the character malts selected, the type of base malt, the yeast strain, the pitching rate, and even the yeast cell size have an impact on the perceived bittering. For most strong bitters, a bitterness-to-starting gravity ratio (IBU divided by OG) between 0.6 and 0.9 gives the proper result. The bulk of the hopping should be as a bittering addition at 60 minutes. I prefer a single, large, late hop addition near flame-out. This gives the beer a noticeable hop aroma without too much hop flavor like earlier additions may give. You can add multiple small hop additions around ¼ to ½ ounce (7 to 14 g) for a 5-gallon (19-L) batch at 20 minutes and later, but for this style I like one larger addition. Remember that this isn't an extremely hoppy style, so don't go overboard. Traditional cask conditioning can include dry hopping, perhaps a ¼ to ½ ounce (7 to 14 g) per 5 gallons (19 L). If you do dry hop this beer, reduce

the late hop additions to keep the hop flavor and aroma under control.

Much has been written about the high sulfate water of Burton-upon-Trent being a key element in brewing bitters. It is true that water with high sulfate content enhances the sharp, bitter aspect of hops. However, this is very easily overdone, which results in a chalky, metallic, or harsh character. Brewers today brew good bitter with a wide range of water types. In most cases, any water is well suited as is unless it is on the soft end of the spectrum. If you have soft water, add some gypsum or Burton salts, but start low, targeting half the amount of sulfate typical of Burton water. Use no more than 1 teaspoon of Burton salts per 5 gallons (19 L) or no more than 3 grams (0.1 oz.) of gypsum per gallon (3.8 L). It is always better to add less than more. While this won't exactly mimic the water of Burton-upon-Trent, it is more than enough to accentuate the hop bitterness. You can add your mineral salts to the mash water or, if you're extract brewing, you can add the mineral salts to your water before you heat it. For all other water types, first try brewing this style without any additional mineral salts.

Fermentation creates much of the flavor and aroma in most British beers. "English" yeast strains provide a variety of interesting esters and tend to be low to moderately attenuating, leaving some residual sweetness to balance the bitterness and help fill out the beer. They are also extremely flocculent, which makes them ideal for cask conditioning. These yeasts produce a fairly low level of esters at cool fermentation temperatures (<65 °F/18 °C) and abundant fruity esters and alcohol notes at high temperatures (>70 °F/21 °C). It is better to start in the middle of this range, letting the temperature slowly rise a few degrees over a couple days. This creates the expected level of esters and keeps the amount of diacetyl in the finished beer at a minimum.

My favorite yeasts for this style are White Labs WLP002 (English Ale) and Wyeast 1968 (London ESB Ale). They provide a nice ester profile without being over the top. If you like to experiment, try to select English yeasts that create interesting ester profiles and an attenuation percentage from the upper 60s to the low 70s. If you prefer dry yeast, DCL Safale S-04 produces good results. No matter which yeast you're using, it is important to aerate the wort immediately before or after pitching your yeast. Oxygen is important to proper cell growth and growth is important to beer flavor development.

Serving bitter at around 55 °F (13 °C), allows the character of the beer to come out and can improve drinkability. Colder temperatures prevent the drinker from picking up the interesting fermentation and malt flavors and aromas, so don't go below 50 °F (10 °C). Target a carbonation level around 2 volumes of CO_2 for bottled, 1.5 volumes for kegged, and 1 volume of CO_2 for cask conditioned beer.

Jamil Zainasheff is coauthor of the book "Brewing Classic Styles," which contains more than 80 of his award-winning recipes (in both extract and all-grain versions) and covers every BJCP recognized style.

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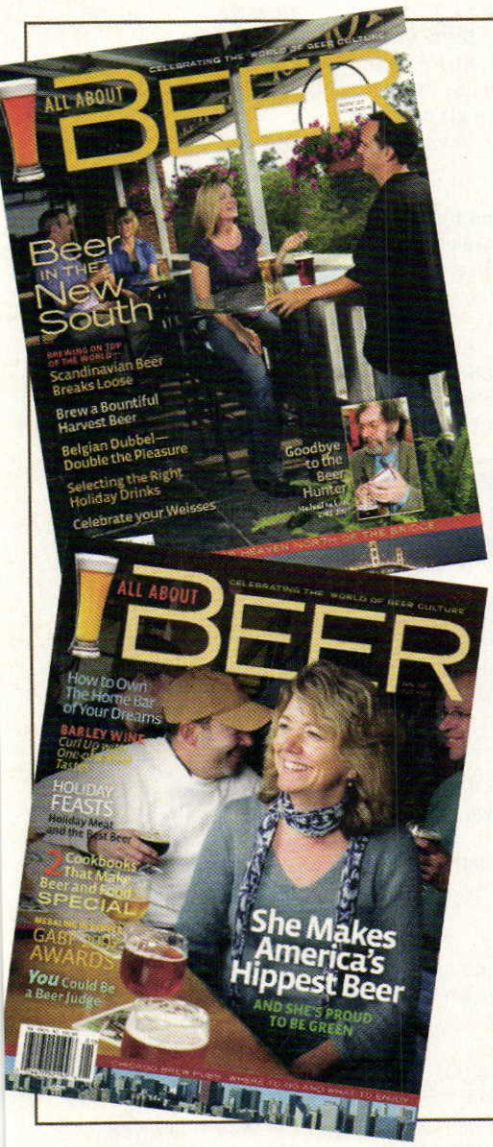

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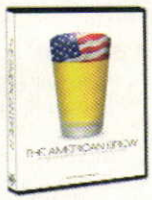

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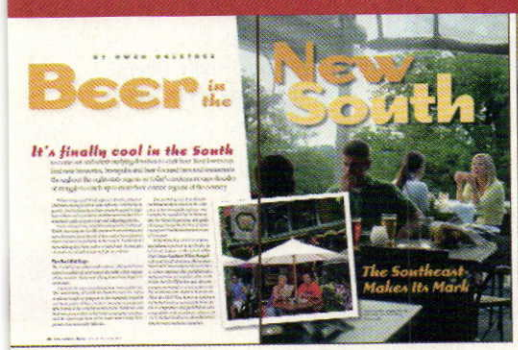

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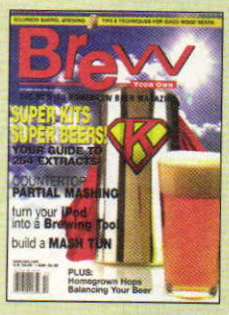

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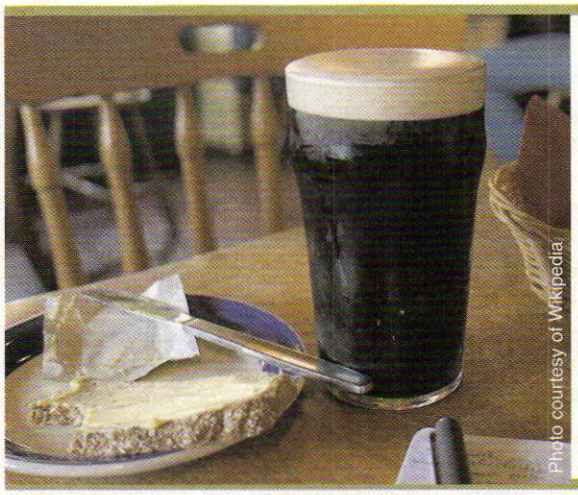

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the stuff of stout ... and more

Roasted barley. The name is simple enough. However, even though it's called roasted barley, many brewers still think it's a malt. It is not. Roasted barley is made from unmalted barley — a fact that, as you will see, has some practical implications for brewers. It is the among darkest of the dark grains, with a Lovibond rating around 500 °L. Black malt is the only other malt in the same league. (There are also lighter shades of roasted barley, around 300 °L.)

How it is Made

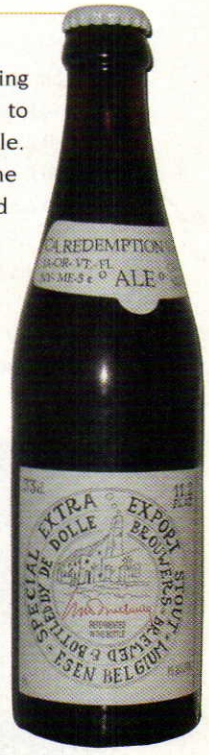
Roasted barley can be made from either 2-row or 6-row barley and there is no real difference in the color, potential extract or flavor and aroma profile between the two. Higher-protein barley is easier to darken than that with lesser protein levels.

Unmalted barley is put into roasting drums that turn to keep the barley moving. While the barley roasts, water is sprayed to "quench" the barley. The moisture level in the grain is maintained between 5 and 10% because water is one of the key components of the Maillard reaction — without it, the barley would burn instead of roasting. Roasting takes about 3 ½ hours and the process is mostly automated. The critical last 15 minutes of the roasting process is done manually by an experienced operator that will make the call to stop the roasting by the sight of it. Dave Kuske from Briess Malting says, "There is no instrument on earth than can match the human eye for judging when the color is just right."

Ironically, roasting barley longer doesn't always increase its extractable color. The longer you roast a grain, the darker it appears. However, the extractable color only increases to a point. Once a grain reaches about 500 °L, the amount of color you can obtain from the grain has hit its maximum. As the grain continues to roast, it will change from mahogany to black, but the extractable color will drop from 500 °L down to 100 °L. If you examined the inside of a grain of roasted barley (500 °L), you would see a solid deep reddish brown and taste coffee. On the other hand, the interior of the "over-roasted" grain would be pitted, black and taste acrid and burnt.

The roasting process for roasted barley is mostly the same as for the other types of roasted malts. The "recipes" for the temperature of the roaster, the time in the roaster and the amount of moisture vary by the type of product being produced. Black malt, which is the closest product to roasted barley, has nearly the same exact roasting profile. The biggest difference lies in the finished product. The malting process produces many volatile flavor and aroma compounds. When roasted, black malt loses most of these. Roasted barley doesn't have these compounds. Its interior is mostly composed of large starch molecules. When it is roasted, it produces a deep aromatic espresso character for which it is typically known.

Primarily, roasted barley is *the* stout grain. Not that you can't have a stout made without it — but what it brings to the party, nothing else can. It is used in lesser amounts in some other beer styles.



Light in the Darkness

Although roasted barley produces dark beers, the foam in these beers is light colored. The reason for this counterintuitive result lies in the fact that roasted barley is not malted. Malting produces simple sugars that, when roasted, react with amino acids and form Maillard products. These Maillard products are soluble and produce dark beer foam. Unmalted barley has fewer simple sugars, so the foam in beers made from it does not pick up as much dark color.

Behind the simplicity of this unmalted grain, roasted barley has a world of flavor, aroma and color complexity.

RECIPES

1879 Dublin XXX Stout

(5 gallon/19 L, all-grain)

OG = 1.086 FG = 1.015

IBU = 87 SRM = 55 ABV = 9.1%

A large stout, what today would be called a foreign extra stout, was made in Dublin in 1879. Most assuredly, there would also be a little sourness brought on by Brettanomyces, *giving this beer a finishing acidic twang.*

Ingredients

10.25 lbs. (4.7 kg) British 2-row pale malt (2-row)
1.0 lb. (0.45 kg) crystal malt (75 °L)
1.5 lbs. (0.68 kg) roasted barley
3.5 lbs. (1.6 kg) corn sugar
10 AAU Fuggle hops (120 mins) (2.0 oz./57 g of 5% alpha acids)
10 AAU Fuggle hops (60 mins) (2.0 oz./57 g of 5% alpha acids)
2.0 oz. (57 g) Fuggle hops (10 mins)
Fermentis Safale S-04 yeast

Step by Step

Mash grains at 154 °F (68 °C) in 11.5 qts. (11 L) of water. Boil for 120 minutes, adding hops at times indicated and sugar for final 15 minutes. Ferment at 68 °F (20 °C). As an option, you can add a *Brettanomyces* culture once the primary fermentation slows.

Countertop partial mash option: Reduce amount of British pale malt to 3.0 lbs. (4.7 kg) and add 2.0 lbs (0.91 kg) of Muntons Light dried malt extract and 2.75 lbs. (1.3 kg) of John Bull light liquid malt extract (late addition).

Begin by heating 5.5 qts. (5.2 L) of soft or distilled water to 165 °F (74 °C) in a large kitchen pot. Stir ½ tsp. of calcium sulfate (gypsum) or calcium chloride into this water. In another pot, heat 2.25 qts. (2.1 L) of soft water to around 164 °F (73 °C). Stir 1 tsp. calcium carbonate (chalk) or ½ tsp. sodium bicarbonate (baking soda) into this water. In your brewpot, begin heating a half-gallon (~2 L) of water to around 170 °F (77 °C). Place crushed pale and crystal malts in one grain bag and place in cooler. Put remaining roasted barley (crushed) in the other bag. Add the 5.5 qts. (5.2 L) of water to the malts in the cooler and stir it in. Let this mash, starting at 154 °F (68 °C), for 45 minutes. Likewise, steep the specialty grains in the pot of carbonate-rich water for 45 minutes (around 153 °F/67 °C), although this exact temperature is not critical. While grains mash and steep, heat about 8.0 qts. (7.6 L) of water to 180 °F (82 °C).

When mashing and steeping is complete, scoop 1 qt. (~1 L) of 170 °F (77 °C) water from your brewpot with a large measuring cup or beer pitcher. Lift the specialty grains out of their steeping pot and place them in a colander over your brewpot. Pour the "grain tea" through the grain bag (to strain out any large bits of grain) and then rinse the grains with the water pulled from your brewpot. Start heating this "grain tea" while you collect the wort from the cooler.

To collect wort from mash, recirculate about 2.5 qts. (2.4 L) of wort, then add 180 °F (82 °C) water to cooler until it is full to the rim. Draw off wort and add to brewpot until the liquid level in the cooler is just above the grain bed. Add 180 °F (82 °C) water to the rim again. Repeat this process

until you have collected 2.0 gallons/8 qts. (7.6 L) of wort. Add dried malt extract and bring wort to a boil. Add first dose of hops and boil for 60 minutes.

Add hops at times indicated in the ingredient list. Stir in sugar and liquid malt extract for the final 15 minutes of the boil. Cool wort, in sink or with wort chiller, to 70 °F (21 °C) and transfer to fermenter. Add water to top up to 5 gallons (19 L), aerate and pitch yeast. Ferment at 68 °F (20 °C). As an option, you can add a *Brettanomyces* culture once the primary fermentation slows to a halt.

Hitachino Nest Sweet Stout clone

(5 gallon/19 L, all-grain)

OG = 1.049 FG = 1.019

IBU = 16 SRM = 41 ABV = 3.8%

The Kiuchi brewery's Hitachino Nest Sweet Stout is like a delicately sweetened cappuccino. Dark roasted coffee with dark fruit notes and the unmistakable aroma and flavor of lactose. For breakfast? Sure, and also lunch, dinner . . . and karaoke!

Ingredients

6.0 lbs. (2.7 kg) 2-row pale malt
0.50 lbs. (0.23 kg) wheat malt
1.0 lbs. (0. 45 kg) crystal malt (55 °L)
1.25 lbs. (0.57 kg) roasted barley
1.0 lbs. (0. 45 kg) lactose (15 mins)
4.1 AAU Kent Goldings hops (60 mins)
(0.75 oz./21 g of 5.5% alpha acids)
Wyeast 1099 (Whitbread Ale) yeast

Step by Step

Mash at 153 °F (67 °C) in 10 qts. (9.4 L) of water. Boil wort for 60 minutes. Add lactose for the final 15 minutes of the boil. Ferment at 68 °F (20 °C).

Countertop partial mash option:

Reduce amount of pale malt to 2.5 lbs. (1.1 kg) and add 2.75 lbs. (1.3 kg) Coopers Light liquid malt extract.

Begin by heating 5.5 qts. (5.2 L) of soft or distilled water to 164 °F (73 °C) in a large kitchen pot. Stir ½ tsp. calcium sulfate (gypsum) or calcium chloride into this water. In another pot, heat 2.0 qts (1.9 L) of soft water to around 164 °F (73 °C). Stir 1 tsp. calcium carbonate (chalk) or ½ tsp. sodium bicarbonate (baking soda) into this water. In your brewpot, begin heating a half-gallon (~2 L) of water to around 170 °F (77 °C). Place crushed pale, wheat and crystal malts in one grain bag and place in cooler. Put remaining roasted barley (crushed) in the other bag. Add the 5.5 qts. (5.2 L) of water to the grains in the cooler and stir it in. Let this mash, starting at 154 °F (68 °C), for 45 minutes. Likewise, steep the specialty grains in the pot of carbonate-rich water for 45 minutes (around 153 °F/67 °C), although this exact temperature is not critical. While grains mash and steep, heat about 8.0 qts. (7.6 L) of water to 180 °F (82 °C). When mashing and steeping is complete, scoop 1 qt. (~1 L) of 170 °F (77 °C) water from your brewpot (you can use a large measuring cup for this). Lift the specialty grains out of their steeping pot and place in a colander over your brewpot. Pour the "grain tea" through the grain bag (to strain out any large bits of grain) and then rinse the grains with the water pulled from your brewpot. Start heating this "grain tea"

while you collect the wort from the cooler. To collect wort from mash, recirculate about 2.5 qts. (2.4 L) of wort, then add 180 °F (82 °C) water to cooler until it is full. Draw off wort and add to brewpot until the liquid level in the cooler is just above the grain bed. Add 180 °F (82 °C) water again. Repeat this process until you have collected 2.0 gallons/8 qts. (7.6 L) of wort. Bring wort to a boil. (Don't add extract now.) Add first dose of hops and boil for 60 minutes.

Add hops at times indicated in the ingredient list. Stir in liquid malt extract and lactose for the final 15 minutes of the boil. Cool wort, in sink or with wort chiller, to 68 °F (20 °C) and transfer to fermenter. Add water to top up to 5 gallons (19 L), aerate and pitch yeast. Ferment at 68 °F (20 °C).

De Dolle Extra Export Stout clone

(5 gallons/19 L, all-grain)

OG = 1.086 FG = 1.015

IBU = 53 SRM = 68 ABV = 9.2%

De Dolle is a small Belgian village brewery that produces only 900 barrels of beer per year. Their stout recipe includes Belgian dark candi sugar (the syrup, not the rocks) and the Orval strain of yeast.

Ingredients

10 lbs. (4.5 kg) Dingemans pale malt
1.0 lbs. (0.45 kg) Special B malt
0.50 lbs. (0.23 kg) chocolate malt
1.25 lbs. (0.57 kg) roasted barley
3.0 lbs. (1.4 kg) Belgian dark candi sugar
14 AAU Nugget hops (60 mins) (1.0 oz./28 g of 14% alpha acids)
0.50 oz. Nugget hops (20 mins)
White Labs WLP510 (Bastogne Belgian Ale) yeast

Step by Step

Step mash at 125 °F (52 °C) for 15 mins, 145 °F (63 °C) for 35 mins, 165 °F (74 °C) for 25 mins and 172 °F (78 °C) for 5 mins. Boil for 60 minutes. Ferment at 72 °F (22 °C).

Countertop partial mash option:

Reduce amount of pale malt to 3.0 lbs. (1.4 kg) and add 2.0 lbs. (0.91 kg) of Briess Light dried malt extract and 3.3 lbs. (1.5 kg) of Briess Light liquid malt extract. Begin by heating 5.5 qts. (5.2 L) of soft water to 163 °F (73 °C) in a large kitchen pot. Stir ½ tsp. calcium sulfate (gypsum) or calcium chloride into this water. In another pot, heat 2.5 qts (2.4 L) of soft water to around 163 °F (73 °C). Stir 1 tsp. calcium carbonate (chalk) or ½ tsp. sodium bicarbonate (baking soda) into this water. In your brewpot, begin heating a half-gallon (~2 L) of water to around 170 °F (77 °C). Place crushed pale malt and Special B in one grain bag and place in cooler. Put remaining dark grains (crushed) in the other bag. Add the 5.5 qts. (5.2 L) of water to the pale grains in the cooler and stir it in. Let this mash, starting at 152 °F (67 °C), for 45 minutes. Likewise, steep the specialty grains in the pot of carbonate-rich water for 45 minutes (around 152 °F/67 °C). While grains mash and steep, heat about 8.0 qts. (7.6 L) of water to 180 °F (82 °C). When mashing and steeping is complete, scoop 1 qt. (~1 L) of 170 °F (77 °C) water from your brewpot. Lift the specialty grains out of their pot and place in a

colander over your brewpot. Pour the "grain tea" through the grain bag and then rinse the grains with the water pulled from your brewpot. Start heating this "grain tea" while you collect the wort from the cooler.

To collect wort from mash, recirculate about 2.5 qts. (2.4 L) of wort, then add 180 °F (82 °C) water to cooler until it is full. Draw off wort and add to brewpot until the liquid level in the cooler is just above the grain bed. Add 180 °F (82 °C) water to fill cooler again. Repeat this process until you have collected 2.0 gallons/8 qts. (7.6 L) of wort. Add dried malt extract and bring wort to a boil. Add first dose of hops and boil for 60 minutes. Add hops at times indicated in the ingredient list. Stir in liquid malt extract and Belgian candi sugar for the final 15 minutes of the boil. Cool wort to 72 °F (22 °C) and transfer to fermenter. Add water to top up to 5 gallons (19 L), aerate and pitch yeast. Ferment at 72 °F (22 °C).

Traquair House Ale clone

(5 gallon/19 L, all-grain)

OG = 1.070 FG = 1.017
IBU = 37 SRM = 18 ABV = 6.8%

Traquair House is the oldest inhabited house in Scotland. Some say their house ale is the paragon of Scottish Wee Heavy ales.

Ingredients

14 lbs. (6.4 kg) Scottish pale malt (Golden Promise)
0.25 lbs. (113 g) roasted barley
10 AAU Kent Goldings hops (60 mins) (2.0 oz./57 g of 5% alpha acids)
Wyeast 1728 (Scottish Ale) yeast

Step by Step

Mash at 153 °F (67 °C). Boil for 60 minutes. Ferment at 60 °F (16 °C).

Extract option:

Reduce pale malt to 1.75 lbs. (0.79 kg) and add 2.0 lbs (0.91 kg) of Muntons Light dried malt extract and 6.6 lbs. (3.0 kg) of Muntons Light liquid malt extract. Steep grains at 153°F (67 °C). Boil wort, with dried malt extract and hops, for 60 minutes. Add liquid extract for final 15 minutes of boil. Ferment at 60 °F (16 °C).

Kristen England wrote about chocolate malt in the December 2007 issue and roasted malt in the November 2007 issue of Brew Your Own *magazine.*

HOP SURVIVAL GUIDE

by **Chris Colby**

TABLE OF CONTENTS

These days, survival-themed entertainment is all the rage. TV shows such as "Man vs. Wild" and "Survivorman" show us how to navigate a gator-filled swamp or to survive a night on a glacier. Bookstore shelves are filled with books such as "Worst-Case-Scenario Survival Handbook," by Piven and Borgenicht and my favorite, "The Zombie Survival Guide," by Max Brooks. With the current hop crisis upon us, I thought it would be beneficial to present "The BYO 2008 Hop Survival Guide."

The Scenario

The hop crisis is real. For many commercial brewers, 2008 and 2009 will be very trying. The good news for homebrewers is that homebrew shops will have plenty of hops to offer in 2008. By weight, they will likely have more than last year. Representatives from the major homebrew wholesalers — including LD Carlson, Crosby and Baker and Brewcraft USA (formerly Steinbart) — all told me that they have hops in stock and are refusing orders from commercial breweries to keep homebrew shops stocked.

The bad news is that the number of available hop varieties available will be down, in some cases by as much as half. As I write this article, it is impossible to give the exact lineup of hop varieties that will be available at your local homebrew shop. A few specifics are known, but a lot is still up in the air.

All the information I have gathered indicates that hop selection will vary from shop to shop; and, for any given shop, it will likely change as the year progresses.

Skills for Survival

In the last issue of *Brew Your Own*, we presented the reasons for the current hop shortage. In this issue, we'll give you some ideas of what you can do about it.

First off, we present our hop substitution guide. All hop varieties taste and smell different, but some have similarities that allow them to be substituted for others — it's all just a matter of degree.

Next, we take a close look at four fairly new hop varieties — Glacier, Santiam, Sterling and Vanguard. We'll give you the stats on these hops and four recipes that highlight their characteristics.

Finally, we'll take a look at growing your own. Hops are are easy to grow, produce decorative foliage and — in a couple years — will yield all the hops you can possibly use. We'll explain how to grow, dry, store and use them.

Getting through the 2008 crisis will take some skills. However, it won't require skills comparable to having to hike out of a forest with no food and only the stars for navigation. It will be more akin to not having enough electricity in the Winnebago to run the blender and the big screen TV at the same time. Yep, we'll be just fine . . . until the zombies come.

HOP SUBSTITUTION & SURVIVAL GUIDE

By Chris Colby

So what should you do if you're planning to brew a recipe, but your homebrew shop doesn't have the hop variety or varieties that you need? The first and most obvious solution is to pick a similar hop variety and substitute it for the missing hop. And the easiest way to do this, if you aren't personally familiar with a lot of hop varieties, is to consult a hop substitution chart. The BYO Hop Substitution Chart, found on pages 36–37, lists 72 hop varieties, their published characteristics and suggested substitutions. This, or a similar chart, is going to be your first and most fruitful approach when searching for a substitute hop. In most cases, you should be able to find a reasonable alternative.

Of course, if your local shop doesn't have a particular hop variety, you can expect the most well-known substitutes to dry up fairly soon after that. Then what? When that happens, there are a couple general hop substitution strategies (which are mostly just applied common sense) to consider and one way to think about the problem in a slightly larger context.

All Hops Taste Different . . . Yet the Same

OK, so let's say your recipe calls for "hop A" and your shop is out. You check with a substitution chart and see that the substitute hops — hops "B" and "C" — are also out of stock. Now what?

Let's start at the very beginning. If two hop varieties are named differently, it's usually because they taste different. (Occasionally, the same hop variety may be available under a couple different names. For example, Columbus, Zeus and Tomahawk are all the same variety.) Conversely, all brewing varieties of hops are descended from one (or perhaps a few) wild progenitors. They all have hop resins (most importantly, the alpha and beta acids) and hop oils (such as humulene, myrcene and a host of others) and they all basically taste like . . . hops. So, all hops taste different, but they also all taste similar. Thus, the success of any hop substitution is going to be a matter of degree.

The Good, the Bad and the Fuggle-y

The easiest situation you could hope for would be a recipe that calls for a mix of "neutral" hops (hops without a strong varietal character). In this case, you would not need to come up with substitutions on a hop-by-hop basis — just pick a variety of other neutral hops. The actual number of hop varieties you choose need not even be the same as in the recipe. For example, if a recipe called for Hallertau, Tettnang and Saaz, you might choose a mix of Sterling, Vanguard, Santiam and Mt. Hood as a substitute.

Many German lager recipes call for noble hops, which are all fairly neutral (although they each have subtle varietal differences). If that is what you usually brew, you should be in good shape. Because the world's largest breweries drive the research and development of new hop varieties, most new hop varieties are bred either for high alpha or for high-

yielding dual-purpose or aroma hops that won't stick out in an American or International-style Pilsner (such as Bud, Miller, Heineken, Stella Artois, etc.). So, a lot of the new aroma or dual-purpose varieties you run into will be low cohumulone hops with a mild aroma. Often, the primary oil in these hops is humulene. In the accompanying story, "Meet the New Hops," on page 38, four new hop varieties are profiled. Three of these of hops can be used as noble hop substitutes.

For English ales, Kent Goldings is the most common "neutral" English hop. If you can't find this, First Gold is a good substitute. Things get a bit more ugly when you consider Fuggles. Styrian Goldings is usually the first hop people mention when they need a substitute for Fuggles, but both these varieties are in short supply this year. The new hop Glacier — the last of the four new hops profiled in the above-mentioned story — should be an acceptable, if not outstanding, substitute for Fuggles (or Styrian Goldings for that matter).

The most difficult situation is coming up with a substitution for a single variety with a strong varietal character. Hoppy American brews featuring Cascade, Centennial and Amarillo hops have been very popular among homebrewers and beer drinkers. Finding a good hop substitute for these is going to be difficult. If you're lucky, you'll run into some Ahtanum. Ahtanum — profiled in this issue's "Homebrew Nation" — is fairly similar to Cascade. If you're slightly less lucky, you might find some Palisade, which also has some "American" hop characteristics. (There's also a brand new hop called Bravo, but there isn't a lot of info out on it yet.) If you can't find any "C" hops or these suggested substitutions, you're probably out of luck for capturing the citrusy blast of a hoppy American-style pale ale or IPA. Northern Brewer is another "characterful" hop for which finding a substitute will be difficult.

The last resort for any hop substitution is a mix of neutral hops. This will work well for most lightly-hopped or balanced beers. For heavily-hopped beers, you'll still get a nice, rounded hop character, but the "edge" may be gone. For most homebrewers, it won't ever come to this worst-case scenario — and even if it does, this is far preferable than having to resort to non-hop bittering agents.

Iron Brewer — or, Let the Hops Lead

When deciding what to brew this year, one option will be to see what hops are available first and make your recipe decisions second. When I said that Glacier would not be an outstanding substitute for Fuggles, the converse is also true. Both Fuggle and Glacier have their own "personality." In the TV show Iron Chef, chefs are given a random assortment of ingredients on the spot and asked to come up with a meal. The winning iron chef is the one that makes the most of the ingredients at hand. The losing chefs frequently try to cram the ingredient into whatever style of cuisine they are used to cooking. This year, you may need to brew at least a couple beers as an Iron Brewer — pick a new hop variety and see what you can get it to do.

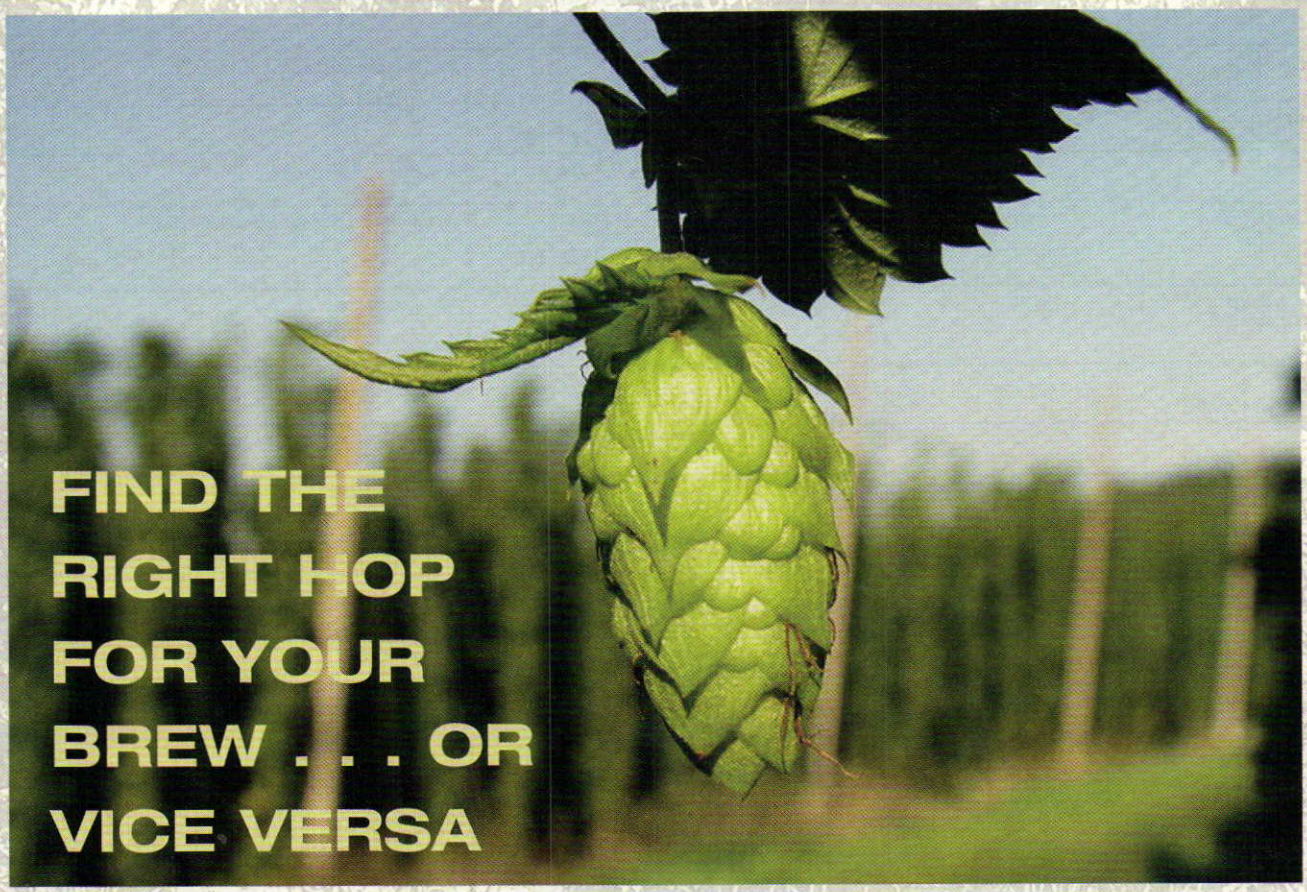


Photo Courtesy of Wikipedia

HOMEBREW HOP GUIDE

name	alpha acid %	typical beer styles	possible substitutes	flavor description
Admiral (U.K.)	13.5 to 16%	Ale	U.K. Target, U.K. Northdown, U.K. Challenger	Known for its bittering potential.
Ahtanum	4 to 6.3%	Lager, American ales	Cascade, Amarillo	Floral, citrus, sharp and piney.
Amarillo	8 to 9%	Ale, IPA	Cascade, Centennial	Citrusy, flowery.
Bramling Cross (U.K.)	5 to 7%	ESB, bitter, pale ale	U.K. Kent Golding, U.K. Progress, Whitbread Goldings Variety	Quite mild, fruity currant aroma.
Bravo	14–17%	American-style IPA?		
Brewer's Gold	7 to 8.5%	English ale	Bullion	Bittering hop with neutral aroma character.
Brewer's Gold (German)	6 to 7%	Ale, heavier German-style lagers	Northdown, Northern Brewer, Galena, Bullion	Black currant, fruity, spicy.
Bullion	6.5 to 9%	IPA, ESB, stout	Columbus, Northern Brewer, German Brewer's Gold	A rich hop primarily used for bittering. Intense black currant aroma.
Cascade	4.5 to 7%	Pale ale, IPA, porter, barleywine	Centennial, Amarillo, possibly Columbus	Flowery, citrusy. Can have a grapefruit flavor.
Centennial	8 to 11.5%	All ale styles, has been used with wheat beer	Cascade, Columbus, Chinook	Medium with floral and citrus tones.
Challenger (U.K.)	6.5 to 8.5%	English-style ales, porter, stout, ESB, bitter	U.S. or German Perle, Northern Brewer	Mild to moderate, quite spicy.
Chinook	10 to 14%	Pale ale, IPA, stout, porter, lager	Nugget, Columbus, Northern Brewer, U.K. Target	Mild to medium-heavy, spicy, piney and grapefruity.
Cluster	5.5 to 8.5%	Ale and lager (good aroma for ale, good bittering for lager)	Galena	Medium and quite spicy.
Columbus	11 to 16%	IPA, pale ale, stout	Tomahawk, Zeus	Pungent.
Crystal	2 to 4.5%	Lager, pilsner, ESB	Mt. Hood, Hersbrucker, French Strisslespalt, Liberty, Hallertauer	Mild, spicy and flowery.
First Gold (U.K.)	6.5 to 8.5%	Ale, ESB	U.K. Kent Golding, maybe Crystal	A little like Golding family; spicy.
Fuggle (U.S.)	4 to 5.5%	Any English-style beer or American ale	U.K. Fuggle, Willamette, Styrian Golding, U.S. Tettnanger	Mild, woody and fruity.
Fuggle (U.K.)	4 to 5.5%	All English-style ales, ESB, bitter, lager	U.S. Fuggle, Willamette, Styrian Golding	Mild, pleasant and hoppy.
Galena	10 to 14%	Ale, porter, stout, ESB, bitter	Nugget, Pride of Ringwood, Chinook	Citrusy.
Glacier	3.3 to 9.7%	English ales, stout, porter	Willamette, U.S. Fuggles	Mild flavor, earthy aroma.
Golding (U.S.)	4 to 6%	Pale ale, ESB, all English-style beer	U.K. Golding, Whitbread Golding Variety, U.K. Progress, and possibly the Fuggle family Willamette or Fuggles	Mild, extremely pleasant and gently hoppy.
Green Bullet (New Zealand)	11 to 14%		Liberty, Ultra, Hallertauer Tradition Crystal, Mt. Hood	Dual purpose hop.
Hallertauer (U.S.)	3.5 to 5.5%	Lager, pilsner, bock, wheat	Liberty, German Tradition, Ultra	Very mild, pleasant and slightly flowery, some spicy.
Hallertauer Gold	6 to 6.5%	Lager	U.S. Hallertauer	Known for aromatic properties similar to Hallertauer.
Hallertauer Mittelfrüh	3 to 5.5%	Lager, bock, wheat, maybe pilsner	Vanguard	Mild and pleasant.
Hallertauer Tradition (Ger.)	3.5 to 5.5%	Mild-flavored beers	Crystal, Liberty	Very fine, similar to German Hallertau Mittlefrüh.
Hersbrucker (German)	3 to 5.5%	Lager, pilsner, bock, wheat	Mt. Hood, French Strisslespalt	Mild to semi-strong, pleasant and hoppy.
Horizon	11 to 14%	Ale, lager	Magnum or a high-alpha hop	Floral and spicy.
Kent Golding (U.K.)	4 to 5.5%	All English-style ales, ESB, bitter	U.S. Golding, WGV, U.K. Progress	Gentle, fragrant, and pleasant.
Liberty	3 to 6%	Lager, pilsner, bock, wheat	Hallertauer Tradition, Hallertauer, Mt. Hood	Mild and clean aroma, slightly spicy character.
Magnum	13 to 15%	All beers, particularly lager, pilsner, stout	Northern Brewer	Good, bitter quality.
Mt. Hood	3 to 8%	Lager, pilsner, bock, wheat	Crystal, French Strisslespalt, Hersbrucker	Mild, pleasant and clean, somewhat pungent and resiny.
Newport	13–17%	any	Galena, Nugget	Fairly pungent.

name	alpha acid %	typical beer styles	possible substitutes	flavor description
Nelson Sauvin (N.Z.)	12–14%			Unique hop with grape-like character.
Northdown (U.K.)	7.5 to 9.5%	All ales, porter		Mild, pleasant, delicate aroma.
Northern Brewer (U.S.)	6 to 10%	ESB, bitter, English pale ale, porter, California (steam) beer	Nugget, Chinook	Medium-strong.
Northern Brewer (German)	7 to 10%	ESB, bitter, English pale ale, porter	Chinook, U.S. Northern Brewer	Medium-strong with some wild American tones.
Northwest Golding	4 to 5%	Ale, porter, stout, ESB, bitter		Known for aromatic properties.
Nugget	11 to 14.5%	Light lager	Columbus, Chinook, U.K. Target, Galena	Herbal.
Pacific Gem (New Zealand)	13–15%			Bittering hop with a woody character.
Palisade	5.5 to 9.5%		perhaps Cascade	some "American" characteristics.
Perle (U.S.)	6 to 9.5%	Pale ale, porter, German styles	Northern Brewer, Cluster, Galena, Chinook	Floral, slightly spicy.
Perle (German)	6 to 8.5%	Pale ale, porter, lager	U.S. Perle, Northern Brewer	Moderately intense, good and hoppy.
Phoenix (U.K.)	4.2 to 5.5%	All ales	U.K. Northdown, U.K. Kent Golding, U.K. Challenger	Similar to U.K. Challenger.
Pioneer (U.K.)	8 to 10%	Ale, ESB	U.K. Kent Golding	A mild, typical English aroma.
Polish Lublin	3 to 4.5%	Pilsner	U.S. Saaz, Czech Saaz, U.S. Tettnanger	Mild and typical of noble aroma types, spicy, herbal.
Pride of Ringwood (Australia)	7 to 10%	Australian lager	Galena, Cluster	Quite pronounced, but not unpleasant.
Progress (U.K.)	5 to 7.5%	Ale, bitter, ESB, porter	U.K. Kent Golding, Fuggle	Moderately strong, good aroma.
Saaz (Czech)	3 to 4.5%	Pilsner	U.S. Saaz, Polish Lublin	Very mild with pleasant hoppy notes.
Saaz (U.S.)	3 to 5%	Pilsner, lager, wheat	Czech Saaz, Polish Lublin	Very mild, earthy and spicy.
Santiam	5 to 7.9%	Lager, American ale, pilsner	German Tettnanger, German Spalt, German Spalt Select	Floral, slightly spicy.
Satus	12.5 to 14%		Galena	Known for its bittering and aromatic properties.
Saphir (German)	2.5–4.5%	Lagers	any noble hop	Mild aroma hop.
Simcoe	12 to 14%	hoppy Amercian ales		A bittering and aromatic hop. Piney aroma.
Sorachi Ace (Japan)	13 to 16%			Bittering hop with lemony aroma.
Spalt (German)	4 to 5.5%	Lager	U.S. Saaz, U.S. Tettnanger, German Spalt Select	Mild and pleasant, slightly spicy.
Spalt Select (German)	4 to 6%	Lager, and any beer in which noble aroma is appropriate	U.S. Saaz, U.S. Tettnanger, German Spalt	Very fine Spalter-type aroma.
Spalt Select (U.S.)	3 to 5%	German lagers	Tettnanger, Saaz	Medium intensity and pleasant hoppy qualities. Medium-strong aroma with wild American tones.
Sterling	6 to 9%	Lager, ale, pilsner	Saaz, Polish Lublin	Herbal, spicy, pleasant aroma, hint of floral and citrus.
Strisslespalt (France)	3 to 5%	Pilsner, lager, wheat	Mt. Hood, Crystal, Hersbrucker	Medium intensity, pleasant, hoppy.
Styrian Golding (Slovenia)	4.5 to 6%	All English-style ales, ESB, bitter, lager	U.S. Fuggle, U.K. Fuggle, Willamette	Delicate, slightly spicy.
Target (U.K.)	9.5 to 12.5%	All ale and lager	Fuggle, Willamette	Pleasant English hop aroma, quite intense.
Tettnanger (U.S.)	3.4 to 5.2%	German ales and lagers, American lagers, wheat	German Spalt, Czech Saaz, Santiam	An aromatic hop, mild and slightly spicy.
Tettnanger (German)	3.5 to 5.5%	Lager, ale	German Spalt, German Spalt Select, U.S. Tettnanger, Saaz	Mild and pleasant, slightly spicy, herbal.
Tomahawk	15 to 17%	Ale	Columbus, Zeus	Primarily a bittering hop.
Tradition (German)	5 to 7%	Lager, pilsner	Hersbrucker, Hallertauer Mittelfrüh	Very fine and similar to Hallertauer Mittelfrüh.
Vanguard	4 to 5.67%		Saaz, Hallertauer Mittelfrüh	Aroma similar to continental European types.
Warrior	15 to 17%	Ale, stout	Nugget	A bittering and aromatic hop.
WGV (Whitbread Golding Variety) (U.K.)	5 to 7%	Ale	U.K. Kent Golding, U.K. Progress	Quite pleasant and hoppy, moderately intense.
Willamette	3.5 to 6%	Pale ale, ESB, bitter, English-style ale, porter, stout	U.S. Fuggle, U.S. Tettnanger, Styrian Golding	Mild and pleasant, slightly spicy, fruity, floral, a little earthy.
Yakima Cluster	6 to 8.5%			Used as a kettle hop for bittering.
Zeus	13 to 17%		Columbus, Tomahawk	Aromatic and pleasant.

GLACIER SANTIAM

MEET THE NEW HOPS

Every dark cloud has a silver lining. One silver lining to this year's hop crisis is that many homebrewers may be forced to try new varieties of hops and end up finding one that they really like.

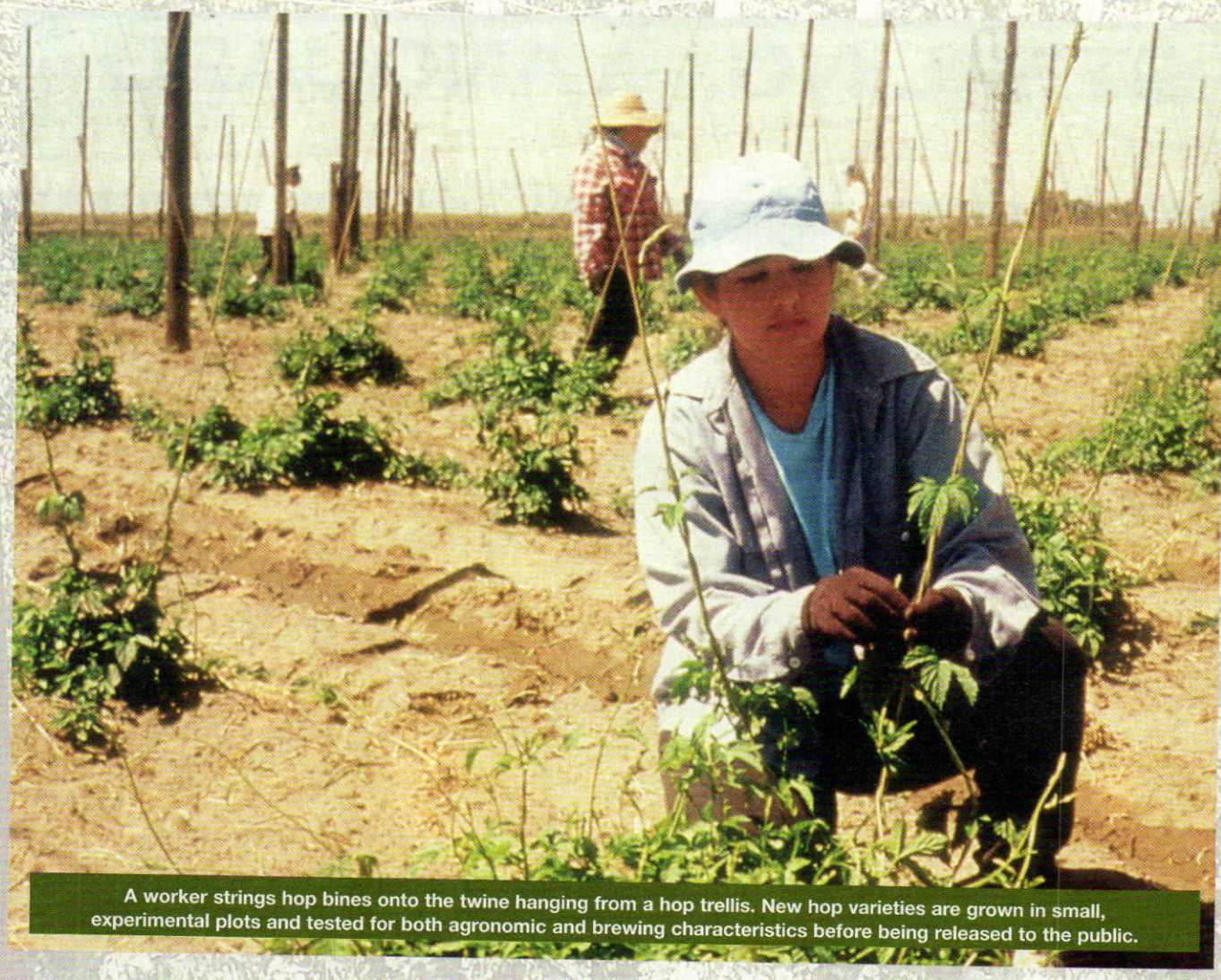
New hop varieties are bred all the time. Plant breeders look to develop hop varieties with higher yields, higher alpha acid content, better resistance to hop diseases (such as downy or powdery mildew), better storage properties or a better ability to withstand the rigors of mechanical harvesting. If they can do this — and the hop is proven to have good brewing characteristics — the new variety will be released.

In an effort to get acquainted with some hop varieties that are both fairly new and likely to be available to homebrewers in 2008, I took a closer look at four hop varieties — Glacier, Santiam, Sterling and Vanguard.

There are a lot of ways to get acquainted with new varieties of hops. First of all, you can read up on them. Hop merchants, such as Hop Union, Yakima Chief and Hopsteiner, all maintain websites with descriptions of the hops they sell. (A Google search for any of these names will yield the appropriate site.) Hop descriptions usually contain a variety of measured parameters, including alpha acid and beta acid percentages, percentage of cohumulone, total oil percentage and others. The descriptions usually also give a verbal description of the hops' characteristics. These may include the lineage of the hop (what varieties were its parents), varieties with comparable brewing characteristics and perhaps a description of the flavor or aroma properties of the hop. Keep in mind that, with newer varieties of hops, the statistics are based on a limited number of growing seasons and acres. As such, information sometimes varies among different sources and may change in the future as data from more growing seasons and wider plantings becomes available.

STERLING VANGUARD

by **Chris Colby**



A worker strings hop bines onto the twine hanging from a hop trellis. New hop varieties are grown in small, experimental plots and tested for both agronomic and brewing characteristics before being released to the public.

Homebrewers know that the alpha acid percentage is a measurement of how much bitterness the hop will impart. It is usually given as a weight to weight (w/w) percentage. This is one of the key numbers we plug into our recipe calculators to get an IBU estimate. However, just because the other quoted numbers don't show up in brewing software doesn't mean they aren't conveying worthwhile information.

The amount of cohumulone, given as a percentage of the total alpha acids, will tell you how neutral or "characterful" a hop is. Some describe the character high-cohumulone hops as simply "harsh," but this glosses over the interesting flavors of many high-cohumulone homebrewer favorites (including Cascade and most of the "C" hops). If you're looking to brew a graceful, elegant lager, with a refined hop taste, look for a hop with a low cohumulone percentage (under 30%). If you're looking for something more flavorful, that can hold its own in a big, bold IPA, look for a higher cohumulone percentage.

The total oil percentage will give you some idea of how aromatic a variety is. This is usually expressed in milliliters of oil per 100 grams of hops. Most hop profiles will also list the amounts of the major oils as a percentage of the total oils.

Myrcene, humulene, farnesene and caryophylene are the four major hop oils, with myrcene and humulene usually being the most abundant. Myrcene is the most prevalent oil in many American hops, such as Amarillo, the "C" hops and Brewer's Gold. Humulene is the most prevalent oil in most of the noble hops and other hops with "elegant" aroma characteristics (including Saaz, Hallertau and Goldings). When looking for an aroma hop, look for hops high in humulene if you want a nice, refined hop aroma. If you want a bit more "zing," look for a hop with a little more myrcene. Hops with a roughly equal balance of the two, such as Tettnang and Willamette, have an intermediate character.

After reading up on the hops featured in this article, I ordered some of each and smelled them. Based on my impressions of the hops' aromas, I came up with the four recipes presented on page 42. More than anything, brewing these beers and tasting the results helped me evaluate these varieties.

With all this in mind, let's meet the new hops:

GLACIER

Glacier is a moderate alpha hop, with an average alpha acid rating around 5.5%. The percentage of cohumulone is 11–13% (which is very low, comparatively). The total oil content is usually between 0.7 and 1.6%, with myrcene being more abundant than humulene. (Myrcene has averaged 47% of the total oils, compared to 29% for humulene.) It is said to be a good replacement for Willamette, US-grown Fuggles or Styrian Goldings. I thought the hops smelled "earthy" (like UK Fuggles) and this was reinforced when I smelled the beer I brewed with it.

In my wheat porter, the Glacier hops had enough "umph" to

be smelled along with the roast, but weren't overly coarse or aggressive. The flavor was mild compared to the aroma. I think this would make a great hop for a wide variety of English ales or Irish stouts. It might also work well in a lot of Belgian styles that call for Styrian Goldings.

SANTIAM

Santiam is regarded as a substitute for German-grown Tettnanger, and this is a good description for this hop. The alpha acid level is usually between 5 and 7%, with a cohumulone percentage around 22%. The total oil percentage varies between 1.3–1.7%, with myrcene levels (at 27–36%) somewhat higher than humulene levels (at 23–26%). In German-grown Tettnang, myrcene and humulene levels are roughly equal. Santiam has a refined but spicy aroma. Every year, I brew at least one Vienna lager with Tettnang hops and Santiam definitely resembles Tettnang, although its aroma is slightly more assertive. It would certainly work well anywhere a lightly spicy hop is called for, including most lagers (and especially Vienna lagers, Märzens and Octoberfests) and some ales (for example, alts).

STERLING

Sterling is regarded as a Saaz substitute, sometimes compared to a blend of Saaz and Mt. Hood (a Hallertau-derived variety). However, I found its aroma to be very similar to Santiam. Sterling contains 6–9% alpha acids, with 22–28% cohumulone. Total oil content is 1.3–1.9%, with myrcene levels (at 44–48%) considerably higher than humulene levels (at 19–23%). For comparison, Saaz has a higher percentage of humulene than myrcene. I tried this hop in two beers and thought it was very similar to Santiam.

VANGUARD

Vanguard is a very mild hop. With 5.5–6% alpha acids and only 14–16% cohumulone, it has a very elegant, noble hop feel to it. Total oils comprise 0.9–1.2% of the hop, with humulene levels (at 45–50%) roughly twice that of myrcene (at 20–25%). It is regarded as a Hallertau substitute. Compared to the other hops in this article, the aroma of of Vanguard was very refined. The others all had fairly prominent aroma notes beyond just smelling like hops. Vanguard, however, smelled "clean." For the middle-of-the-road ale I brewed with it, I bumped up the amount of late addition hops so they would show through. Even so, the hop aroma is fairly subdued. Given this experience, I would say that Vanguard would be excellent for any balanced, lightly-flavored lager or ale (such as a Kölsch or maybe even Scottish ales), although it might get overwhelmed in fruitier ales. It will also likely blend well with other hops. If I wanted to brew a Pilsner with a lot of Saaz-like character, I'd go with a mix of two-thirds Vanguard and one-third Santiam or Sterling.

Subjectively, I liked all of these hop varieties and I think each will have its uses in homebrewing — even when the hops they substitute for return.

Chris Colby, Editor of Brew Your Own, *is a third-year hop grower hoping for a good crop.*

NEW HOP RECIPES

Red Queen Ale

(5 gallons/19 L, all-grain)

OG = 1.044 FG = 1.008
IBU = 24 SRM = 10 ABV = 4.6%

In Lewis Carroll's "Through the Looking-Glass," Alice encounters the Red Queen, who needs to keep running as fast as she can just to stay in place. Like the Red Queen, brewers will be doing some scrambling just to hold their ground in 2008. In my Red Queen Ale, I tried to come up with a recipe that made the most of some ingredients that should be plentiful, and of high quality, this year. I chose Santiam and Sterling hops because I liked their spicy character. This year, the US crop of 6-row barley was excellent, whereas 2-row barley crops around the world were variable. This beer is dry and the Nottingham yeast leaves a refreshing crispness.

Ingredients

4.5 lbs. (2.0 kg) 6-row pale malt
2.25 lbs. (1.0 kg) 2-row pale malt
8.0 oz. (0.22 kg) crystal malt (90 °L)
2.25 lbs. (1.0 kg) flaked maize
2.3 AAU Sterling hops (60 mins)
(0.46 oz./13 g of 5% alpha acids)
2.3 AAU Santiam hops (60 mins)
(0.38 oz./11 g of 6% alpha acids)
0.33 oz. Santiam hops (15 mins)
0.33 oz. Sterling hops (7.5 mins)
0.33 oz. Santiam hops (0 mins)
1 tsp Irish moss (15 mins)
¼ tsp. yeast nutrients
Danstar Nottingham Ale yeast
1 cup corn sugar (for priming)

Step by Step

Add crushed grains and flaked maize to kettle and stir in 14.3 qts. (13.5 L) of mash liquor at 142 °F (61 °C). Mash should settle into 131 °F (55 °C). Immediately begin heating mash to ramp temperature up to 150 °F (66 °C). Stir constantly and aim to raise the temperature at a rate of 2 °F (~1 °C) per minute. Hold for 45 minutes at 150 °F (66 °C) then heat mash — again stirring constantly — to a mash out temperature of 168 °F (76 °C). Scoop mash over to lauter tun and let sit for 5 minutes. Recirculate wort for 20 minutes (or until wort is clear) then begin running off wort. Keep sparge water heated such that grain bed temperature remains close to, but not over, 168 °F (76 °C). Collect about 5 gallons (19 L) of wort, Add 1.5 gallons (5.7 L) of water to wort and boil for 90 minutes. Add hops at times indicated in the ingredient list. Add Irish moss and yeast nutrients with 15 minutes left in boil. Cool wort to around 65 °F (18 °C) and transfer to fermenter. Aerate thoroughly and pitch yeast. Ferment at 65 °F (18 °C) until fermentation is complete (about 4–6 days). Let beer sit on yeast for a day or two, at 68–70 °F (20–21 °C), then rack directly to keg or bottling bucket.

Red Queen Ale

(5 gallons/19 L, extract w/grains)

OG = 1.044 FG = 1.008
IBU = 24 SRM = 10 ABV = 4.6%

Ingredients

1.0 lb. (0.45 kg) 6-row pale malt
8.0 oz. (0.23 kg) 2-row pale malt
8.0 oz. (0.23 kg) crystal malt (90 °L)
1.5 lbs. (0.68 kg) Briess Light dried malt extract
1.25 lbs. (0.57 kg) cane sugar (late addition)
1.5 lbs. (0.68 kg) Briess Light liquid malt extract (late addition)
2.3 AAU Sterling hops (60 mins)
(0.46 oz./13 g of 5% alpha acids)
2.3 AAU Santiam hops (60 mins)
(0.38 oz./11 g of 6% alpha acids)
0.33 oz. Santiam hops (15 mins)
0.33 oz. Sterling hops (7.5 mins)
0.33 oz. Santiam hops (0 mins)
1 tsp Irish moss (15 mins)
¼ tsp. yeast nutrients
Danstar Nottingham Ale yeast
1 cup corn sugar (for priming)

Step by Step

Place crushed grains in a large steeping bag. In a large kitchen pot, heat 3.0 qts. (2.8 L) of water to 161 °F (72 °C). Submerge grain bag and let steep, at 150 °F (66 °C), for 45 minutes. While grains are steeping, heat 2.0 gallons (7.6 L) of water to a boil in your brewpot. In a small third pot, heat 1.5 quarts (1.4 L) of water to 170 °F (77 °C). Once grains are done steeping, lift out grain bag and place it in a colander suspended over your brewpot. Slowly pour the "grain tea" through the grain bag (to strain out the "floaties"), then pour the 170 °F (77 °C) water through the bag (to rinse the grains). Add dried malt extract and bring the wort to a boil, add first dose of hops and boil for 60 minutes. Add hops at times indicated in ingredient list. With 15 minutes left in the boil, stir in liquid malt extract, sugar, Irish moss and yeast nutrients. After boil, cool wort — in sink or with a wort chiller — then transfer to fermenter. (Do not pour hot wort into cold water for chilling.) Add cool water to top volume up to 5.0 gallons (19 L) and make temperature 65 °F (18 °C). Aerate thoroughly and pitch yeast. Ferment at 65 °F (18 °C) until fermentation is complete (about 4–6 days). Let beer sit on yeast for a day or two, at 68–70 °F (20–21 °C), then rack directly to keg or bottling bucket. (No secondary fermentation is required).

Glutinous Butt

(5 gallons/19 L, all-grain)

OG = 1.056 FG = 1.014
IBU = 48 SRM = 55 ABV = 5.4%

This beer is essentially a porter formulated

with a wheat beer base. (The name comes from the fact that wheat has a high gluten content compared to barley and some porters used to be referred to as entire or entire butt.) The Glacier hops give an "earthy" hop flavor to the beer that works well with the roasted grains. Brew this and, at your next homebrew club meeting, everyone will be glad to see your Glutinous Butt.

Ingredients

5.5 lbs. (2.5 kg) wheat malt
4.25 lbs. (1.9 kg) Pilsner malt
8.0 oz. (0.23 kg) crystal malt (40 °L)
6.0 oz. (0.17 kg) crystal malt (60 °L)
8.0 oz. (0.23 kg) chocolate malt
4.0 oz. (0.11 kg) black patent malt
3.0 oz. (0.09 kg) roasted barley (500 °L)
11 AAU Newport hops (60 mins)
(0.79 oz./22 g of 14% alpha acids)
0.75 oz. (21 g) Glacier hops (15 mins)
Wyeast 1028 (London Ale) yeast
(2 qt./2 L yeast starter)
⅞ cup corn sugar
(for priming)

Step by Step

Single infusion mash at 153 °F (67 °C) in 16 qts. (15 L) of mash liquor. Mash out to 168 °F (76 °C). Recirculate, then run off wort. Sparge water should be hot enough to keep grain bed temperature near 168 °F (76 °C). Be careful not to oversparge. Stop collecting when specific gravity of final runnings falls below 1.010 (or pH climbs above 5.8) — about 6.0 gallons (23 L) of wort total. Bring wort to a boil. Once first signs of hot break appear, add first dose of hops and boil for 60 minutes. Add finishing hops with 15 minutes left in boil. Cool wort to 68 °F (20 °C) and transfer to fermenter. Aerate and pitch yeast. Ferment at 68 °F (20 °C) for 7–10 days, then rack to secondary fermenter. After 4–7 days in secondary, rack to bottling bucket or keg.

Glutinous Butt

(5 gallons/19 L, countertop partial mash)

OG = 1.056 FG = 1.014
IBU = 48 SRM = 56 ABV = 5.5%

Ingredients

2.5 lbs. (1.1 kg) wheat malt
1.5 lbs. (0.68 kg) Pilsner malt
8.0 oz. (0.23 kg) crystal malt (40 °L)
6.0 oz. (0.17 kg) crystal malt (60 °L)
8.0 oz. (0.23 kg) chocolate malt
4.0 oz. (0.11 kg) black patent malt
3.0 oz. (0.09 kg) roasted barley (500 °L)
5.0 oz. (0.14 kg) Muntons Light dried malt extract
4.0 lbs. (1.8 kg) Muntons Light liquid malt extract (late addition)
11 AAU Newport hops (60 mins)
(0.79 oz./22 g of 14% alpha acids)
0.75 oz. (21 g) Glacier hops (15 mins)
½ tsp. calcium sulfate (gypsum) or calcium chloride
1 tsp. calcium carbonate (chalk) or ½ tsp. sodium bicarbonate (baking soda)
Wyeast 1028 (London Ale) yeast
(2 qt./2 L yeast starter)
⅞ cup corn sugar (for priming)

Step by Step

This recipe uses a modification of countertop partial mash procedures. You will need a 2-gallon (7.6-L) beverage cooler and two grain bags, one large enough to hold four pounds of grain. Begin by heating 5.5 qts. (5.2 L) of soft or distilled water to 165 °F (74 °C) in a large kitchen pot. Stir ½ tsp. calcium sulfate (gypsum) or calcium chloride into this water. In another pot, heat 2.75 qts (2.6 L) of soft water to around 164 °F (73 °C). Stir 1 tsp. calcium carbonate (chalk) or ½ tsp. sodium bicarbonate (baking soda) into this water. In your brewpot, begin heating a half-gallon (~2 L) of water to around 170 °F (77 °C). (Tap water is fine, as long as it tastes good.) Place crushed pale malts (Pilsner and wheat) in one grain bag and place in cooler. Put

remaining crystal and dark malts (all crushed) in the other bag. Add the 5.5 qts. (5.2 L) of water to the pale grains in the cooler and stir it in. Let this mash, starting at 154 °F (68 °C), for 45 minutes. Likewise, steep the specialty grains in the pot of carbonate-rich water for 45 minutes (around 153 °F/67 °C), although this exact temperature is not critical. While grains mash and steep, heat about 8.0 qts. (7.6 L) of water (tap is fine) to 180 °F (82 °C).

When mashing and steeping is complete, scoop 1 qt. (~1 L) of 170 °F (77 °C) water from your brewpot (you can use a large measuring cup for this). Lift the specialty grains out of their steeping pot and place in a colander over your brewpot. Pour the "grain tea" through the grain bag (to strain out any large bits of grain) and then rinse the grains with the water pulled from your brewpot. Start heating this "grain tea" while you collect the wort from the cooler. To collect wort from mash, recirculate about 2.5 qts. (2.4 L) of wort, then add 180 °F (82 °C) water to cooler until it is full to the rim. Draw off wort and add to brewpot until the liquid level in the cooler is just above the grain bed. Add 180 °F (82 °C) water to the rim again. Repeat this process until you have collected 2.0 gallons/8 qts. (7.6 L) of wort. Add dried malt extract and bring wort to a boil. Add first dose of hops and boil for 60 minutes.

Add hops at times indicated in the ingredient list. Cool wort, in sink or with wort chiller, to 68 °F (20 °C) and transfer to fermenter. Add water to top up to 5 gallons (19 L), aerate and pitch yeast. Ferment at 68 °F (20 °C) for 7–10 days, then rack to secondary fermenter. After 4–7 days in secondary, rack to bottling bucket or keg.

Bronze Ale

(5 gallons/19 L, all-grain)

OG = 1.048 FG = 1.012
IBU = 30 SRM = 20 ABV = 4.7%

In the March-April 2007 issue of BYO, I used a beer I called my copper ale as an example in an article on balancing beer recipes. This is a slightly reworked version of that beer that features Vanguard hops.

Ingredients

5 lb. 14 oz. (2.7 kg) 6-row malt
3.5 lbs. (1.6 kg) Vienna malt
13 oz. (0.37 kg) crystal malt (30 L)
5.0 oz. (0.14 kg) Victory malt
2.5 oz. (71 g) chocolate malt
6.0 AAU Glacier hops (60 mins)
(1.0 oz./28 of 6% alpha acids)
0.50 oz. (14 g) Sterling hops (20 mins)
0.50 oz. (14 g) Vanguard hops (10 mins)
0.50 oz. (14 g) Vanguard hops (0 mins)
¾ tsp. Irish moss (15 mins)
Wyeast 1056 (American Ale), White Labs WLP001 (California Ale) or Fermentis Safale US-05 yeast (2 qt./2 L yeast starter)
⅞ cup corn sugar (for priming)

Step by Step

Mash at 152 °F (67 °C) in 13 qts. (12.5 L) of mash liquor. Collect about 5.5 gallons (21 L) of wort, add 1.0 gallon (3.8 L) of water and boil for 90 minutes. Add hops and Irish moss at times indicated in the ingredient list. Add Irish moss with 15 minutes left in boil. Ferment at 70 °F (21 °C).

Bronze Ale

(5 gallons/19 L, countertop partial mash)

OG = 1.048 FG = 1.012
IBU = 30 SRM = 20 ABV = 4.7%

Ingredients

2.75 lbs. (1.25 kg) Vienna malt
13 oz. (0.37 kg) crystal malt (30 L)
5.0 oz. (0.14 kg) Victory malt
2.5 oz. (71 g) chocolate malt
14 oz. (0.40 kg) light dried malt extract
3.3 lbs. (1.5 kg) Coopers Light liquid malt extract (late addition)
6.0 AAU Glacier hops (60 mins)
(1.0 oz./28 of 6% alpha acids)
0.50 oz. (14 g) Sterling hops (20 mins)

0.50 oz. (14 g) Vanguard hops (10 mins)
0.50 oz. (14 g) Vanguard hops (0 mins)
¾ tsp. Irish moss (15 mins)
Wyeast 1056 (American Ale), White Labs WLP001 (California Ale) or Fermentis Safale US-05 yeast (2 qt./2 L yeast starter)
⅞ cup corn sugar (for priming)

Step by Step

This recipe follows basic countertop partial mash procedures, as described in the October 2006 issue of BYO or on the web at byo.com/feature/1536.html. (See also the October 2007 issue, and the Glutinous Butt recipe above, for some options to consider with this recipe.) Partial mash at 152 °F (67 °C) for 45 minutes. Boil wort for 60 minutes. Add hops at times indicated in the ingredient list. Add Irish moss with 15 minutes left in boil. Ferment at 70 °F (21 °C).

Venkman's Vit

(5 gallons/19 L, all-grain)

OG = 1.052 FG = 1.013
IBU = 20 SRM = 15 ABV = 5.1%

You can think of this beer as a cross between a wit beer and and a schwarzbier, although it is not quite that dark. Venkman's Vit is finished with Sterling hops (whose character is seen by some as a cross between Saaz and Mt. Hood hops) and spiced with the zest from an Oro Blanco Grapefruit (which is a cross between a grapefruit and a pummelo) and should appeal to anyone who thinks that "crossing the streams" might be a great idea.

Ingredients

6 lb. 5 oz. (2.9 kg) Pilsner malt
4 lb. 3 oz. (1.9 kg) wheat malt
2.5 oz. (71 kg) dehusked black patent
4.5 AAU Santiam hops (60 mins) (0.75 oz./21 g of 6% alpha acids)
0.5o oz. (14 g) Sterling hops (10 mins)
Oro Blanco Grapefruit zest (1/2 fruit)
Wyeast 3463 (Forbidden Fruit) yeast
1.0 cup cane sugar (for priming)

Step by Step

Mash at 152 °F (67 °C) in 16 qts. (15 L) of mash liquor. Collect 5.5 gallons (21 L) of wort, add 1.0 gallon (3.8 L) of water and boil vigorously for 90 minutes. Ferment starting at 70 °F (21 °C). Let temperature rise to 76 °F (24 °C) when fermentation slows. Add zest in secondary and carbonate to around 2.7–3.0 volumes of CO_2. (If bottling, use heavy bottles, like the bottles that German wheat beers are packaged in.)

Here are some other hops you may run into in the coming years.

Ahtanum (US)
5.7–6.3% alpha acids
30–35% cohumulone
Total Oils 0.8–1.2%
Myrcene 50–55%/Humulene 16–20%
Similar to Cascade or Amarillo.

Horizon (US)
10.2–16.5% alpha acids
16–22% cohumulone
Total Oils 1.5–2.0%
Myrcene 65–75%/Humulene 8–10%
High-alpha, but good aroma.

Palisade (US)
5.5–9.5% alpha acids
24–29% cohumulone
Total Oils 1.4–1.6%
Myrcene 9–10%/Humulene 19–22%
Aroma hop with some "American" hop characteristics.

Newport (US)
13.4–17% alpha acids
36–38% cohumulone
Total Oils 1.6–3.4%
Myrcene 47–54%/Humulene 9–14%
Similar to Galena or Nugget.

Bravo (US)
14–17% alpha acids
29–34% cohumulone
Total Oils 1.6–2.4%
Newly-released variety.

First Gold (UK)
6.5–8.5% alpha acids
31–36% cohumulone
Total Oils 0.7–1.5%
Myrcene 27–28%/Humulene 20–24%
A dwarf hop with similar properties to Kent Goldings.

Saphir (German)
2.5–4.5% alpha acids
12–15% cohumulone
Total Oils 1.1–1.5%
Myrcene 21–40%/Humulene 20–35%
A mild aroma hop.

Sorachi Ace (Japan)
13–16% alpha acids
23% cohumulone
New high-alpha hop with a lemony aroma.

Pacific Gem (New Zealand)
13–15% alpha acids
37–40% cohumulone
Total Oils 1.2%
Myrcene 33%/Humulene 30%
Bittering hop with a woody character.

HOP GROWING

by **Betsy Parks**

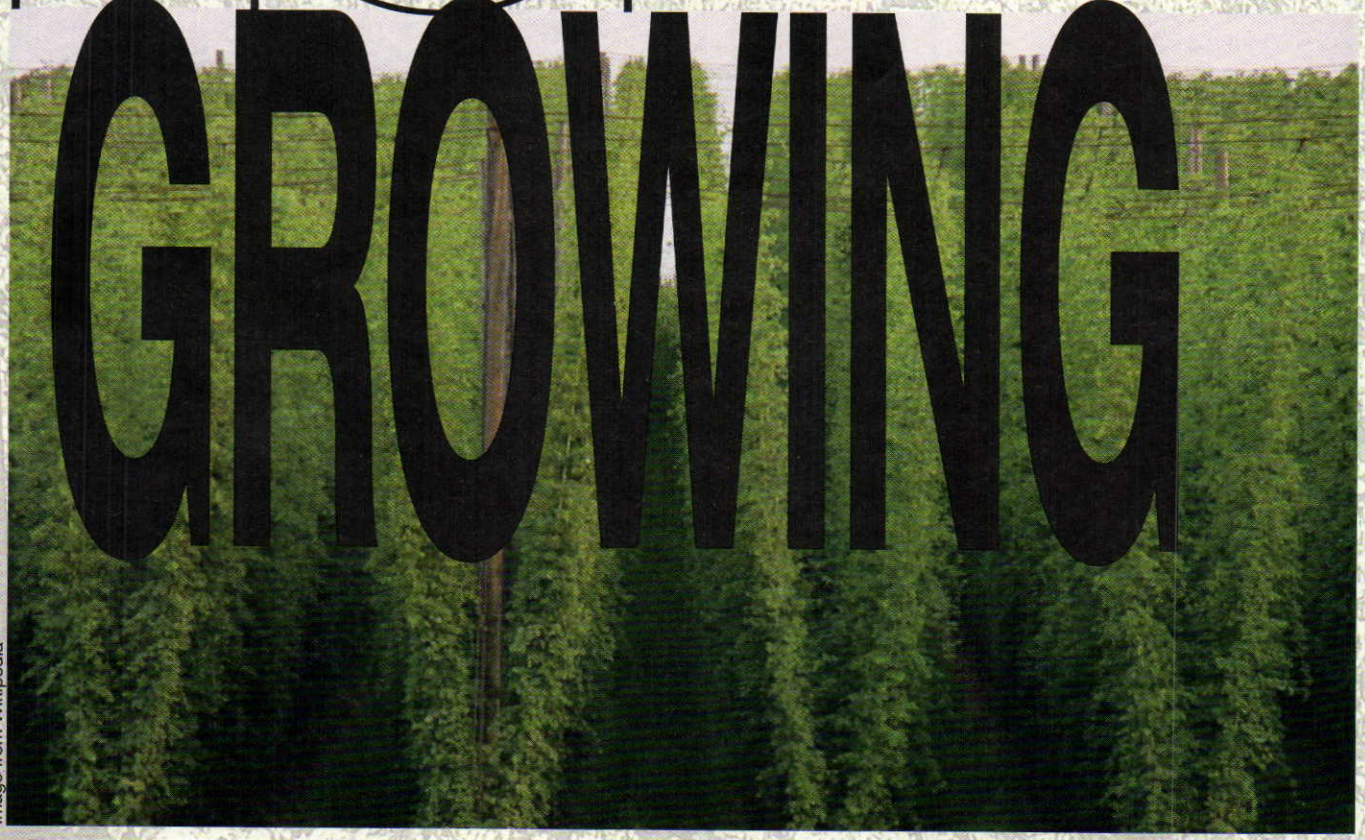


Image from Wikipedia

Growing Your Own Hops

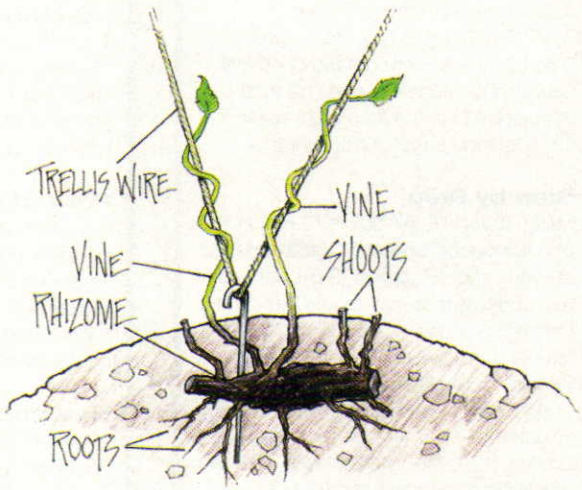
A hop shortage is no reason to panic, hoard varieties or give up on brewing. If you already make your own beer, why not start growing your own hops? Not only will you create a ready supply of your favorite varieties, the beers brewed from your own hops will also be a little more homemade.

Where To Grow

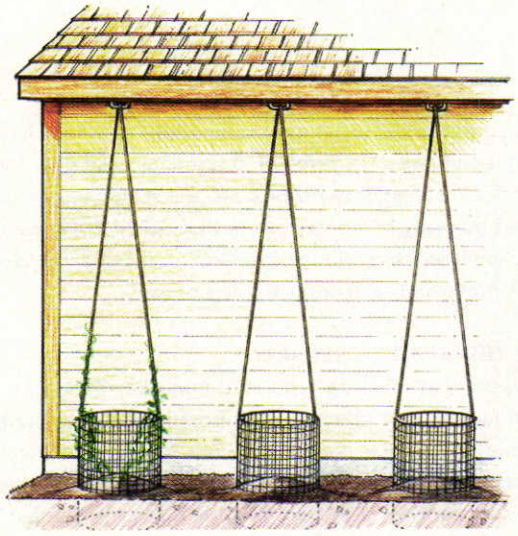
While certain parts of the world like Germany's Hallertau region or the Yakima and Willamette valleys of Washington and Oregon are famous for growing hops, the vines (known as bines) are quite hardy and can be grown in many kinds of soil conditions. All you need is an area with lots of sun (at least 6 to 8 hours per day), lots of vertical space (vines can grow more than 30 feet high), good drainage and plenty of ventilation to prevent disease. Hops like soil that is in a pH range of about 6 to 7.5, so testing and adjusting your soil isn't a bad idea if you want the best yield. They will grow in most soil conditions, however, as long as you maintain a lot of airflow in the soil by turning it over before planting and incorporate lots of compost or manure to fertilize.

How To Plant

Hops grow from woody, root-like cuttings called rhizomes, which are usually around a foot (0.3 m) long. There are both male and female rhizomes, but only female plants produce the



When planting a rhizome, be sure the green bumps (or sprouts) are facing up and the roots are facing down. Heap an inch or two of soil over it, allowing the sprouts, if already growing, to show. The vines will grow clockwise; train them around a string.



The simplest method is to grow hops against a south-facing wall of your house. Hammer a big staple in the roof, above each hill. Tie a trellis string to one side of a buried tomato cage, loop it through the staple, and tie it to the opposite side.

cones used in brewing beer. You can buy rhizomes from most homebrewing retailers (either online or local) in early spring and plant them as soon as your soil is dry enough for tilling.

For planting, find a location with a lot of vertical space and plenty of sun. An easy method for growing hops at home is planting against a south-facing wall of a two-story (or more) house or building, running a trellis line from a stake in the ground near the rhizome to a staple on the second story. You can also plant like commercial growers by using a central pole (like a flagpole) with trellis lines from the ground to the top of the pole. Keep in mind that your trellis lines need to be strong enough to support full-grown vines, which can weigh more than 20 pounds.

To achieve the best drainage, plant your rhizomes around 4 inches (10 cm) deep in a mound of soil around a foot (0.3 m) high. The rhizome needs to be planted so that the root is facing down and the green bumps are facing up. If there are already shoots, allow them to poke out of the soil. Cover the mound with straw or hay mulch to keep the weeds at bay and preserve more water in the soil. Water your hops well on a regular basis and fertilize often.

Once the vines start to grow, you should choose three or four strong shoots from each plant and prune the rest. You may need to train the shoots to the trellis at first by twisting them around the trellis every day until they start to do it on their own. The vines will follow the sun and grow from east to west, so twist accordingly. Also, look for stray shoots, especially if you're growing more than one variety next to another. Prune any of these extra shoots so that they don't get mixed up with other varieties.

What To Plant

Joe and Dennis Fisher, authors of "The Homebrewer's Garden," recommend that you plant three or four different varieties to start. To choose the best hops for your local climate, ask people in your area who may know what is best to grow, such as faculty at a local university extension, regional homebrew suppliers or other brewers who grow hops. You can also use trial and error: if a certain variety isn't right for where you live, you will know within a year or so by how well the vines grow and produce cones.

Harvesting

If you planted your rhizomes in the early spring, your hops should be ready to harvest toward the end of the summer if you live in an area with a moderate growing season. If you live in an area with a longer growing season, look for slowing vine growth and cones appearing. Check your cones daily to determine if it's time to harvest. A mature cone will smell aromatic, feel dry (drier than a green cone) and springy and will leave traces of yellow lupulin powder on your fingers. If you think the cones are ready but you're not sure, pick one and pull it open. The lupulin powder should be thick and yellow-gold in color.

When the cones are ready, you can start picking them from the vines. If want to pick all your hops at one time, cut your trellis line down and lay it on the ground to pick the flowers. This may mean that you will have a few unripe cones in your batch, however. Instead of picking all at once, you can also leave the vine intact and pick the cones from a ladder. You might consider inviting some friends to help you harvest, as it can be labor intensive. Pick your varieties one at a time and label the containers well to prevent mixing them up.

After the cones are off the vine, they need to be taken out of direct sunlight and dried as soon as possible to preserve the essential oils. Your harvests will likely be small enough that you can dry your cones in small batches in a warm, dry spot in your house, such as the attic. Place the cones in paper bags, or on a clean screen with the hops covered with a sheet, and shake the hops around every few days to keep them aerated. After a week or so, they should be well dried. Store the dried hops away from oxygen and light in a sealed plastic zipper bag with as much air removed as possible or vacuum pack if possible. If you don't plan to use all your hops right away, store the bags in the freezer for up to a year.

Post Season

After you've harvested, cut the vines back to only a few feet (or a meter) from the ground and let them die off. When the first hard frost hits (if that's the case in your area) or when you close up your garden for the season, cut the remaining vines to a few inches (~5 cm) from the ground, cover them with compost or manure and re-mulch.

The following spring, pull back the mulch and soil and cut around the rhizome with a spade or knife so that it is around a foot (0.3 m) long. Remove any root pieces you cut off. This is called root pruning, which should be done before your new shoots are 6 inches (5 cm) tall. It prevents hops from taking over your garden or intermingling with other varieties. With proper maintainence, you should have a sustainable supply of hops for years to come.

A Comparison of Batch and Continuous Sparging

by **Steve Holle**

Batch sparging is an old technique that modern breweries have generally abandoned in favor of continuous sparging. Yet, because it is a straightforward process, batch sparging is still employed by many homebrewers. In this article, I will examine the origins of each method, the relative merits of each and some general principles that homebrewers can apply to their brewing.

BATCH SPARGING (HOMEBREW STYLE)

After mashing, the sweet wort must be separated from the spent grains. This process is called lautering and the two most popular lautering methods among homebrewers are batch sparging and continuous sparging. In batch sparging, once the mash is complete, the wort is recirculated through the grain bed to clarify it. (The German term for this is "vorlauf.") Next, it is completely drained from the mash/lauter tun. A second sparge water addition is added to the lauter tun, the mash remixed and the second weaker wort recirculated and completely drained from the lauter tun. Finally, a third yet weaker wort can be produced in the same manner as the second.

Homebrewing practices vary, but a popular batch sparging program involves collecting the first and second wort only, with sparge water being added to the mash before each runoff. At the end of the mash, a small volume of sparge water is added before any wort is drawn off. This slightly diluted first wort is then recirculated and quickly drawn off, completely draining the mash/lauter tun. A second volume of sparge water is stirred into the grain bed and the second wort is recirculated and run off again. The volume of sparge water added to each mash is adjusted so that the

BREWERS can decide between a **simple procedure** or one that yields **higher-quality wort** . . . or is there a method to get the **BEST OF BOTH WORLDS?**

Photo courtesy of Wikipedia

first and second worts are of equal volume. (For a complete description of this process and the equipment needed for it, see Denny Conn's "Quick and Easy Batch Sparging," in the January-February 2004 issue of *BYO*.)

HISTORY OF BATCH SPARGING

According to Randy Mosher (*Brewing Techniques*, March-April 1994), batch sparging is an archaic commercial sparging method employed at a time when technology had not yet been developed to make metal kettles large enough to accept the entire volume of wort from larger wooden lauter tuns. Consequently, the first runnings were used to fill the first kettle. After the lauter tun was filled with the second batch of sparge water, the mash remixed and recirculated, the second weaker wort filled the next kettle for a lower gravity beer. A third sparge water addition could be added for an even weaker third beer. In fact, this sparging method is the historical basis to create triple, double and single Trappist beers.

Modern homebrewers have also used batch sparging to make more than one beer from the same mash, occasionally with the twist of adding some dark specialty grains to the grist when the sparge water is added to make the second wort. In this way, a strong pale beer can be made from the first wort and a weaker dark beer can be made from the second.

It is important to note that there is a lautering technique used in some modern breweries that could also be described as batch sparging. It is similar to the homebrew style of batch sparging in that the sparge water is added in "batches;" however, in the commercial method, the grain bed is never exposed to air. (This will be discussed later in the article.)

BENEFITS OF BATCH SPARGING

Homebrewers who practice batch sparging cite several reasons for their preference — it's simple, fast, avoids channeling and minimizes the extraction of phenolic compounds with the removal of the last wort runnings.

Batch sparging is simple because no special equipment is needed to spray sparge water on top of the grain bed. The brewer simply pours mash water into the mash tun as if they were mashing in. Furthermore, the design of the lauter tun is unimportant since the specific gravity of each wort is uniform. (The wort at the top of the mash is the same gravity as the wort on the bottom, unlike in continuous sparging where the wort gets progressively weaker from bottom to top.)

For the same reason, channeling is not a concern because remixing allows uniform contact of the grain with the sparge water. Channeling is the tendency of sparge water to drain primarily through a few clear channels in the grain bed and bypass other more compacted or poorly drained sections. In continuous sparging, failure to rinse extract from these areas results in decreased efficiency.

When batch sparging, the brewer also does not need to continuously monitor the process to match the rate of sparge water inflow to wort outflow.

In spite of the fact that sparge water additions must be remashed and recirculated, proponents claim that batch sparging requires less time because wort can be drained as quickly as possible. Since dilution is the principle in use, sparge water does not need to flow slowly behind the wort to remove extract by displacement.

If continuous sparging is overdone, the sparge water may extract harsh tannins. During continuous sparging, wort gravity steadily declines and pH increases. Batch sparging reduces this risk because it is inherently inefficient. Thus, the gravity of the last runnings remain above the critical level of 1.5 to 2.0 °Plato (specific gravity 1.006 to 1.008).

CONTINUOUS SPARGING

Most modern breweries use continuous sparging because it produces higher quality wort and is more efficient in rinsing extract from the grains. To understand why, it pays to know how they produce wort.

In most modern breweries, mashing is performed in a mash tun that is constantly stirred by mash paddles. The mash is then pumped to a separate lauter tun and allowed to sit for 30 minutes to allow the grain bed to set up. To minimize oxygen pickup, the mash is pumped into the lauter tun from the bottom. (Performing the mash and lautering in separate vessels allows for a greater number of brews per day. While the grain bed from one mash is setting up in the lauter tun, the next is begun in the mash tun.)

Once the grain bed has set up, the first wort is run off until the wort is about an inch (2.5 cm) above the top of the grain bed. Then, sparge water is applied at the same rate that wort is drawn off. Rakes circulate and cut the top of the mash to ensure an even flow through the top layer of the grain bed. (If the knives cut too deeply, channeling can occur.)

In order to utilize continuous sparging, breweries require flow meters to measure the rate of sparge water entering the lauter tun and the rate of wort leaving it. Note also that, with this brewhouse configuration, batch sparging (of the homebrew type) is not possible as there would be no way to mix the sparge water and grain in the lauter tun.

Minimizing oxygen pickup is important to brewers and modern lauter tuns

have a closed piping system leading to the kettle. This ensures that the hot wort exiting the lauter tun is not exposed to oxygen on the way to the kettle. This setup, however, requires that wort be pumped from the lauter tun, not drained by gravity flow.

For homebrewers, continuous sparging requires some type of device to sprinkle sparge water on top of the grain bed. In practice, the heat loss from these devices — such as "whirligigs" — is fairly high and the sparge water must be heated several degrees above the target sparge water temperature. Brewers learn by trial error the required sparge water temperature for their system.

Likewise, brewers must learn how to balance the inflow of sparge water with the outflow of wort. Fluid flow in a homebrewery may be regulated by ball valves, hose clamps or pump speed and the process is almost always monitored visually (as opposed to with flow meters).

Finally, brewers who continuously sparge must monitor the specific gravity or pH of their final runnings to avoid oversparging and leaching tannins from the husks of the grains. (With experience, you can also estimate how much wort you should collect based your grain bill.)

Continuous sparging requires more equipment, more attention on brewday and has a slightly steeper learning curve compared to that for batch sparging. However, once a homebrewer has his continuous sparging system up, tested and running, wort collection is straightforward.

COMPARATIVE ADVANTAGES

The main concern with batch sparging is oxidation of tannins. Tannins are the harsh, mouth-drying polyphenols that are extracted primarily from grain husks during wort production. Repeatedly exposing the grain bed to air after the wort cover is removed is deleterious to wort quality. And, air is further entrained as the mash is remixed with each new batch of sparge water. When the grain bed is run dry, the heat, water and large surface area of the exposed grains favor the oxidation of tannins and the crosslinking of proteins in the teig (the gray sludge that settles on top of the grain bed after recirculation).

Oxidized phenols in the grain bed contribute to a darker wort color, harsher flavor, reduced protein coagulation (Narziss, "Die Bierbrauerei, Band II," Chapter 4, 1992) and reduced flavor stability in the packaged beer. Continuous sparging results in less oxidation of grain compounds because the constant cover of water protects them from oxygen.

Continuous sparging is also more efficient because it is based on the principle of displacement rather than dilution (De Clerck, "A Textbook of Brewing," Chapter 13, 1957). To illustrate, let's compare sparging with rinsing a soapy floor. Batch sparging would be similar to closing the floor drain, covering the entire floor with water and then opening the drain to remove the soap diluted by the water. The floor would then be re-flooded and drained until the soap was washed away. Continuous sparging would be like opening the drain, and throwing a sheet of

water across the floor that pushes the soap to the drain. Clearly the latter method removes more soap with the same amount of water than the former. It's more efficient.

A possible secondary concern is the speed that wort is runoff in batch sparging. Fast runoff can cause the grainbed to compact and slow (or stop) wort collection. In addition, faster lautering techniques can result in worts with higher lipid content (Briggs, Hough, Stevens and Young, "Malting and Brewing Science, Volume I," Chapter 9, 1981).

MODERN BATCH SPARGING

While touring breweries in Germany, I encountered a traditional sparging method used in commercial breweries all over the world that combines the simplicity of batch sparging while retaining the efficiency and wort quality associated with continuous sparging.

In this method, brewers quickly drain (or pump) the first runnings until about an inch (2.5 cm) of water remains over the grain bed. The first addition of sparge water is then added all at once. The second runnings are removed slowly until one inch (2.5 cm) of water is again left above the grain. During wort collection, the rakes are engaged to loosen the grain bed to increase permeability and reduce channeling. A second and third volume of water is added and the process is repeated until all of the wort has been collected.

There is evidence that this method results in a higher efficiency than continuous sparging because the sparge water has more contact time with the grain (Kunze, "Technologie Brauer und Maelzer," Chapter 3, 1994). Efficiency increases with higher levels of sparge water, but wort quality suffers because the amount of dissolved undesirable substances (tannins and other phenols, silicate, ash) increases with increasing levels of sparge water. Therefore, Germans typically use higher volumes of mash water and lower sparge volumes when making delicate beers like Pilsner, where phenols are undesirable. However, more full-bodied beers like Märzen benefit from lower volumes of mash water and more intense sparging to extract the grainy malt flavors. The water volume is basically constant, only the proportions applied to mashing and sparging are changed.

One benefit of this procedure is that the brewery does not need flow meters. Instead, they only need to measure the volume of water added and wort collected to know when to add more water. For example, they might add a barrel or two of sparge water to the mash, collect that same amount of wort and repeat. Many, many brewpubs sparge in this manner.

APPLICATION IN HOMEBREWING

The above method is easily adaptable to homebrewing. In my homebrewing, I do not have an elaborate sparging system. After I have clarified the wort by recirculating, I divide the volume of sparge water into three batches. I drain the first runnings at a slightly accelerated rate until about one inch (2.5 cm) of water covers the grain. (I'm careful not to drain too fast because the increased suction from the flow rate can overly compact the bed.) I then measure my sparge water volume with a half-gallon (~2 L) plastic pitcher and gently pour the water over my upside-down stainless mash spoon to gently spread the water. I open the lauter tun valve enough to allow a slow flow of wort into the kettle. When about an inch of water remains in the mash tun, I add more water. I make tick marks on my brewing protocol sheet to accurately keep track of the volume of sparge water. If I'm concerned about channeling, I insert the thin handle of my spoon a few inches into the grain bed and make gentle cuts across the grain bed like I'm cutting a pie. I'm careful not to cut too deeply or too roughly, since this could increase the turbidity of the wort to an unacceptable level.

Obviously, this technique requires excess capacity in the later tun since several inches of water will stand on the grain bed. (Be careful not to add too much water, as this will increase the hydraulic pressure and suction on the bed that could compact the filter bed and potentially lead to a stuck mash.) However, this excess capacity should be no greater than the increased volume of the larger mash required for the less efficient batch sparging method.

BATCH TO THE FUTURE

Batch sparging is a method of wort collection favored by many homebrewers for its ease, speed and simplicity. However, repeatedly exposing the grain bed to air causes oxidation of wort compounds.

Continuous sparging is more complex, although not dauntingly so, and requires more equipment (a sparge arm and a way to move hot water through it). While lautering, the brewer must balance the inflow of sparge water with the outflow of wort. He must also know when to stop collecting wort. However, because the grain bed is not exposed to the air, less oxidation of wort compounds occurs.

Batch sparging without fully draining the lauter tun retains the simplicity of batch sparging, while also protecting against the oxidation of tannins. An increase in efficiency over "old-school" batch sparging should also be seen.

Steve Holle wrote about the factors affecting bitterness in homebrews in the September 2004 issue of Brew Your Own *magazine.*

Cooling Out

The science and method of wort chilling

by Jon Stika

Wort chilling is a simple part of brewing that can have a major impact on your finished beer. The process can be as simple as tucking a brewpot of hot wort into a convenient snowdrift or as complicated as running the wort through a high-tech stainless steel heat exchanger. However you choose to accomplish the cooling process, it is a vital step to achieving the best flavor and appearance of your beer as possible.

Why cooling is critical

There are many important factors to keep in mind as wort makes the transition from the hot side to the cool side. Rapidly cooling wort after the boil facilitates the formation of cold break material, the tiny pale-colored stringy bits of protein-tannin and coagulated protein that slowly sink to the bottom of the kettle as the wort is chilled below 140 °F (60 °C).

Cold break is the same stuff as hot break (which forms during the boil) but the cold break material typically forms in smaller clumps. If the hot and cold break material does not form during either the boiling or chilling process, the uncoagulated proteinaceous material can come back to haunt you later as a haze when the finished beer is cooled below room temperature. Therefore, a vigorous boil followed by rapid cooling of the wort will help limit the potential for chill haze to occur in your glass.

Rapid wort cooling also limits the amount of unwanted volatile compounds such as dimethyl sulfide (DMS) that can continue to be formed from the conversion of S-methyl methionine, a DMS precursor, to DMS while wort is still hot (140 °F/60 °C or higher) but no longer boiling. Boiling drives DMS off in the steam. DMS lends a cooked-corn flavor to beer.

Temperature control

Rapidly chilling your wort will also control what lives and grows in your fledgling batch of beer. Wort must be chilled to get it into the proper temperature range where your chosen strain of yeast can ferment the beer and produce the desired flavor profile for the style of beer being brewed. For ale yeast this is typically 62–75 °F (17–24 °C) and for lager yeast 46–58 °F (8–14 °C).

Lager fermentations may be started around 70 °F (21 °C) and slowly cooled, after fermentation begins, to reduce lag time. Many professional brewers will actually begin a lager fermentation at the coolest end of the temperature range and allow the temperature to rise to what they feel is an acceptable maximum. Cooler wort also allows more oxygen to go into solution during aeration. This oxygen is important for the formation of sterols and unsaturated fatty acids that yeast need to synthesize their cell walls.

Ways to chill

In years past, wort was initially cooled with the aid of a coolship, a large shallow vessel that provided a large surface area for heat to be lost by convection, evaporation and radiation. Once the initial cooling occurred in the coolship, the wort was allowed to flow over a Baudelot cooler, which consists of a set of tubes with cold water flowing through them. This would effectively cool the wort the rest of the way down to fermentation temperatures. This method of cooling allowed DMS to volatize off and the wort to be aerated as it flowed over heat exchange tubes, but also exposed the wort to the open air and a significant risk of contamination.

Most modern-day breweries use some type of heat exchanger where the wort is cooled within an enclosed arrangement with cold water or coolant recovering significant amounts of heat that is used to heat additional brewing or cleaning water.

When I started brewing my first extract-based beers I had very little in the way of equipment, particularly any sophisticated apparatus for chilling wort. As I alluded to earlier, my first wort chiller was

WORT CHILLING METHODS

METHOD	SPEED	RISK OF CONTAMINATION	COST	LIMITATIONS
Snowdrift	Slow	Moderate	Low	Seasonal/Climate
Ice-water bath	Slow	Low	Low	Sink size/bathtub
Ice/cold make-up water	Moderately Fast	Moderate	Low	Pre-sanitize water before freezing/sanitation during handling
Immersion chiller	Moderately Fast	Low	Moderate	Input water temperature and difficult use of hopback
Counterflow chiller	Faster	Low	Moderate	Input water temperature and cold break in fermenter
Plate heat exchanger	Fastest	Low	High	Input water temperature and cold break in fermenter

a snowdrift outside of my garage. Homebrewers today can use a variety of methods to cool wort, including placing the brew pot in a snowdrift or cold water bath, adding ice to the wort itself, placing an immersion chiller in the brew pot, running the hot wort through a counterflow chiller or coil placed in an icewater bath, or some variety of plate-type heat exchanger.

I have personally progressed from the snowdrift to an icewater bath, to adding ice directly to the hot wort, to a homemade immersion chiller. My immersion chiller consists of 36 feet (10.8 m) of ¼" (6.25 mm) inside diameter copper tubing in which I run 52 °F (11 °C) tap water to cool a full-wort boil (5 to 6 gallons/19 to 23 L) down to 68 °F (20 °C) in about 20 minutes.

The table on the previous page lists various wort chilling techniques and the factors of speed, sanitation, cost, and other possible limitations imposed by the brewing environment to help you decide which approach might work best for you.

"In years past, wort was initially cooled with the aid of a coolship, a large shallow vessel . . ."

Methodology and equipment

If you are brewing from extract and not boiling the full volume of wort, the snowdrift, ice-water bath or ice/cold make-up water methods work reasonably well since you are not attempting to cool a full 5-gallon (19-L) volume of wort. A less-than-full-wort boil leaves room to add cold water or ice to both cool the wort and bring it up to full batch volume. To cool wort using either the snowdrift or ice water bath methods; simply place the brewpot of hot wort in the snow or water bath being careful to not let the pot tip or float (and spill any of the wort) or allow any snow or water to enter the brew pot. Leaving the lid off of the pot will hasten wort cooling by convection and evaporation, but will greatly increase the risk of contamination. The snowdrift or ice-water bath methods of wort cooling are effective, but can also be slow. They also provide greater opportunity for contamination and the accumulation of DMS in your brew. (Read "Beginner's Block" on page 12 for more about chilling wort for stovetop).

Immersion and counterflow chillers or other types of heat exchangers work well whether you are performing a full or partial-wort boil. These types of chillers all need to be sanitized before use. An immersion chiller is sanitized by simply placing it in the brew pot during the last ten minutes of the boil. An immersion chiller is a coil of copper or stainless steel

tubing usually between 25 and 50 feet (7.6 to 15 m) long. After the boil is complete and the heat source turned off, cold water is run through the coil, picking up heat from the wort. A variation on this concept involves supplying water from a container with ice floating in it, and continuously recirculating the water to cool the wort. This method uses less water than a flow of water directly from the tap. (See the "Projects" column "D.I.Y. Wort Chiller – Turn an immersion version into a recirculator" by Forrest Whitesides in the December 2007 issue of BYO). An immersion chiller is easier and less expensive to build than a counterflow chiller, and is easier to clean by simply scrubbing the outside surface of the coil.

Since an immersion chiller sits directly in the brew pot, both the hot and cold break material settle to the bottom of the pot and are left behind when the wort is drained or siphoned into the fermenter. This leaves most of the break material and hop residues (collectively referred to as trub) behind in the brewpot. Additionally, an immersion chiller can be gently swirled to stir the wort and increase the volume of wort that comes into contact with the coils to speed the cooling process. This can also create a whirlpool that helps to concentrate the trub in the center of the pot away from the outflow valve.

"Wort chilling may be a relatively simple part of the brewing process, but its effect on beer flavor and appearance is critical."

Counterflow or plate heat exchangers can be sanitized either by running boiling water through the chiller for 30 to 40 minutes or flushing the chiller with a sanitizing solution followed by a potable/sanitized water rinse (if the type of sanitizer used requires rinsing). If your chiller is made of stainless steel you should not use bleach as a sanitizer as it may lead to corrosion of the metal surfaces.

A counterflow chiller consists of a tube within a tube, often copper tubing within copper tubing or copper tubing within rubber or vinyl garden hose. The outer tube is enclosed around the inner tube with fittings on each end that allow water to flow through the outer tube in one direction while hot wort runs through the inner tube in the opposite direction, hence the name counter-flow. In this manner the hot wort must pass by an oncoming flow of cold water creating a very high volume of cold water to hot wort interaction. Some of the newer counterflow chillers have coiled or otherwise convoluted inner tubes or inner tubes with fins to increase the surface area for heat exchange. A variation of the counterflow design allows the hot wort to flow through

a coil of tubing placed in an ice water bath. This method requires the use of ice, but uses less water than a typical counterflow set up.

A counterflow chiller is more difficult and expensive to build than an immersion chiller and the user must be very diligent about cleaning the chiller after use. A counterflow chiller should be rinsed with hot water and cleaning solution (such as Powdered Brewers Wash) immediately following use to be sure the inside coil (where the wort flows) is clean prior to the next application.

Another slight disadvantage of a counterflow chiller is that development of some of the cold break material occurs within the chiller and is subsequently delivered to the fermenter instead of being retained in the kettle with the rest of the trub. There is continuing debate among brewers as to the effect on beer flavor of excessive trub in the fermenter. Some trub in the fermenter provides nutrients necessary for healthy yeast, while an excessive amount of trub can lead to off flavors.

Advantages of using a counterflow chiller are that it cools the wort very quickly and a hopback may be placed between the brewpot and the chiller. This can increase hop flavor and aroma in the wort and help filter out trub that may flow from the kettle. Using a hopback is not as practical when using an immersion chiller as the wort is cooled before it leaves the kettle. Use of a hopback in combination with an immersion chiller would necessitate some sort of intermediate vessel (often called a grant) between the hopback and fermenter where the immersion chiller would have an opportunity to cool the wort in the grant before being delivered to the fermenter.

If you live in a relatively warm climate, the tap or ground water used for cooling in an immersion, counterflow or plate heat exchanger may not be very cold (warmer than 60 °F or 15.5 °C). If this is the case, a water pre-chiller becomes necessary. A pre-chiller will cool the water down enough to be effective before it runs through the wort chiller. Pre-chilling cooling water can be accomplished by placing a coil of tubing in a bucket of ice-water in the line supplying water to the wort chiller. Even in a cold climate like mine (North Dakota) where a pre-chiller is not necessary, I have laid the hose supplying water to my immersion chiller in a snowdrift for increased chiller effectiveness.

Wort chilling may be a relatively simple part of the brewing process, but its effect on beer flavor and appearance is critical. Choose a wort chilling technique that suits your brewing environment and budget to help you accomplish this important step in making better beer.

Jon Stika writes "Techniques" for every issue of Brew Your Own.

Web extra:

Want to know the keys to an efficient wort chiller? Visit us online:
http://www.byo.com/mrwizard/1569.html

Behind the IBU

Methods of measurement and estimation

by John Palmer

Bitterness is an important component in beer and is measured in IBUs — International Bitterness Units. The definition of IBUs that most homebrewers are familiar with is one IBU equals 1 milligram (mg) of isomerized alpha acid per liter (L). (Equivalently, one IBU can also be expressed as one part per million (ppm) iso-alpha acids.) In practice, however, measured levels of IBUs in a beer may deviate from this definition.

This past summer, I attended the International Brewers Symposium on Hop Flavor and Aroma at Oregon State University in Corvallis. There, I was able to talk with several of the top hop researchers and brewing scientists in the world. In addition to a lot of molecular structure and organic chemistry that was way over my head, I learned about the history of measuring bitterness in beer. Although this knowledge will not change our brewing practices, it provides insight into the theory and measurement of bitterness in our favorite beverage.

History of measurement

Brewers have been attempting to classify and quantify hop bitterness in beer since the late 1800s. The alpha (humulone-type) and beta acids (lupulone-type) in the lupulin glands were isolated about this time, and by the early 1900s, scientists realized that those particular components were not present in beer — the hop bitterness and aroma components were transformed by the brewing process. During the 1920s, 30s and 40s, the molecular structures of these compounds were investigated to determine how alpha and beta acid bitterness was manifested in beer. In 1939, W. Windisch described the bittering potential of the oxidation products of beta acids, and in 1947, an isomerized form of humulone (one of the alpha acids) was isolated from beer by F. Goveart and M. Verzele. These discoveries lead to efforts to develop a reliable and repeatable test method for measuring bitterness in beer.

Photo courtesy of HopUnion

In 1953, F.L. Rigby and J.L. Bethune used countercurrent distribution (or CCD) to isolate iso-humulone from beer. Countercurrent distribution uses a series of small glass chambers to sequentially isolate different components in a liquid by using two immiscible solvents. In fact, they were able to use this technique on lupulin in hops and determine that there were actually three main types of both alpha and beta acids: humulone, cohumulone and adhumolone, and lupulone, colupulone and adlupulone. Their method was sound, but it took an entire day to test one sample.

Countercurrent distribution was the forerunner of modern high performance liquid chromatography (HPLC), which was developed in the 1970s. Today, using HPLC, samples can be run quickly, and methods have been developed for accurately measuring alpha and beta acid content in hops. Prior to the '70s, though, a straightforward method of estimating IBUs was needed. Even today, however, most IBU measurements are made using this older method because the required equipment is relatively inexpensive.

The standard method

Spectrophotometry involves shining a light through a sample and seeing how much of that light passes through. All dissolved substances absorb light strongly at some wavelengths and weakly at others. If you know that a particular molecule — such as an iso-alpha acid — absorbs strongly at a certain wavelength, you can measure the absorbance of light at that wavelength. The more of the substance in the sample, the more light it will block from passing through the sample.

Two competing methods

Spectrophotometric methods for iso-alpha content, similar to the American Society of Brewing Chemists (ASBC) method adopted in 1950 for determining beer color, were investigated and two competing methods were published in 1955. The first method, by Rigby and Bethune, focused on isolating the iso-alpha content of beer via spectrometry of a multiple-step, solvent-extracted sample. Solvent extraction works on the principal that the organic hop compounds (such as iso-alpha acids) are more soluble in solvent than they are in water. They reported that the method over-reported the iso-alpha by 30% compared to the CCD method for the same beers due to "interfering substances" and that the results for iso-humulone were probably not the best indicator for overall beer bitterness.

The second method, proposed by the team of A. B. Moltke and M. Meilgaard, in communication with Rigby and Bethune, took a step back and used a simpler solvent extraction method to isolate a menagerie of hop compounds that were chemically similar to iso-alpha. This sample was then measured at a wavelength of 275 nanometers (nm) and the number was compared to iso-alpha measurements of the same beers by CCD.

This data was analyzed to develop a linear regression equation for perceived bitterness as a function of spectrophotometrically measured iso-alpha acid extract (which, remember, includes other compounds as well as). Over the next ten years, the ASBC and the European Brewing Congress (EBC) went back and forth with different variations and equations based on the method, and by 1968 they had both settled on the following equation that is still in use today.

The formula is:
IBU = 50 x Abs@275nm

where Abs@275nm stands for absorbance of the sample at 275 nm. The number 50 is a coefficient, rounded down from 51.2, based on the slope of the correlation and ratio of solvent used.

If the chemistry in the article is a little perplexing to you, here is all you need to know to this point. In the past a fairly accurate measure of iso-alpha acids was developed — the CCD method. However, this method was very time consuming. Later, a "quick and dirty" method — using spectrophotometry and correlated to the CCD method — was developed, and this method is still used today.

Fresh versus aged hops

Now we need to take a step back and look at the beer that was being measured then, versus what is being measured today. For most of the twentieth century, hops were low alpha acid aroma varieties, and they were transported and stored with only moderate refrigeration. In addition, hops were typically anywhere from 6 to 20 months old at the time of use. An aroma hop that has been stored for 18 months at 40 °F (4 °C) will have lost about 50% of its original alpha acid content. Hop beta acids are being oxidized meanwhile, and those oxidation products (called hulupones) are bitter, perhaps as much as iso-alpha, but the quality of the bitterness is different.

Several hop aging studies have been conducted over the years and all have demonstrated the loss of alpha acids to oxidation over time. M. Ono, et. al., (ASBC Journal 45-02, 1987) compared two batches of beer brewed with fresh versus aged European aroma variety hop pellets. The bitterness of the two beers was found to be very different. The fresh-hopped beer measured 22 IBUs (standard method) with 23.5 ppm of iso-alpha as determined by HPLC. The aged-pellet hop beer was made with hops stored for one year at 50 °F (10 °C) in a punctured oxygen-barrier bag. This beer also measured 22 IBUs by the standard method, but HPLC showed that it only had 3.6 ppm of iso-alpha acids.

The flavor of the two beers was evaluated by an experienced five member tasting panel, and found to be quite different. The beer brewed with aged hops "tasted markedly less bitter, exhibited less sharp bitterness, and showed a more strongly oxidized hoppy and less fragrant hoppy aroma" than the fresh-hopped beer. But, the aged hop bitterness was not perceived as being more astringent. All five panelists preferred the fresh hopped beer flavor, however.

That study illustrates two important points. First, that the standard international UV spectroscopy method for IBUs does not measure the actual concentration of iso-alpha acid, it measures the absorption at a specific wavelength of light of a group of compounds that are chemically similar to iso-alpha.

Secondly, in the spectrophotometric method, compounds other than iso-alpha acids contribute to the measured IBU

number — and this can yield similar IBU values in beers brewed with fresh or aged hops, despite differences in perceived bitterness. The other compounds that contribute to IBU in the spectrophotometric method include bitter oxidized beta acids, decomposition products of alpha and beta acids (which are not bitter) and some hop polyphenols (which are thought to be bitter), like xanthohumol.

Homebrews and IBUs

So what does this mean, practically, to homebrewers? Do we need to change the way we formulate our recipes? The results of the Ono study really tell us all we need to know. When fresh hops are used, the HPLC, spectrophotometric method and tasting panel were all basically in agreement. When aged hops were used, the HPLC and tasting panel indicated that the beer was less bitter, but the spectrophotometric method returned a level of bitterness similar to that of the fresh-hopped beer. However, unless you are brewing with aged hops and measuring your IBUs using the standard method, this shouldn't affect your brewday practices.

When we calculate IBUs with our brewing software, we input the amount of alpha acid that is going into the kettle, as well as the boil time and wort gravity. The software then outputs a number that is an estimation of the concentration of retained iso-alpha acids in the beer. If we use fresh hops — and have estimated our hop utilization accurately — our calculated IBU values should be tolerably close to IBUs as measured by either lab method (although this would need to be confirmed with lab testing). Keep in mind, though, that overall utilization involves more than isomerization of alpha acids in the kettle. Alpha and iso-alpha losses are known to occur throughout the brewing process, for example by being carried out of solution by adhering to break material, trub, yeast and vessel walls.

A complete model of beer bitterness would include not only iso-alpha acids, but other bitter compounds found in hops (fresh or aged) and beer. Likewise, a 100% percent reliable method of measurement would not be influenced by non-bitter substances. However, the "simple" method of IBU calculation based on the alpha acid content of our hops, boil time and wort gravity works well in practice and should yield a value in the ballpark of the IBU value that would be measured by the spectrophotometric method. We don't need to develop a perfect model. We simply need to understand the basis of an IBU, and what it means as a target for our raw materials. We can then apply our skill and art as brewers to craft a good beer.

John Palmer is Brew Your Own's *"Advanced Brewing" columnist. The majority of the material for this article comes from the paper, "The International Bitterness Unit (IBU), its Creation and what it Measures," by V. Peacock, Proceedings of the First International Symposium on Hop Flavor and Aroma, 2007 (in press). The author would like to thank Val Peacock of Anheuser-Busch, Tom Neilsen of Sierra Nevada, and Brad Sturgeon of Monmouth College for their help in understanding this material.*

Projects

Suspended Infuser

A step by step spice steeping project

Story and photos by Forrest Whitesides

Quite a few seasonal beer styles or other specialty recipes call for the addition of various spices, herbs and other flavoring adjuncts that may not be part of your normal brewing regimen. Some recipes advise to add these spices during the boil, some during primary or secondary fermentation, and some may specify additions during multiple phases of the brewing process.

Adding such spices during the boil is simple enough. Either throw them in during the last 15 minutes of the boil and leave them behind when transferring to primary, or put them in a small hop bag and remove either before or after chilling the wort (depending on the type of chiller you use). Spice additions to the primary or secondary fermenter, on the other hand, can be a bit trickier, especially when it comes to removing the spices without disturbing the beer. And if your plans change unexpectedly, your beer may well sit on the spices for days or weeks longer than you originally intended.

Stainless steel tea balls will have either a "jump" ring at the end of a chain (top) or a double bend loop (bottom). 2

Enter the "suspended spice infuser," which will allow you to add spice additions to, and remove them from, your beer whenever you have just a minute or two — and without requiring you to rack the beer.

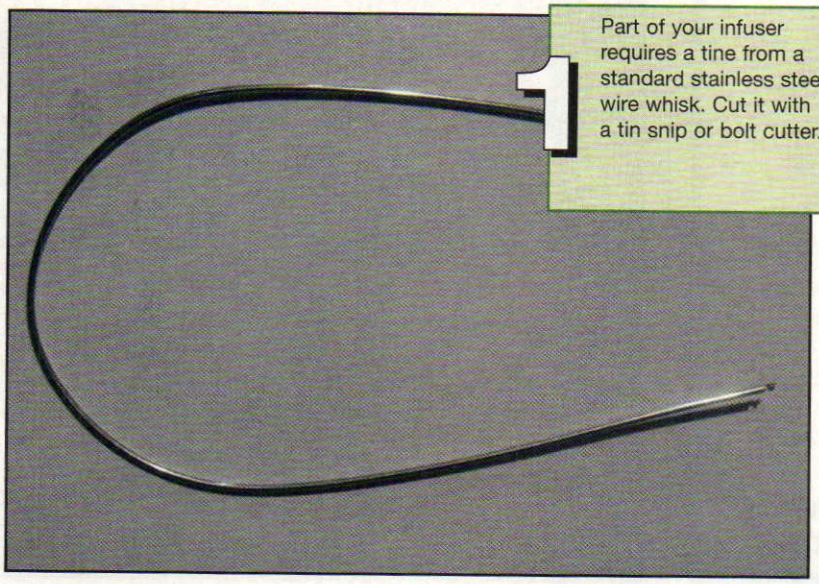
PARTS LIST

For Wide Mouth Fermenters:

- At least one stainless steel tea ball infuser
- One inexpensive 12" stainless steel whisk, or a length of stainless steel welding wire

For Glass Carboys:

- A fine mesh stainless steel strainer of at least 5" diameter
- One inexpensive 12" stainless steel whisk or a length of stainless steel welding wire



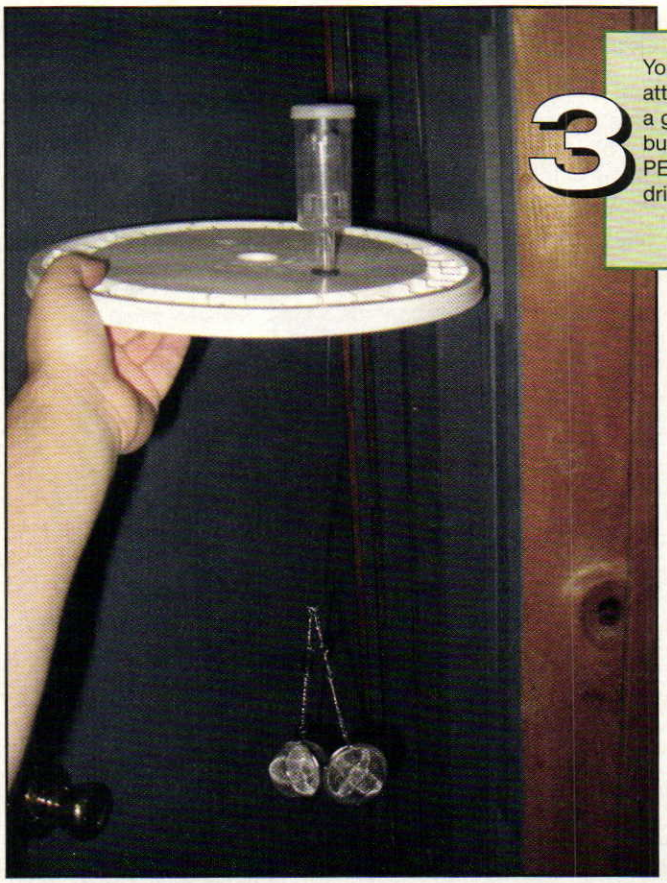
Part of your infuser requires a tine from a standard stainless steel wire whisk. Cut it with a tin snip or bolt cutter. 1

Bill of materials

The construction of the suspended infuser varies a bit based on what type of fermenting vessel you're using. But whether it's glass, Polyethylene terephthalate (PET) or a plastic bucket, the overall idea is the same: you need some type of stainless steel mesh container to hold the spices and a way to suspend and retrieve it. Because of the relative wide mouth of PET carboys and the huge opening of buckets, making the infuser for these fermenters is a bit easier than for glass carboys. For these fermenters, you'll need at least one stainless steel tea "ball" infuser and a 12" stainless steel whisk. As an alternative to the whisk, you can use stainless steel welding wire, but avoid aluminum.

If you're using the old standby glass fermenters, you'll need a fine-mesh stainless steel strainer of at least 5" in diameter and a 12" stainless steel whisk.

All of the items above are available at home goods retailers such as Linens N' Things, restaurant supply stores, and sometimes even at general retailers like Target. Total cost for these should be in the $10 to $12 range for one completed infuser, but the price goes down if you make multiple units as the whisk can be used to make six or eight infusers.



3 Your infuser can be attached to either a grommeted bucket lid or in a PET carboy with a drilled #10 stopper

Make it mesh

For PET carboys or buckets, making use of existing mesh containers is the easiest way to go. Stainless steel mesh tea balls, traditionally used by tea aficionados for steeping loose tea by the cup, have a very fine mesh and a handy fastening mechanism to make loading and cleaning up spices a snap.

For PET carboys, be sure to get a tea ball that will fit through the neck opening, which has an interior diameter of approximately 1⅝ inches. If you can't find one that will fit, you can also follow the next set of instructions for glass carboys. For use with a bucket, use the largest tea balls you can find.

Now that you have your spice container figured out, it's time to rig up a way to insert and remove it from your fermenter. Cut one of the individual wire loops from the whisk (Figure 1). You may need a tin snip or bolt cutter to cut the whisk, as the wires that form the loops are quite thick on most stainless steel whisks. As usual, I used my trusty Dremel to make the cuts.

Straighten out the center portion of the wire, and then use a pair of pliers to put a U-shaped bend in the last half-inch or so of each end (I know this seems like unnecessary destruction to a perfectly good whisk). Attach the tea ball to one end of the wire, which will either have a "jump" ring on the end of a small chain or will be of the larger type that has a large double-bend ring (Figure 2). The other end of the wire will slip through the center shaft of a three-piece style airlock, which can then be used in either a grommeted bucket lid or in a PET carboy with a drilled #10 stopper (Figure 3). With a bucket, you can easily attach multiple tea balls.

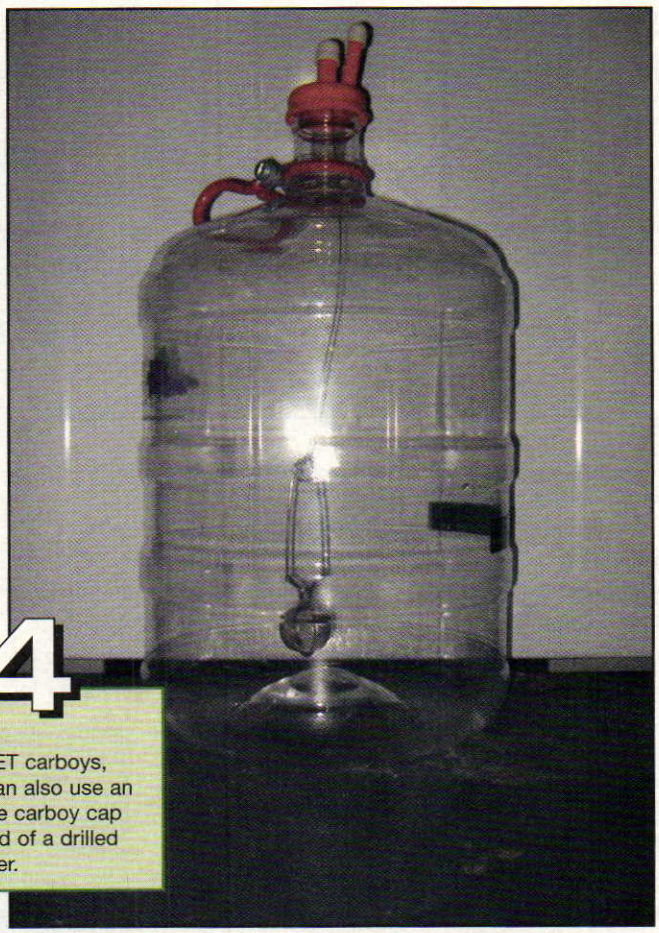
And that's all there is to it! Now grab a copy of Randy Mosher's "Radical Brewing," load up that infuser, and get to brewing. Note: Be sure to cut off the hop-restraining shield on the bottom of the airlock to allow your wire to fit through. As an alternative to the drilled stopper, PET carboy owners can also use an orange carboy cap (Figure 4).

Rolling your own

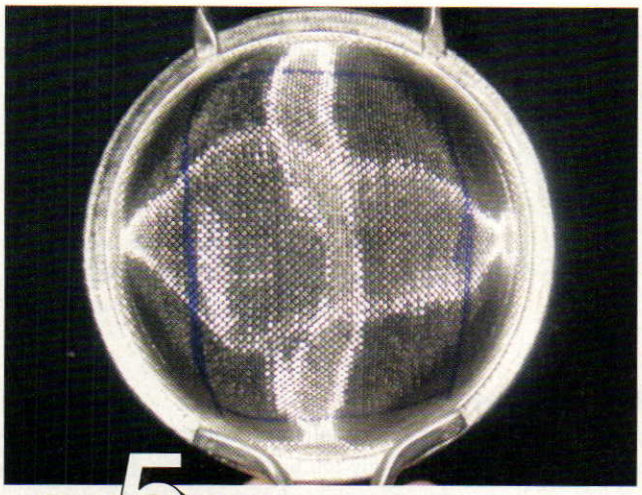
For glass carboys, you're going to have to create your own mesh container. I could not find any tea balls or anything else similar that was small enough to pass through the opening of a glass carboy (approximately 1⅛ inches interior diameter) that was also food grade and safe for extended steeping.

Mark off a rectangular area in the center portion of the strainer and cut out the mesh (Figure 5). Take extra care when cutting and handling the mesh, as it is very easy to cut yourself on the rough edges. A rotary tool with a cutting wheel specified for metal will make quick work of this cut, as will tin snips.

Roll the mesh cutout into a cylinder shape (Figure 6). I found it helpful to use a small length of ⅜-inch copper pipe as a guide to bend the mesh around, but it doesn't have to be perfectly round. Use a vise or pair of pliers to flatten the last ⅛ inch of one end of



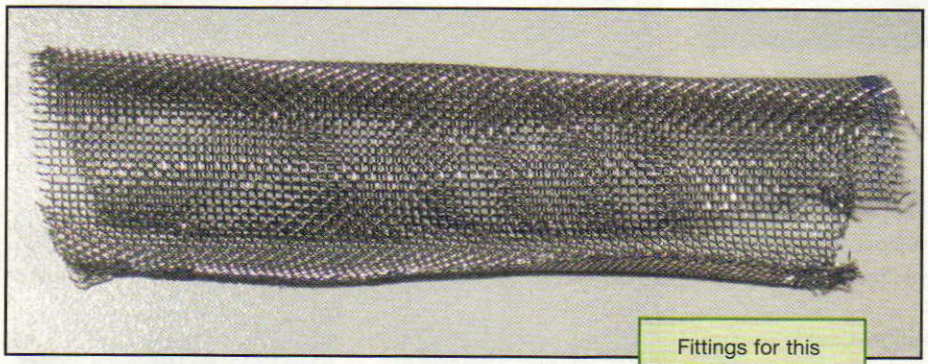
4 For PET carboys, you can also use an orange carboy cap instead of a drilled stopper.



5 Mark the area of the strainer you intend to cut to make your infuser.

the mesh cylinder. With pliers, fold this flattened section back onto the cylinder and flatten it again, creating a securely crimped bottom for the cylinder (Figure 7).

Next use an awl or center punch to make a small hole about an inch down from the top of the non-crimped end. The hole should go through to the other side of the cylinder. Prepare a metal wire from a stainless steel whisk as described previously to use to suspend your new infuser.



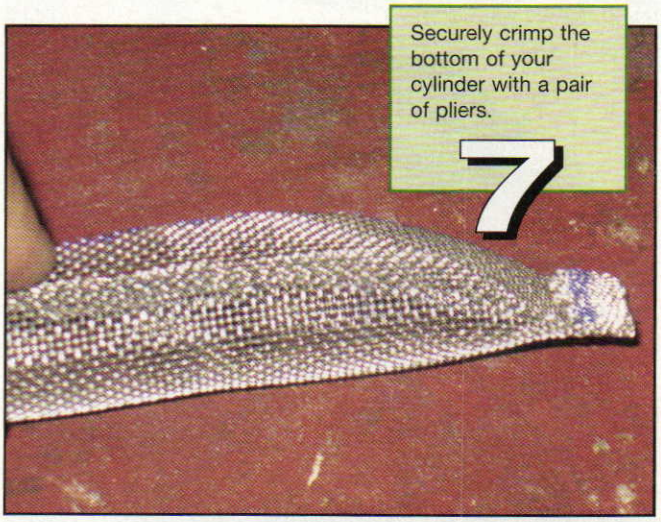
Fittings for this project are common, and are easily found at regular hardware stores. 6

All that's left now is to fill the infuser with the spice of your choice (I use a small funnel to reduce spillage), slide one hooked end of the metal wire into the hole, and very lightly crimp the top end of the cylinder (Figure 8). In my testing, I've found that a light touch with a pair of pliers will close off the top end well enough to keep the spices in but also allow for easy reopening. Stainless steel mesh in this range of thickness is remarkably easy to work with and very durable. I crimped and reopened the pictured infuser more than 40 times without noticing any functional degradation.

Now simply attach the whole thing to your three-piece airlock or carboy cap. This is the same attachment method as described in the previous section on PET carboys and buckets.

Alterations and tweaking

What I've described here is a very basic approach to making an infuser that can be inserted and removed on the fly. There is a lot of room in this project for customization to fit your setup. For example, the glass carboy infuser I made is only four inches long, but you could easily make one twice that size by starting with a large strainer. You could also twist two of the steel whisk wires together to facilitate attaching multiple infusers (each with a different spice). Be creative, be careful, and have fun!

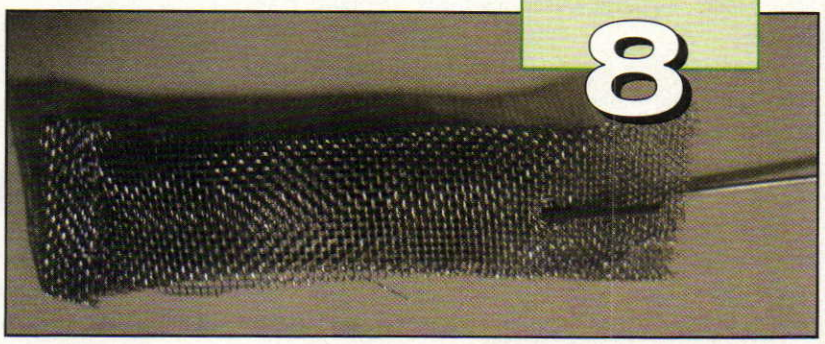


Securely crimp the bottom of your cylinder with a pair of pliers. 7

Forrest Whitesides writes the "Projects" column for every issue of Brew Your Own. *He lives with his wife in Hopatcong, New Jersey.*

Web extra:

Want some spice recipes for your new infuser? Get them at: **byo.com/feature/56.html**



Once you've filled your mesh cylinder, lightly crimp the top to close it. 8

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LCD Brewing Co.

Seven homebrewers with a common dream

Matthew Cummiskey • Oxford, Pennsylvania

The LCD Brewing Company, from left to right: Eustace, Salty, MJ, Tapper, Clark, Archie, Yetti, Cheryl (Yetti's wife), Audrey (Archie's wife), Kat (Tapper's wife), Joanne (Salty's wife), Maggie (MJ's wife), Shirley (Eustace's wife), Lauren (Clark's wife).

No one really knows exactly when or how the LCD Brewing Company in Oxford, Pennsylvania got its start, least of all the seven of us members: Yetti, Archie, Clark, Salty, MJ, Eustace and Tapper. Individually we might claim it was the first time Yetti and Clark cranked out an extract brew in Clark's kitchen while Archie and Salty toasted their health from the comfort of the kitchen table. But none of those details matter to us as much as why LCD started. "Why" is easier.

We never officially started LCD, rather we discovered it. In the mid 1990s, the seven of us settled in Oxford, Pennsylvania, the heart of Amish Country, from different parts of the country. We all had growing families, all had a great love for life, and, not surprisingly, we all had a great love of quality beer. We met over the course of a year in church (of all places) and found many commonalities, not the least of which was a shared passion for homebrewing. It was like this: one guy knew this other guy, who "is kind of goofy but loves brewing beer too. . ." etc. Someone suggested that maybe it would be fun to start working together to share ideas and learn from one another. Two of us brewed together, then a third and eventually seven: the LCD seven. As for the name, we try to pretend that it doesn't stand for anything, but it's from the phrase "Lowest Common Denominator." It kind of speaks to the quality of the jokes and comments that get traded on brew day.

Years ago, the Company used to rotate the brew location every month from home to home, emptying out the garage and hauling in pots, kettles, carboys, and burners. Over time, however, we realized that more effort spent setting up meant brewing later in the day, which meant cleaning up in the dark. This inevitably led to one of our wives wisely suggesting at midnight that it is still possible to purchase beer at the store.

So LCD set up permanent shop in "The Shed." The Shed is located at the top of a big hill on Yetti's property and got its clever name because it is a 12' x 20' tool shed. This arrangement didn't last too long though, as more of us were progressing from extracts to all-grains. We found, with the added equipment, we were simply outgrowing The Shed.

Somehow (and it is a mystery to this day) Yetti convinced his wife to allow him to build a 25' x 35' Brew Barn with 13' high walls at the end of his driveway. It's so large that you can literally drive your car in and do a U-turn to get out. We installed six individual gravity-fed brewing stations, all with running water, individual drains and shelving. There is plenty of ventilation and light and the building is so tall that we constructed attic space for storing unused kegs, brew kettles and sundry equipment. We called this homebrewer's paradise "The Shack."

We average about 70 gallons (265 L) a month of various brews and would be surprised to learn that there is a beer style that we have not attempted to brew at some point. We like to say, "people with character, characteristically drink beer with character."

The ultimate goal of the LCD Brewing Company is to open our own brewpub (check us out at www.lcdbrewing.com). We are still a few years away but we have a unique skill set among us and know we have the business acumen and creativity to pull it off. In our group we have an engineer, insurance agent, marketing executive, mortgage broker, real estate agent, product marketer and an artist. Some of us also happen to be excellent barbeque chefs (if we do say so ourselves), which comes in especially handy on brew day when you start hankering for a serious brisket sandwich. The only thing really preventing us from opening our own place is our ponderous lack of money. To remedy this, we pay monthly dues, but at the moment those funds would probably only the cover the cost of the sign out front and maybe the light for it — a small light.

It would be a grave injustice if we led you to believe that LCD Brewing Co. thrives with just us seven brewers. It's also the love and support (or tolerance, depending who you ask) of the extended LCD family that has made this experiment so much fun and successful. When we do the numbers it shakes out to seven brewers and their seven patient wives, 22 children, three boxers, a beagle and few feral cats. Brew day normally finds us all together at the end, after hauling the last of a few hundred pounds of spent grains up the big hill and dumping them in the pit behind a lonely, little, former brew shed and having dinner. It's always great food, better company and tankards of Yetti's porter. Or MJ's IPA. Or Clark' s stout. Or Salty's Pilsner . . .

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