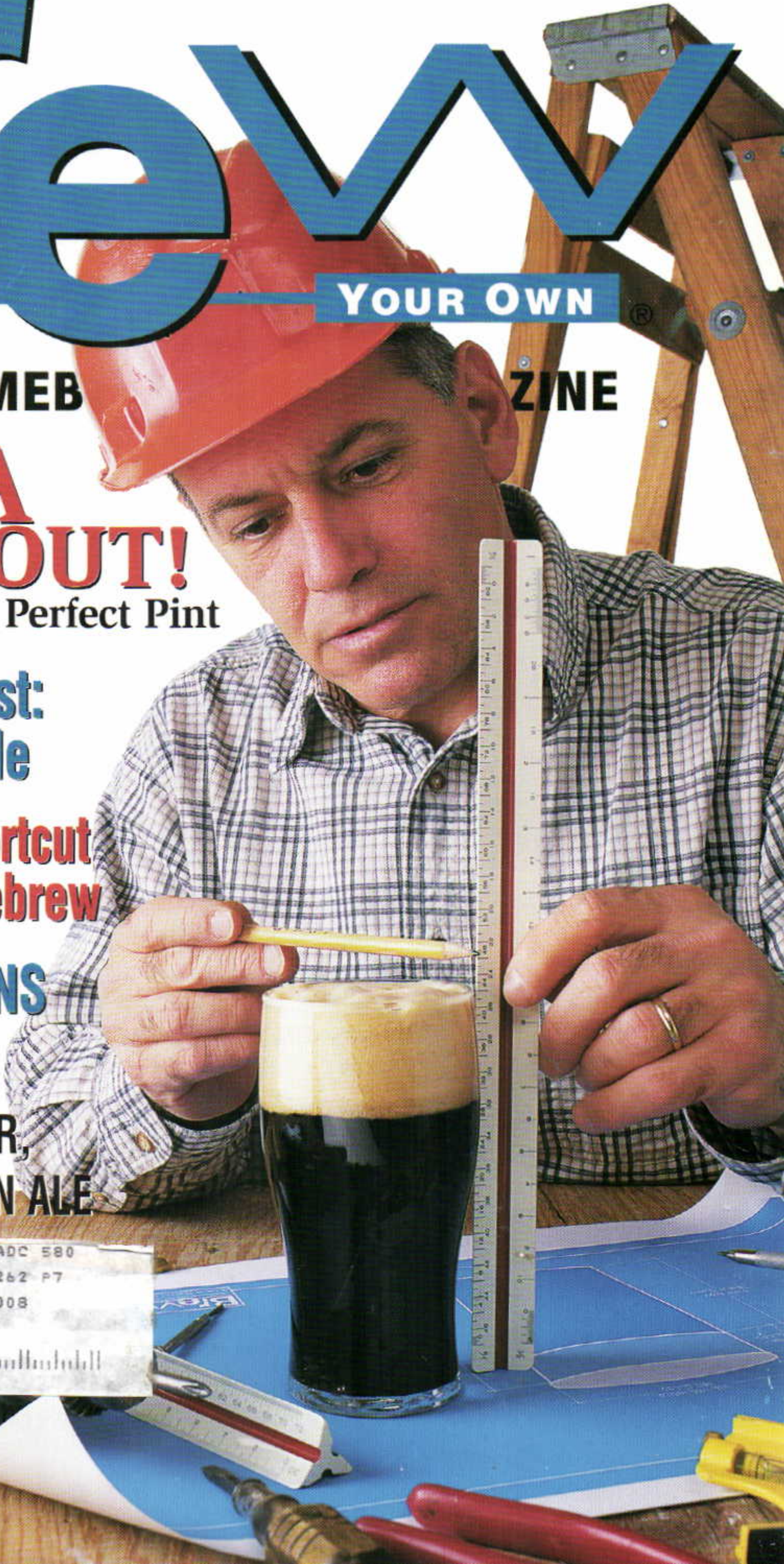
Brew YOUR OWN®

MARCH 2001, VOL.7, NO.3

THE HOW-TO HOMEB ZINE



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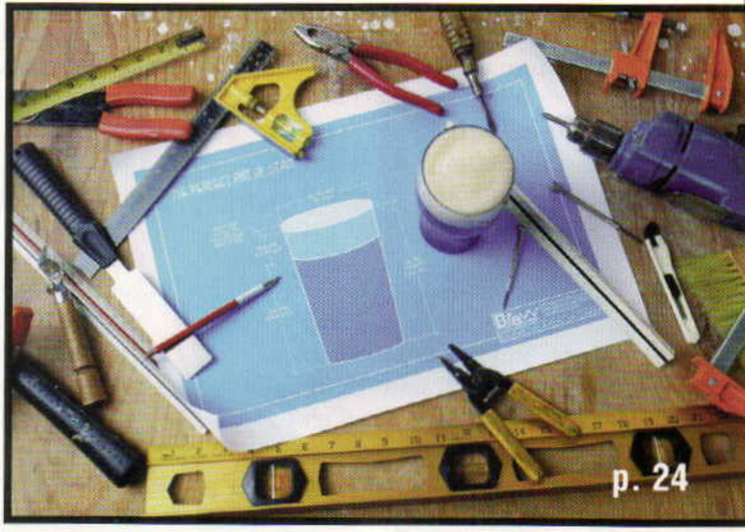
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Cover photo: Charles A. Parker/Images Plus

Editor's Note

Around Eire in 80 stouts

Our two-week honeymoon was an exercise in immersion. An immersion in Guinness, to be precise. We rented a car and circumnavigated the island of Ireland, stopping in almost every pub we spotted to share and sip a well-poured pint. Well, not every pub. But close.

We have great memories from those intimate pubs, where we found the local patrons friendly, highly entertaining and all too willing to treat the Yanks to another pint. One evening, I looked to my left and saw — I kid you not — five pints of Guinness lined up on the bar, waiting for me. We were walking home that night, so I gave it a go. I didn't succeed, thankfully, but I did promise an elderly gentleman that I would name my first-born son after him. (We have two little girls, so to date there is no Seamus O'Brien Ring living in our house.)

Little wonder, then, that when we first started homebrewing, just a few months after our honeymoon, we focused our early efforts almost entirely on stout. Thanks to high-quality extract kits and some good instruction from our local homebrew supply shop, our first Guinness clones tasted great and got us hooked on the hobby. That's the beauty of brewing stout at home: It's pretty hard to screw up ... unless you dump five pounds of whole cherries into the secondary, but that's another matter entirely.

This month's cover story, written by professional brewer Gretchen Schmidhausler and timed to coincide with St. Patrick's Day, offers great tips and guidelines for brewing three main styles of stout: dry or Irish, sweet or milk, and Imperial. It also includes step-by-step recipes. So here's to Guinness .. and to all fine stouts!

Kathleen

Contributors

Schmidhausler graduated from the homebrew hobby to become a pro.

Gretchen Schmidhausler has accomplished what some of our readers daydream about: In only eight years, she advanced from the status of first-time homebrewer to full-time professional. Gretchen was recently promoted to head brewer for Basil T's Brewpub and Italian Grill, overseeing the kettles at a pair of restaurants in Red Bank and Toms River, near the New Jersey shore. She joined Basil T's just eighteen months ago as a site brewer at the Toms River grill.

Gretchen grew up in New Jersey and graduated from Mount Holyoke in Massachusetts. She has a diploma from the three-month Brewer's Apprenticeship Program conducted by the American Brewer's Guild, a program she completed in December 1998. To date, she's the only female professional craft brewer in the state of New Jersey.

Her favorite styles to brew? Pale ales, porters and stouts. For her top tips on brewing fine stouts at home, turn to her excellent cover story, which begins on page 24. Cheers!

Brew Your Own
THE HOW-TO HOMEBREW BEER MAGAZINE

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MaiL

Holiday Ales

In the December issue, in "Tips from the Pros" on page 11, Steve Dresler of Sierra Nevada Brewing Company stated that, for his Celebration Ale, the OG was 1.064 and his finishing gravity was 1.056, giving a potential alcohol of 6.8 percent. Looking at my hydrometer, it looks more like 2 to 3 percent. Am I misreading things? Also, he states that he shoots for 60 to 65 bittering units. Does he mean IBUs?

Aldo Fusaro
Chicago, Illinois

Steve: Sorry for the typo! The FG should have read 1.016. As for the second question: IBUs and bittering units are the same.

Three Cheers for the Table of Beers

I have been a subscriber to *BYO* for a number of years now and I was compelled to send my compliments after seeing the January issue. The "Periodic Table of Beer Styles" on page 22 is by far one of the most unique and interesting presentations I have ever seen. I intend to enlarge it and make it a poster for my wall, not only as a reference but a great conversation piece. My compliments to author Andrei Chapoval.

Mike Runkle
Virginia Beach, Virginia

Sugar Mystery

There seems to be an error in "Baking With Beer" in the January 2001 issue. On page 35, the list of ingredients for the jalapeño bread doesn't mention sugar, yet in the first step, it calls for mixing the sugar with other ingredients. Is there supposed to be sugar, and if so, how much?

Jim Collins
via e-mail

Author Lucy Saunders replies: "It's true — the procedure mentions sugar but omits it from the ingredient list. As a frequent baker, I know that Chef Joseph George is priming the yeast with the sugar, and that requires one tablespoon of white table sugar. You could also prime the yeast with a tablespoon of honey. I hope that straightens things out. Enjoy the bread!"

Alaskan Again

I recently brewed the extract version of Scott Russell's Alaskan Amber recipe from the September 2000 issue. I followed the exact recipe, but I used an "Oxynator" to aerate the wort. I used two 15-second shots of oxygen just before pitching my Wyeast 1007. By noon the next day there was such a vigorous fermentation that the lid on my plastic container was whistling. I replaced the airlock with a blow-off hose, but even with that, air was still blowing out the sides. I lifted the side of the lid a couple of times to release pressure but it would just build up again instantly. NUCLEAR!! By evening it settled and remained like this for about two days. Then it slowed and pretty much stopped.

I transferred early on the sixth day. The SG reading was 1.011. The taste test was good and there seemed to be a good level of alcohol as well as some mild carbonation. The secondary is now in a refrigerator at around 45° F. I haven't noticed any bubbling yet.

Should I follow the recipe at this point, which says to condition cold (40° F) for 10 days? Should there be some fermentation activity? I'm afraid that since the initial fermentation was so intense there's nothing for the yeast to feed on.

Vinnie Moore
via e-mail

Scott Russell replies: "Many brewers feel that, no matter the yeast and no matter the temperature, primary (visible, active) fermentation should be done in just a few days. What happens from then on is maturation, clarification and settling. If your fermenter was emitting gas, it wasn't letting the beer get infected, so it's probably okay. Go on with the prescribed cold conditioning and bottle on schedule. Fresh Wyeast 1007 will usually go very quickly at warm (65° F plus) temps, and may flocculate quickly (even instantly) in the cold."

Pressurized PETs

I just read Thom Cannell's article on using soda bottles as minikegs (*December 2000*). I don't own a keg system, and I've been looking for an inexpensive and reliable alternative to bottling. I enjoy consuming one pint per night, almost every night. With this "drinking behavior" in mind, do you think I will benefit from this idea? One concern is whether soda bottles will keep beer fresh for at least a month. Also, I assume that a standard bicycle-tire, 12-gram CO_2 cylinder/regulator will help carbonate the beer inside the soda bottles. Will that idea work?

Javier Blanco
Woodbridge, Virginia

Thom Cannell replies: "Several of my homebrew club members have made these mini-kegs and have kept beer in them for four to six weeks. Note that Pepsi, Coke and all the fizzy soda-sellers expect the bottles to keep their product fresh for months. Warning: Beer is sensitive to light, so keep those clear bottles in the dark. Or paint them black.

I think a 12-gram CO_2 cylinder/regulator would work, provided you could mate the 12-gram bottle to the valve fitting. But I would worry about the price: Those little CO_2 bottles are expensive. If you could use one to pressurize two mini-kegs at the same time, the cost would be well worth it."

Seeking Sell-Outs

Ever since I started reading your magazine, I've been hooked on brewing. I'm a novice but have been able to brew some great beers with the help of your articles. I wonder if any subscribers have the issues that are sold out and if they are interested in selling their copies? Thanks for putting out a great magazine. ■

Pancho Luna
via e-mail

Pancho is referring to the Premier 1995, February 1996 and March 1996 issues of BYO, which are indeed sold out. Are any readers willing to sell Pancho their copies? If so, drop Pancho an e-mail at pancho@postnet.com.

Pot Shots
Great Gizmos

Cool Fermentation

A condo-dweller's quest to save space and keep his brew cold

Mark Nicholson • Redding, California

PHOTO COURTESY OF MARK NICHOLSON

Mark Nicholson kneels in awe of his homemade cooling contraption.

I was having a tough time managing my fermentation temperatures. After many batches fermented at room temperature (68° F at night and as high as 80° F during the day), my homebrew always had that "homemade taste." You know, kind of fruity and just not crisp.

I was recently in Costco and spied a 12 volt / 110 volt refrigerated ice-chest cooler. It was an Igloo KoolMate 50, to be exact. This device will cool down to 30° F. Pretty cool, I thought. So my wife purchased the $119.99 unit for my birthday. She's the best! After getting the cooler home, I discovered that it didn't have a thermostat. The only controls were: plug it in ... ON, or unplug it ... OFF. Some modifications were definitely required to adapt it for homebrewing.

My five-gallon fermenting bucket fit nicely inside the cooler but it protruded above the opening by about eight inches, preventing the lid from closing. This was not a problem, because with the lid closed, the wort would surely get too cool. I removed the shelf that comes with the KoolMate and put it on the bottom of the cooler, so the air would flow under the five-gallon bucket. Then I cut out three cardboard inserts to cover the open areas of the cooler where the bucket was sticking out of the top. I then cut a small piece of cardboard to deflect the ice-cold air from the interior fan, which had been blowing directly onto my fermenter.

I inserted a thermometer into a small hole I had cut in the cardboard to monitor the temperature in the cooler. And I used a standard adhesive-strip thermometer to monitor the wort temperature. After staying up most of the night experimenting with and adjusting the cardboard inserts and deflector, I discovered that I could control the wort temperature by plus or minus a few degrees without much trouble. To expand on this idea, I plan on building a handy low-voltage thermostat for my homebrew cooler someday.

My motivation for going with the electric cooler was space, broad usability and money. I live in a condominium in northern California and just don't have any room for another refrigerator. Also, I can take this cooler camping, on trips and use it for keeping my Party Pigs or bottled beer cool. This cooler will chill wort to near-freezing temperatures, so brewing a true lager is now in my plans as well.

The key benefit is that I am able to keep my wort below the maximum rated temperature for my favorite yeast style — 65° to 68° F, in this case. Ideally, this will allow me to brew a more true-to-style beer without that telltale, fruity homebrew note.

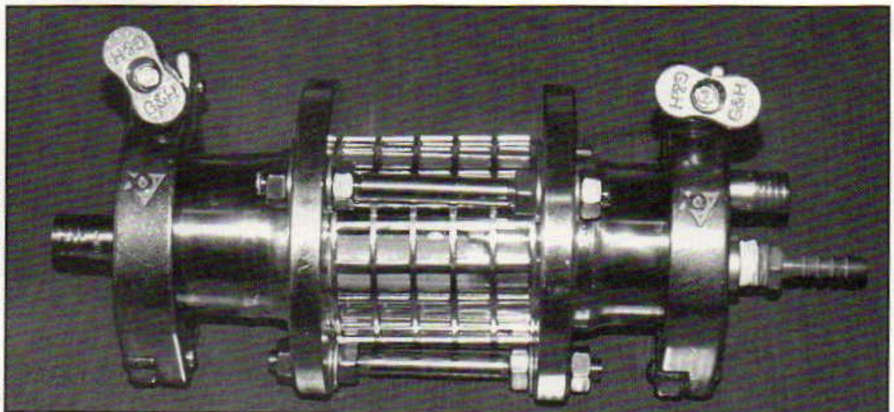
Well, that's my latest gadget. I hope that this information can offer help to other homebrewers who might be struggling with high fermentation temperatures and limited brewing space. ⟶

The five-gallon fermenting bucket with cardboard inserts in the cooler.

An ideal place to store your beers, with easy access from the couch.

The Next-Generation Aerator

Bruce Ross • Houston, Texas



PHOTOS COURTESY OF BRUCE ROSS

Not exactly low budget, but a dream come true! Bruce Ross' next-generation aerator is made from a 3-3/4 by 3/4-inch airstone, combined with some off-the-shelf parts from a friend's wine-industry machine shop in Napa Valley.

I read Thom Cannell's article on building an in-line aeration system (*December 2000*) with interest, as I also was intrigued by the concept. My brews are predominantly high-gravity ales, barleywines, sweet meads and IPAs, made in large batches (10 to 15 gallons) with a RIMS. Before I started oxygenating my wort, I often experienced slow or stuck fermentations with the resulting off-flavors.

My first in-line aerator was made from a 2-1/2 by 8-inch section of acrylic tubing, a couple of those orange rubber carboy caps, two hose clamps, and a 1/4-inch NPT hose barb fitting from the hardware store for the air source. Total cost (minus the scintered steel airstone, a gift from my brewing mentor Wayne Burgsthaler) was about $12.

It could be easily disassembled with a screwdriver for cleaning and sanitizing and worked well with compressed air supplied by an aquarium air pump. While I was nervous about the risk of infections from all of the porous materials in this crude aerator, none of my brews ever became infected.

After a year of using this improvised model, I asked Wayne to build the "Next Generation Aerator" (NGA), using the same 3-3/4 by 3/4-inch airstone, combined with several off-the-shelf parts from his Napa Valley wine-industry machine shop. While the end product is not exactly within the average homebrewer's budget, it is a dream come true.

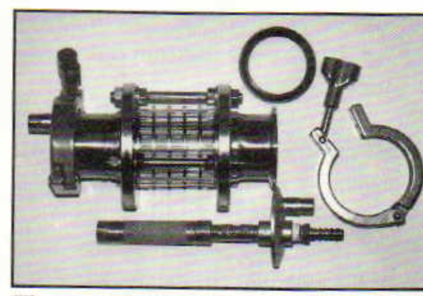
All of the metal components are made of stainless steel, including the aerator body, which is a large in-line sight glass with standard 2-1/2-inch tri-clamp fittings at both ends. The inlet cap was drilled to accept a 1/2-inch threaded coupling that was welded in place. Then a small hose barb was attached to the outside of the coupling for the oxygen line and a short length of threaded 1/2-inch stainless tubing was attached to the inside to hold the airstone.

Finally, both the inlet and outlet caps were drilled for 1/2-inch hose barbs that were welded in place. The unit completely disassembles by hand, by removing the two tri-clamps and unthreading the airstone. Once disassembled it can be sanitized in boiling water or iodophor in just a few minutes.

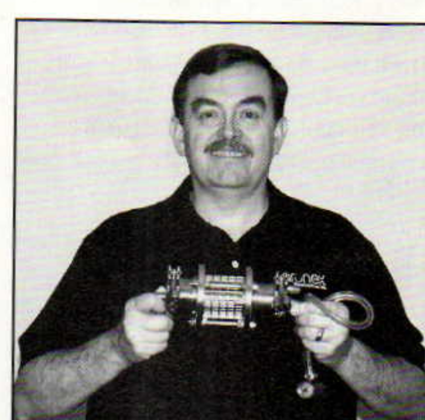
To use the aerator, the RIMS discharge line and the oxygen line are slipped over their respective hose barbs, and a short length of tubing is placed on the outlet cap hose barb to direct the aerated wort into the primary fermenter.

Instead of compressed air, I now use disposable bottles of pure oxygen (The Oxynator), which are good for two to three batches. When the chilled wort is flowing through the aeration chamber at 1 to 2 gallons per minute, the oxygen flow is carefully started.

This aerator is so effective that it once turned 15 gallons of barleywine into 30 gallons of thick whipped cream when I was distracted by a telephone call. I was being a little too generous with the oxygen. With my new aerator, fermentation begins within a few hours and the quality of my brews has definitely been enhanced by the thorough oxygenation of the wort. Of course, one of the best things about having this one-of-a-kind aerator is being able to show it off to my new brewing buddies! ■



The next-generation aerator and all of its parts: a large in-line sight glass, clamps and an airstone.



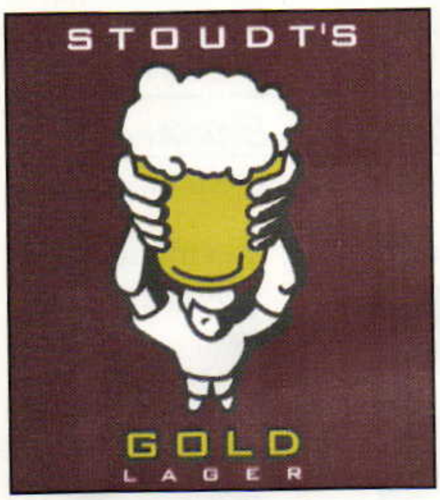
Bruce shows off his clever gadget and waits anxiously for the next batch of wort that needs aerating.

Milling Your Grains

Cracking and grinding your way to better beer

by Thomas J. Miller

When you are brewing with grains, everything starts with the grain you buy. Whether you're adding a few pounds to an extract batch or brewing ten all-grain gallons, lousy grain makes lousy beer and great grain makes great beer. But how the grain is milled is also an important factor. Bad milling can create problems during the brewing process and result in beers with off-flavors. Milling grain isn't rocket science, but it involves precision. The objective is to mill the malt as finely as possible, but not so fine as to cause a stuck mash or compromise wort clarity. Finding the right mill setting for your malts can involve some tinkering and adjusting of your mill. To make the job a bit easier, we offer helpful tips from this month's lineup of benevolent pros.



Brewer: Marc Worona of Stoudt Brewery in Adamstown, Pennsylvania. Marc took the microbiology course at Siebel. He has been the brewer at Stoudt's for more than 5 years.

A lot of specialty grains are six-row, so the kernel is going to be smaller than the two-row pale base malts. This means that you can't use the same mill opening for your base and specialty malts. You'll need to tighten the mill for your specialty malts.

We use all two-row malts, but they are still quite different in size, so we end up setting the mill by visual inspection. We inspect to avoid an excess of grains that aren't crushed at all by the mill. Only about 2 percent should go through the mill uncrushed.

Our goal is to crush the grains as much as possible without making the grist too fine. A "too-fine" grist is powdery, with shredded husks and destroyed grains. The best scenario is to have grains that have been cracked open with the husk separated from the grain, to form a filter bed during the sparge. There are many variations between a "coarse" and a "fine" grind and tinkering with the mill settings will let the homebrewers find what works best for them.

With more problematic grains like wheat malt, I still crush them thoroughly. They can turn gooey in the mash and create a stuck mash, but by adding rice hulls to the mash you can create a filter bed. Rice hulls serve as good filters. Use them at a rate of about 5 percent of the malt bill, adding them evenly as you put the malt into the mash tun.

Brewer: Sean Larkin of Trinity Brewhouse in Providence, Rhode Island. After a one-year internship at Trinity, he became head brewer in 1994.

We were originally buying pre-milled grain from our supplier, but made the decision that it would be better to mill the grain ourselves. After we got the grain and mill, we had to adjust and readjust the mill until we got it set where we liked it. We have settled on a coarse grind. Instead of a 100 percent crush, which means it's fine and powdery, we target a 65 percent crush. This means some whole grains are going to slip through the mill, especially since we don't have screens to catch the different-size grains. But if some whole grains do slip through, we figure our settings are right and we aren't cracking the smallest grains that are going through the mill.

The first rule of milling is to not pulverize the grain. Pulverizing your grains can lead to stuck mashes. When you pulverize the grain, you destroy the embryo and the husk. This leaves you without a filter. You also end up with a bunch of flour that will turn to paste and collect on the bottom of the mash tun, and block the flow of sparge water.

The second rule is to barely crush specialty malts, taking care only to crack open the grains. These are roasted at higher temperatures, so they'll tend to pulverize during milling if you aren't careful. Keep your mill settings wide enough to just break them open. Also, it's best to add them to the mash toward the end of the mash-in to keep them on the top of the mash.

Brewer: Matt Cole *(on left, above)* of Rocky River Brewing Company in Rocky River, Ohio. Matt completed the Siebel Short Course as well as the University of Sunderland (England) Short Course before joining the Rocky River Brewing Company in 1998.

We use pre-milled grain for our brewery because we are constrained by some local laws. (We can't have a bulk grain silo.) This actually works out quite well for us and it's also an option for homebrewers. Many homebrew shops sell pre-milled grain or can order some. Also, they might mill the grain for you at the shop. I like using pre-milled grains for several reasons. I find that extraction efficiency is consistently good with the pre-milled grain, and protein coagulation also tends to go down some.

The only potential downside to pre-milled grain is its shelf life, but even that doesn't impact us too much. We tend to use any grain that we get within three months of the milling date. So far I haven't experienced any negative effects from storing my grain that long. Perhaps six months would be the longest I would store milled grain, but a few months is definitely okay.

We do, however, mill our specialty malts and we do this in our two-roller mill. I don't do any fancy measurements, like making sure the rollers are X millimeters apart. I just eye the setting, make sure I like where it is, and then lock it up so the mill setting will not budge.

My ultimate goal is to just barely crack open the grains. In fact, I would far prefer to undermill my grains rather than overmill, because pulverizing the grains can tend to extract tannins and other things that might cause astringency. There are newer commercial methods of milling and wort separation that allow the use of very fine milling without increasing astringency, but a homebrewer should take care not to mill too finely.

When it comes to overmilling, you have to take care in the case of any highly modified grains. This might be Munich malts on the low end or caramel 120 on the high end. These types of grains tend to shatter, so when milling these, it's important that you adjust your mill settings to be a bit less aggressive than you would with pale malt. ■

"Help Me, Mr. Wizard"

Protein Rests

Moldy extract, lambic sanitation and boiling your beer

Mr. Wizard

I like to do things the hard way. I usually start my mashes at room temperature and I use a good quantity of medium-modified grains. I'm still looking for the best protein rest time and temperature. My boosts are on the stove, so a 30-minute protein rest might be really 22 minutes, including the boost. What is your favorite time and temperature profile for good head retention? Is more than 30 or 40 minutes really bad? I rested my last batch for 13 minutes total.

Howard Schneider
Via e-mail

Mash profiles mean different things to different brewers. There are many brewers who employ low temperature mash rests and their reasons differ.

If you have read any brewing literature over the last century, you will find references to the "protein rest." Historically, European malts were under-modified and required an extensive mash profile to yield the extract from these malts as well as separating the wort from the mash solids. The low-temperature rest, around 122° F, used in these long mash profiles was given the name protein rest because the bi-products of proteolytic activity were observed during this time. Indeed, the protein rest does increase the concentration of "free-amino nitrogen" or the amino acid ends of proteins, polypeptides and amino acids.

Recent literature indicates that most of the proteolytic activity in the mash increases the concentration of amino acids but does not significantly alter the molecular weight spectrum of proteins and polypeptides found in wort. The molecular-weight spectrum would change significantly if high molecular proteins were broken up in size.

Some believe that the products of protein degradation are "foam positive" and increase foam stability in the finished beer. I don't believe that significant changes in the molecular weight distribution of proteins and polypeptides occur during mashing at any temperature. Most of the demonstrable changes in protein size and solubility are seen in malting where proteases are active. Protease activity dramatically declines during kilning because proteases in malt are rendered unstable by heat and proteolytic activity in finished malt is very low.

However, there are enzymes that degrade beta-glucans (beta-glucanase enzymes), that do survive malt kilning and are active in the mash. Beta-glucanase activity is at its peak around 118° F, about the same temperature as the protein rest. Beta-glucanase activity can be very beneficial, especially when using under-and lightly-modified malts, which still have enough viscous, beta-glucan gums to cause wort separation problems during the lauter process.

This beta-glucanase activity is a more compelling reason for low-temperature mash rests than protease activity. I use a low-temperature rest for beers that contain under-modified or unmalted grains. For example, I use unmalted wheat for my unfiltered, American-style wheat and mash in at 120° F to cope with the unmalted wheat. I'm sure some will disagree, but those are my beliefs.

You have raised some good points about mash temperature and time. There are no hard and fast rules because enzyme activity is governed by both enzyme and substrate (what the enzyme is specific to, for example, starch) concentration. If you have a really "hot" malt that is full of amylase activity, you can use a lot of adjunct grains, like rice, because the malt has more than enough enzymes to get starch conversion completed in a set time. If you have a malt that is low in amylase activity, you may have a hard time converting the rice starch, even in a long mash.

The same holds true for proteases and glucanases — the duration of the rest depends on what you hope to accomplish, how much enzyme is present and how much substrate is present. One of the reasons I'm not a big believer in the protein rest is that there's not much protease activity after kilning and without proteases you don't have much chance for proteolysis.

Now onto foam. Foam is affected by numerous variables. It's most greatly affected by proteins, especially higher-molecular proteins and one low-molecular, weight-native protein called "Protein Z." It's also affected by carbon dioxide content, presence of fats and oils and, in the case of nitrogenated beers, dissolved nitrogen content. Certain beers bottled in clear glass use light-stable hop extracts that have their own foam properties, but these compounds are not widely available to the homebrew community.

I believe the key to producing a beer with a good foam is to keep adjuncts to a minimum, thoroughly rinse soapy cleaners from equipment, carbonate your beer enough to create a foam and use extremely clean glassware. The beers I brew with the best foam are my unfiltered wheats, using a portion of unmalted wheat, and my porter, which is nitrogenated. Unmalted wheat boosts the high molecular protein content and the nitrogen in the porter is the best weapon for creating a thick, creamy foam like draft Guinness. Long live beer foam!

Mr. Wizard

I bought some malt extract in 10-pound pails. I recently noticed that mold has developed on top of the malt. Has this ruined my extract or will the mold be eliminated in the boil? Can I scrape the top layer off and use what is left? Will refrigeration of the malt prevent mold? Please help!

John O'Brien
Via e-mail

Malt extract and damp malt will grow mold. Moldy grain certainly should not be used for brewing and I personally would not use malt extract with mold on the surface, though some brewers do. Removing the mold from the surface of the extract may completely remove the mold from the container but then again it may not. Mold is bad for two main reasons.

Moldy grain is a known cause of gushing in beer. Certain molds, for example *Fusarium* species, excrete proteins that act as nucleation sites for carbon dioxide break-out in finished beer. In simple terms this means that when a bottle of beer is opened, the carbon dioxide uncontrollably breaks out of solution and a huge foamy mess gushes from the beer bottle. This is why it is called "gushing." The same thing could possibly result from using moldy malt extract.

Another reason to avoid using moldy malt or malt extract is that certain molds produce mycotoxins (toxins from mold) when they grow. Although many mycotoxins are completely destroyed when heated, some mycotoxins become more toxic when heated, as is the case with certain types of aflotoxin. This same concern applies to eating moldy foods. Not all molds are bad and some add a very nice flavor to food, such as *Penicillium roqefortii* that is used to make blue cheese.

The mold growing on your malt extract is most likely an airborne mold that came into contact with extract when you first opened it for use. Refrigeration will certainly slow the growth of mold and will extend the shelf-life of pails that are opened and only partially used. However, molds will grow in the refrigerator given enough time. Mold growth can be prevented on grains by storing grain in a dry environment.

Mr. Wizard

I was going to attempt to brew a lambic. I was told that all the equipment that comes in contact with the yeast will have to become my exclusive lambic equipment and if I use it to brew anything but lambics the other beers with get off-flavors. Is that true? If so, is there any cleaner I could use to kill the yeast that is left over? I live in Michigan; as a last resort, could I place the fermenter outside when it's below zero? That should kill anything.

Scott Reynolds
Lansing, Michigan

The really big problem with lambic cultures is not the yeast; rather, it is the bacteria. The bacteria in lambics include *Lactobacillus* and *Pediococcus* species. These two genera of bacteria just happen to be the most potent beer spoilage organisms of "regular" beers. They produce sourness and diacetyl (buttery aroma). The other feature of these bacteria is that just a few cells of these buggers can cause beer to spoil. When lambics are made, there are more than just a few cells since the growth of these bacteria is actually encouraged — unthinkable for any other type of beer! Some of the yeast used in lambic fermentations are considered "wild," meaning they are not brewing strains. One such example is the genus *Brettanomyces*. This yeast imparts the wet horse-blanket aroma to lambics.

The bottom line is that all of these microbes are bad news for brewing regular beer. This is one reason why very few brewpubs brew lambics. It's the brewing equivalent of introducing a population of toxic, food spoilage bacteria into your kitchen. As with cooking, these bacteria can be carried from a batch of lambic to a batch of regular beer. This is called "cross-contamination." One way to avoid cross-contamination is to only use certain pieces of equipment for certain tasks, for example, having separate cutting boards for raw and cooked meats. This preventive measure keeps cookware that has not been cleaned properly from carrying bacteria from raw to cooked meat. The same rule is usually not applied to utensils like cutting knives because they are easier to clean. This philosophy can also be applied to brewing equipment.

In general, glass and metal (usually stainless steel) utensils are smooth, hard and should not have crevices that make cleaning difficult. These tools can be used for lambics and for regular beers if they are designed so that they can be cleaned. For example, a stainless-steel fermenter with a threaded fitting is a poor design with respect to cleaning. Racking canes, hoses, tubes, plastic fermenters and other soft materials fall into the cutting board category. I would recommend having separate soft tools for lambic brewing to help prevent cross-contamination.

When it comes to sanitation there are two classes of chemicals: cleaners and sanitizers. Cleaners are formulated to remove soils. Some cleaners, like sodium hydroxide, are also lethal to microorganisms, especially when the cleaner contains sodium hypochlorite (bleach). However, these cleaners typically do not guarantee a sanitized surface. Sanitizers are designed to kill microorganisms and some sanitizers are more effective at killing yeast than bacteria. Most sanitizers do not work well if the surface is dirty and are best used after a thorough cleaning step.

The best sanitizer is hot water or pressurized steam coupled with time. Many people assume that very low temperatures accomplish the same thing, but this is not true. Bacteria and yeast easily survive freezing, even for very long time periods. Placing your lambic fermenter outside in the winter would not be an effective method of converting it back to "regular" beer duty. A good cleaning followed by soaking it in bleach would be a much more effective method.

Mr. Wizard

Recently I made a batch of American lager that had a "stuck" fermentation. I suspect that I under-pitched and possibly under-aerated the wort. The final gravity was in the neighborhood of 1.025. Being somewhat impatient, I went ahead and kegged it to see how it would turn out. As I had suspected, it turned out to be sweet rather than crisp, due to the unfermented sugar. I am thinking about trying to correct the problem by boiling the beer for about 15 minutes to drive off the carbon dioxide, then re-aerating and re-pitching. Is this completely crazy, or will it work barring any contamination problems?

Brian Janes
Sparks, Nevada

I don't get too many questions asking if an idea is completely crazy and often ideas that are proposed as crazy are actually really great ideas. In this case, however, I will use your own terminology — this is a completely crazy plan!

For starters, boiling your beer for 15 minutes will boil most of the alcohol out of the beer. Unless you are trying to make your own non-alcoholic beer this would ruin your brew. The other negative effect of this plan is almost certain severe oxidation. This would occur because of oxygen pick-up when the beer is transferred from keg to kettle and then kicked into high gear when the beer is heated to boiling. So far we have produced oxidized, non-alcoholic, sweet beer. Mmmm! The next step of your plan is to re-aerate and add more yeast. This would work to ferment the residual sugars and you would end up with a very low alcohol, oxidized beer.

The notion that your under-attenuated beer can be fixed is correct and I think it can be done in a much easier way. I would begin by transferring the beer in the keg to a fermenter, securing the top with an air-lock and storing it at fermentation temperature for a few days. This allows most of the carbon dioxide to escape from the beer. The remaining carbon dioxide won't inhibit fermentation and should be low enough to prevent excessive foaming.

Next, make a small batch of wort from dry malt extract. I would use about one pound of dry malt extract, 5 quarts of water and 1 AAU of hops (0.1 ounce or 2.4 grams of 10 percent alpha hops, for example). Boil this for one hour and adjust the volume to one gallon. Then cool, aerate and add yeast. Ferment at room temperature until it begins rapidly fermenting (high-kraeusen stage). This should happen in 24 to 48 hours, depending on how much yeast you added.

When high kraeusen rolls around, add this to the contents of your fermenter. Monitor the fermentation until complete, transfer to your secondary, then age and keg as you did before.

Commercial breweries use kraeusening (the process described above) to help finish fermentations and to naturally carbonate beer. Usually one part of kraeusened beer is added to nine parts of beer at the end of primary fermentation and transferred to a lagering tank. The lagering tank is equipped with a pressure relief valve set to build sufficient pressure for carbonation and vent at pressures that are above the set pressure.

My advice for the future is to be patient and to trust your instincts. If you think an action is likely to cause problems then try something different. In this case you could have kraeusened the beer before you jumped the gun and kegged a batch of half-fermented lager. ■

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

The Replicator

Fat Tire Ale and Black Butte Porter

by Dawnell Smith

Dear Replicator:

I have been searching for a clone recipe of Fat Tire Ale, brewed by the New Belgium Brewing Company in Fort Collins, Colorado.

Tim Kober
Billings, Montana

New Belgium Brewing Company got underway in 1991 and has since expanded production to 170,000 barrels. The brewery is now run by Peter Bouckaert, who worked as the brewmaster for the famous Rodenbach Brouwerij of Belgium from 1987 to 1996. Bouckaert shies away from handing out recipes, but he agreed to offer a few clues and tips for homebrewers.

When trying to emulate Fat Tire Amber Ale, Bouckaert advises that you pay particular attention to the malt bill and the aging process. "We have a malt character that asks for a lot of light-colored malts," he says. "Specialty, Munich and light caramel malts comprise up to 30 percent. For the signature toasted biscuit flavor of this brown-amber beer, add from 5 to 10 percent of malts with a nutty character." For hops, he recommends shooting for 16 IBUs with a subtle late addition of aroma or dry hops. "Don't use Cascade or other overpowering hops," Bouckaert adds.

As for yeast, Bouckaert suggests using a strain low in esters and other flavor components, like American pale ale yeast (Wyeast 1056 or BrewTek CL-10). Fermentation should take place at the low end of the temperature range. The beer should look clear, have low carbonation and give off a malty, fruity aroma with hints of bread crust. It should leave a toasted flavor on the palate and a subtle hop component for balance.

For more information on New Belgium Brewing Company and its well-regarded beers, go to www.newbelgium.com or call (888) NBB-4044 or (970) 221-0524.

Fat Tire Amber Ale
(5 gallons, extract with specialty grains)

OG = 1.050 FG = 1.011 IBUs = 16

Ingredients

5 lbs. Laaglander plain extra-light DME
0.50 lb. crystal malt (20° Lovibond)
0.50 lb. crystal malt (40° Lovibond)
0.50 lb. carapils malt
0.50 lb. Munich malt
0.50 lb. biscuit malt
0.50 lb. chocolate malt
3 AAUs Willamette pellet hops (0.66 oz. at 4.5% alpha acid)
1.33 AAUs Fuggle pellet hops (0.33 oz. at 4% alpha acid)
2 AAUs Fuggle pellet hops (0.50 oz. at 4% alpha acid)
1 tsp. Irish moss
2/3 to 3/4 cup corn sugar to prime
Wyeast 1056 or BrewTek CL-10

Step by Step

Steep specialty grains in 3 gallons of water at 154° F for 45 minutes. Remove grains and add dried malt extract. Bring to boil and add 0.66 oz. Willamette pellet hops. Boil for 60 minutes and add Irish moss. Boil 10 minutes and then add 0.50 oz. Fuggle hops. Boil another 20 minutes, add remaining Fuggles and remove from heat. Cool to about 70° F and transfer to fermenting vessel with yeast. Ferment at 64° to 68° F until complete (7 to 10 days), then transfer to a secondary vessel, or rack into bottles or keg with corn sugar. (Try lowering the amount of priming sugar to mimic the low carbonation level of Fat Tire.) Lay the beer down for at least a few months to mellow and mature for best results.

All-grain option: Omit extract and mash 6 lbs. pale malt with specialty malts in 9 quarts of water to get a single infusion mash temperature of 154° F for 45 minutes. Sparge with hot water of 170° F or more to get 5.5 gallons of wort. Bring to boil and use above hopping and fermentation schedule.

Dear Replicator:

I've always been a huge fan of Black Butte Porter, produced by Deschutes Brewing in Bend, Oregon. I recently tried to brew a clone of it, but ended up with more of a cream stout than an American porter. Do you have a clone recipe or any helpful tips?

Jeff Hertz
Glen Ellyn, Illinois

Ample chocolate malt makes this one of my favorite porters as well. Founded in 1988 as the first brewpub in Bend, Deschutes grew quickly and shipped about 95,000 barrels of beer last year, including 40,000 barrels of the porter alone. Aside from the porter, the lineup includes regulars like stout, ESB, golden ale and a dynamic winter seasonal called Jubelale.

As you know, Black Butte has a dark brown color and a slightly sweet, roasty aroma with mild hop notes. It feels lush and mildly warming on the palate. The taste is malty with a toasted biscuit flavor and an elegant hop balance.

Brewmaster Bill Pengelly offered some quick details that should make your clone version darn close to the real thing. When emulating this fine porter, Pengelly advises to use pale malt, about 6.5 percent medium crystal malt and 6 percent chocolate malt. "It's important that the crystal malt doesn't overpower the chocolate," says Pengelly. Try to find both light and dark chocolate malts, then blend the two like they do at Deschutes. For hops, add Galena, Cascade and Tettnanger in that order. For yeast, go with a good-flocculating London ale yeast strain, such as Wyeast 1318 or 1028.

For more information on Deschutes and its beers, go to www.deschutesbrewery.com or call (541) 385-8606.

Black Butte Porter

(5 gallons, extract with specialty grains)

OG = 1.058 FG = 1.012 IBUs = 30

Ingredients

9 oz. chocolate malt
10 oz. crystal (60° Lovibond)
6.5 lbs. Alexander's pale malt extract
1 tsp. Irish moss
3 AAUs Galena pellet hops (0.33 oz. at 12% alpha acid)
4.5 AAUs Cascade pellet hops (0.75 oz. at 6% alpha acid)
4.5 AAUs Tettnanger pellet hops (1 oz.at 4.5% alpha acid)
Wyeast London Ale III (1318) or Danstar London Ale Yeast

Step by Step

Steep specialty grains in 3 gallons of water at 152° F for 45 minutes. Remove grains and add DME. Bring to boil for 30 minutes. Add Galena pellet hops. Boil 30 minutes and add Cascade hops and Irish Moss. Boil 25 minutes and then add Tettnanger hops. Boil for 5 minutes and remove from heat. Cool to about 70° F and transfer to fermenting vessel with yeast. Ferment at 67° F until complete (about 7 to 10 days), then transfer to a secondary vessel, or rack directly into bottles or keg with corn sugar. Let it age a few weeks and enjoy with a dollop of ice cream.

All-grain version: Omit extract and mash 8.5 lbs. pale malt with specialty malts in 12.5 quarts of water to get a single-infusion mash temperature of 152° F for 45 minutes. Sparge with hot water of 170° F or more to get 5.5 gallons of wort. Bring to boil and use the above hopping and fermentation schedule. ■

ReaderRecipes

Old Monkey Brew

(5 gallons, extract with grain)
OG = 1.048 FG = 1.024
IBUs = 24

This recipe is actually a mistake. I meant to make an Irish stout but bought light malt extract instead of dark malt extract. The results were favorable and this has become my second-favorite recipe.

Bill Martin
Carlisle, Pennsylvania

Ingredients

4 lbs. Muntons light malt extract
2 lbs. Muntons plain light dried malt extract (DME)
10 oz. crystal malt (60° Lovibond)
4 oz. roasted barley
2 oz. black patent malt
5.3 AAU Kent Goldings pellets (1 oz. of 5.3% alpha acid)
1 tbsp. vanilla extract (in primary fermenter)
1 tbsp. vanilla extract (at bottling)
2/3 cup corn sugar
Irish Ale yeast (Wyeast 1084)

Step by Step

Add specialty grains to 5 gallons of water, bring to a boil. Remove from heat and add liquid and dry extracts and stir until dissolved. Bring back to a boil and add Kent Goldings. Boil for 60 minutes. Cool wort to 70° to 75° F, pitch yeast, add vanilla. Transfer to carboy after 6 days. Ferment additional 2 weeks. Add vanilla, corn sugar and then bottle. Age for 3 weeks.

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Send your favorite recipe to edit@byo.com. Be sure to include your full name and address.

Style Calendar 2001

Brown Ale and Märzen

Brew a bold American brown and a malty Oktoberfest Märzen

by Tess and Mark Szamatulski

March is a good month to think like a German and plan ahead for the annual Oktoberfest. We'll brew our Märzen now and lager it for the summer; it will be smooth and mouth-wateringly malty when the celebration rolls around next fall. Since you'll have to wait a while to taste that brew, we'll also whip up a quick-fermenting American brown ale to enjoy in April. And you can celebrate St. Patrick's day with the cream stout that you brewed last month.

AMERICAN BROWN ALE

OG = 1.040 to 1.060 FG = 1.010 to 1.017 IBU = 25 to 60 SRM = 15 to 22

American brown ale is a style that is modeled after English brown ales, but with a stronger, more bitter, hoppier and drier flavor. Citrusy American hops, like Cascade, are commonly used with an occasional blend of English varieties. Some brewers add brown sugar, maple syrup, honey or molasses. Fruit, berries and nut extracts can also be added to these specialty ales.

Our recipe is a judicious blend of malt and hops, with the accent on American hops. We dry-hopped our version. This beer pours with a deep-amber color, topped with a dense, light-beige head. The aroma of Cascade and Willamette hops mingles with the malt, offering a slightly bitter, toasted-malt undertone. The palate is dry with a clean character. The finish is full of malt and hops with a long, dry aftertaste.

Commercial Beers to Try

Many American micro-breweries offer a brown ale. Some of the best include: Hammer & Nails Brown Ale (Watertown, Connecticut), Pete's Wicked Ale (Boston, Massachusetts), Shipyard Moose Brown (Portland, Maine) and Smuttynose Old Brown Dog (Portsmouth, New Hampshire).

The aroma is mild to strong and citrusy. The esters and dark malt aspects are mild to moderate. The color ranges from dark-amber to dark-brown. Hop bitterness, aroma and flavor dominate the malty richness. Some toasty malt character is evident and the body is medium.

Hops, Malt and Yeast

American hops should be used often and generously. Cascade, Centennial, Chinook, Liberty, Willamette and Mt. Hood can be used with a smattering of English hops (East Kent Goldings and Fuggles) if desired. These ales should contain bittering, flavor, aroma and, in some cases, dry hops.

The grist should consist mainly of well-modified pale malt, either U.S. or British two-row pale with crystal and darker malts complementing the grain bill. Appropriate dry and liquid malts for the extract-and-grain brewer to use would include Alexander's pale liquid malt, Northwestern dry gold and Muntons extra-light or light DME.

A myriad of yeasts can be used for this style. If you are aiming for a crisp, clean, dry ale you can use American Ale (Wyeast 1056), American Ale II (Wyeast 1272), or British Ale (Wyeast 1098 or White

THE YEAR IN BEER

JANUARY:
Baltic Porter & German Pilsner

FEBRUARY:
Cream Stout & Dark Lager

MARCH:
Oktoberfest & American Brown Ale

APRIL:
British IPA & Old Ale

MAY:
Dunkelweizen & English Bitter

JUNE:
Fruit Ale & Belgian Strong Dark Ale

SEPTEMBER:
Kölsch & Robust Porter

OCTOBER:
Celebration Ale & Pale Lager

NOVEMBER:
Strong Scotch Ale & Vienna Lager

DECEMBER:
English Barleywine & Doppelbock

Labs WLP005) or London Ale (Wyeast 1028). For a maltier profile, you can use Irish Ale (Wyeast 1084), Whitbread Ale (Wyeast 1099), English Ale (White Labs WLP002) or London Ale III (Wyeast 1318).

Serving Suggestions

Serve at 50° F in a dimpled pub mug with soft-shell crabs in a brown ale-butter sauce, with thick cut sweet potato fries, chopped salad and warm beer bread.

Ides of March Brown Ale

(5 gallons, extract with grains)
OG = 1.057 to 1.058
FG = 1.014 to 1.015 IBU = 34

Ingredients

10 oz. U.S. crystal malt (60° Lovibond)
3.5 oz. British chocolate malt
4 lbs. Alexander's pale malt extract syrup
3.25 lbs. Muntons extra-light DME
2 oz. malto-dextrin
9 AAUs Chinook (0.75 oz. at 12% alpha acid) (bittering)
2.5 AAUs Cascade (0.50 oz. at 5% alpha acid) (flavor)
2.5 AAUs Willamette (0.50 oz. at 5% alpha acid) (flavor)
1 tsp. Irish moss
2.5 AAUs Cascade (0.50 oz. at 5% alpha acid) (aroma)
2.5 AAUs Willamette (0.50 oz. at 5% alpha acid) (aroma)
2.5 AAUs Cascade (0.50 oz. at 5% alpha acid) (dry hop)
2.5 AAUs Willamette (0.50 oz. at 5% alpha acid) (dry hop)
London ESB (Wyeast 1968) or English Ale (White Labs WLP002)
1-1/4 cup Muntons extra-light DME

Step by Step

Bring 1/2 gal. of water to 155° F, add crushed grain and hold for 30 min. at 150° F. Strain the grain into the brewpot and sparge with one gal. of 168° F water. Add the malt extract syrup, dry malt, malto-dextrin and bittering hops. Bring the total volume in the brewpot to 2.5 gal. Boil for 45 min. Add the flavor hops and Irish moss. Boil for 13 min., then add the aroma hops. Boil for 2 min. Remove from the stove.

Cool wort for 15 minutes. Strain into the primary fermenter and add water to obtain 5-1/8 gal. Add yeast when wort has cooled to below 80° F. Oxygenate-aerate well. Ferment at 68° F for 7 days then rack into secondary (glass carboy) and add dry hops. Ferment until target gravity has been reached and beer has cleared (3 weeks). Prime and bottle. Carbonate at 70° to 72° F for 2 to 3 weeks. Store at cellar temperature.

Partial-mash option: Acidify the mash water to below 7.2 pH. Mash 2.25 lbs. U.S. two-row pale malt and the specialty grains in 1 gal. water at 150° F for 90 min. Sparge with 1.5

March 2001

S	M	T	W	THURSDAY	F	SATURDAY
				1	2	3
4	5	6	7	PREP DAY • Prepare starter for brown ale 8	9	BREW DAY • Raise secondary temp. for dark lager (Feb BYO) to 60° to 65° F • Brew brown ale and record OG • Ferment in primary for 7 days • Prime and bottle cream stout (Feb BYO) if desired gravity is reached 10
11	12	13	14	PREP DAY • Prepare starter for Oktoberfest-Märzen 15	16	RACK DAY • Rack brown ale into secondary • Brew Oktoberfest • Record OG • Ferment in primary for 7 days 17
18	19	20	21	CHECK DAY • Baltic Porter and Northern German Pilsner (Jan BYO) 1 month lagering complete, raise temperature to 60° F 22	23	TRANSFER DAY • Prime and bottle N.German Pilsner and Baltic porter (Jan BYO)(or keep lagering porter for two months) • Prime, bottle dark lager (Feb BYO) • Rack Oktoberfest to secondary 24
25	26	27	28	29	30	31

gal. of water at 5.7 pH and 168° F. Then follow the extract recipe, omitting 1.75 lbs. of Muntons extra light DME from the boil.

All- grain option: Acidify the mash water to below 7.2 pH. Mash 10.5 lbs. U.S. two-row pale malt and the specialty grains in 3.75 gal. of water at 153° F for 90 min. Sparge with 4.75 gal. of water at 5.7 pH and 168° F. The total boil time is 90 min. Add 7 AAU of bittering hops for the last 60 min. of the boil. Add the flavor hops, Irish moss, aroma hops and dry hops as indicated.

Helpful Hints: If your water is soft (below 50 ppm hardness), add 1/3 tsp. gypsum and 1/2 tsp. non-iodized table salt to adjust your water for the style. If your water is hard (greater than 200 ppm hardness) dilute it 50/50 with distilled water. This is ready to drink as soon as it's carbonated. It will peak between 1 and 4 months and will last for up to 8 months at cellar temperatures.

OKTOBERFEST MÄRZEN

OG = 1.050 to 1.064 FG =1.012 to 1.016 IBUs = 20 to 30 SRM = 7 to 14

Oktoberfests are intensely appealing. They are best described as liquid bread, with the rich, velvety taste coming from the long lagering period at cold temperatures. Typically they are brewed in the early spring, at the end of the brewing season, and stored in cold cellars (or caves) during the summer until the Oktoberfest celebration. The Oktoberfest festival this year will take place in Munich from September 22nd to October 7th.

This Märzen recipe is a classic German-style Oktoberfest. The first sip enters full of slightly-nutty malt, with nuances of freshly-baked bread. The finish is full of delicious malt without much sweetness.

Commercial Beers to Try

Many commercial examples of this style are available, beginning in early September until late

November. Paulaner Oktoberfest, Würzburger Oktoberfest, Hacker-Pschorr Oktoberfest and Spaten Ur-Märzen are great examples.

The aroma should be a powerful German Vienna or Munich malt nose, with a lightly toasted malt aroma possible. There should be no fruitiness, diacetyl or hop aroma. The color is dark-gold to reddish amber. The malt flavor can have a toasted aspect. The hop bitterness is moderate and hop flavor is low to none. This medium-bodied beer has medium carbonation and the finish is not overly sweet.

Hops, Malt and Yeast

The hops should all be Continental, especially noble varieties. German Hallertau Hersbrucker, Czech Saaz and Tettnanger are the classic choices. The grain bill is composed of German Vienna, German Munich and German pilsner malts with small amounts of crystal malts. All the malt should be the finest two-row barley. We recommend Munich Lager (Wyeast 2308) and Bohemian Lager (Wyeast 2124).

If you can't obtain lager temperatures (47° to 52° F), California Lager (Wyeast 2112) can be used. Ferment the beer at 60° to 62° F. If ale yeasts are used, ferment them at lower-than-normal temperatures (60° to 65° F). We suggest European Ale (Wyeast 1338) and London ESB (Wyeast 1968).

Most basements have cool spots for a carboy. A cement floor close to an outside cement wall is best. If you have outside Bilco doors, use that area for lagering.

Serving Suggestions

Serve in a German one-liter mug at 48° F with assorted grilled wursts. Accompany with thick slices of German black bread, grainy mustard, kraut, sautéed cabbage and onions, dill pickles and horseradish for a wonderful Oktoberfest feast.

Classic Oktoberfest Märzen

(5 gallons, extract with grains)
OG = 1.060 to 1.061 FG =1.016 to 1.017
IBUs = 22

Ingredients

11 oz. Belgian cara-Munich malt
10 oz. German Munich malt
10 oz. German Vienna malt
4 oz. Belgian aromatic Malt
3.5 lbs. Bierkeller light malt extract syrup
3.5 lbs. Muntons extra-light DME
6 oz. malto-dextrin
4.9 AAUs Northern Brewer (0.50 oz. at 9.8% alpha acid) (bittering)
1.0 AAUs German Hallertau Hersbrucker (0.25 oz. at 4% alpha acid) (bittering)
1 tsp. Irish moss
Munich Lager (Wyeast 2308) or Oktoberfest Lager (White Labs WLP820)

1-1/4 cup Muntons extra-light DME for priming

Step by Step

Bring one gal. of water to 155° F, add 10 oz. German Munich malt, 10 oz. German Vienna malt and 4 oz. Belgian aromatic malt and hold for 30 min. at 150° F. In another pot, bring 1/2 gal. water to 155° F, add 11 oz. Belgian cara-Munich malt and hold for 30 min. at 150° F.

Strain into the brewpot and sparge with one gal. of 168° F water. Add the dry malt, malt syrup, malto-dextrin and bittering hops. Bring the total volume in the brewpot to 3.5 gal.

Boil for 45 min. Add the Irish moss. Boil for 15 min., then remove from the stove. Cool wort for 15 minutes. Strain into the primary fermenter and add water to obtain 5-1/8 gal. Add yeast when wort has cooled to below 80° F. Oxygenate-aerate well.

Ferment at 47° to 52° F for 7 days. Rack to secondary. Ferment at 47° to 52° F for 4 weeks. Bring the fermenter to 60° to 62° F until target gravity has been reached and the beer has cleared (approximately 2 weeks). Prime and bottle. Carbonate at 70° to 72° F for 2 to 3 weeks. Store at cellar temperature.

Partial-mash option: Acidify the mash water to below 7.2 pH. Mash 1 lb. German two-row pilsner malt and specialty grains in 1 gal. water at 150° F for 90 min. Sparge with 1.5 gal. water at 5.7 pH and 168° F. Follow the extract recipe, omitting 1.75 lbs. of Muntons extra-light DME from the boil.

All-grain option: Acidify the mash water to below 7.2 pH. Mash 4 lbs. German Vienna malt, 3.75 lbs. German Munich malt, 3.75 lbs. German two-row pilsner malt, 5 oz. Belgian cara-Munich malt and 4 oz. Belgian aromatic malt in 4 gal. of water at 154° F for 90 min. Sparge with 5 gal. of water at 5.7 pH and 168° F. The total boil time is 105 min. Add 5.3 AAU of bittering hops for the last 90 min. of the boil. Add the Irish moss as indicated above.

Helpful Hints: If your water is soft (below 50 ppm) add 3/4 tsp. gypsum, 1/8 tsp. non-iodized table salt and 1/4 tsp. chalk to adjust your water for the style. If it is hard (greater than 200 ppm hardness) dilute it 50/50 with distilled water. This beer can be lagered between 1 and 2 months. Begin lagering at 45° F and slowly decrease the temperature to 34° F over a period of 2 weeks. It will peak between 3 and 7 months after it's carbonated and will last at cellar temperatures for 9 months. ■

Tess and Mark Szamatulski are the authors of "Beer Captured" (Maltose Press, 2000).

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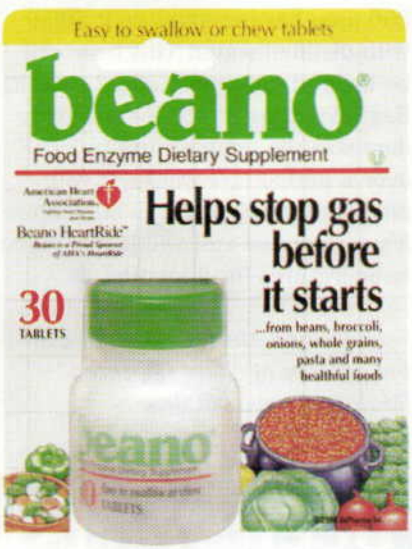


I LIKE QUIRKY FACTS AND the paths that link such facts, and I'm a big fan of the television show "Connections." It always amazes me how the host is able to link so many disjointed facts into a continuous story. I sometimes play weird mind games with myself to determine if I have the knack for making interesting links between seemingly unrelated factoids. In this article, I present the connection between the garden-variety fart and a bottle of light beer — in this case, homebrewed light beer.

The Origin of a Fart

Farts, more appropriately called flatulence, result from consuming flatulents. One of the more amusing lectures in my undergraduate Food Chemistry class at Virginia Tech was on the topic of flatulent-containing foods. The best-known sources of flatulents are foods like beans, broccoli, cabbage, brussels sprouts and cereal grains that are rich in undigestable carbohydrates. These undigestable carbohydrates make their way into the intestine, where bacteria break them down into fermentable sugars. These sugars then ferment and produce carbon dioxide, just like a carboy full of fermenting beer. The result of this intestinal fermentation is the dreaded fart.

For those people who experience physical discomfort and social embarrassment resulting from flatulence, modern science has come up with several remedies. Some people lack the enzyme lactase and experience excessive gas from consuming dairy products. These folks can now purchase milk treated with lactase and can even buy lactase tablets, like Lactaid®, that allow the consumption of other dairy products without having to worry about any side effects.

Another enzyme pill, Beano®, contains the enzyme alpha-glucosidase, also known as amyloglucosidase (AMG), which is consumed before eating foods that contain undigestable carbohydrates, like beans. AMG is an enzyme that breaks the alpha 1 to 6 bonds found in certain undigestable carbohydrates, like raffinose (found in beans, for example). AMG also breaks alpha 1 to 4 bonds. When AMG is consumed along with certain foods it breaks the alpha 1-6 bond before these carbohydrates can make their way into the intestine. Pretty nifty stuff!

The History of American Light Beer

The domestic beer market was flat in the 1960s and 1970s. Domestic brewers wanted to expand their market by appealing to women, who at the time represented a very small portion of the beer-drinking demographic. Miller Brewing Company introduced Miller Lite in 1975 in hopes of appealing to women. Unlike other beers at the time, Miller Lite contained less than 100 calories per serving.

So how did Miller do it? They were able to reduce the caloric content of their Lite by reducing the amount of carbohydrates in the finished beer. Carbohydrates are present in beer because of branches found in the starch amylopectin — these branches are found at a chemical link between two glucose units in the amylopectin, called an alpha 1 to 6 bond. Most of the chemical links between glucose units in amylopectin are called alpha 1 to 4 bonds and all of the bonds in amylose, the other form of starch found in barley and malted barley, are alpha 1 to 4 bonds.

Malted barley contains the enzymes alpha- and beta-amylase and both of these enzymes break alpha 1 to 4 bonds of amylopectin, but not alpha 1 to 6 bonds. The key to Miller Lite is the enzyme amyloglucosidase, allowing almost all of the starch to be converted to fer-

by Ashton Lewis

mentable sugars and for the resulting beer to have a much lower content of these calorie-containing compounds. Miller Lite opened the beer market wide open, and every domestic brewer had their own light beer in the following years.

Not every brewer uses AMG to produce light beer, which legally must contain 1/3 fewer calories than its regular counterpart. Calories in a 12-ounce beer serving can be reduced by adding water, starting off with a lower original gravity wort, adding highly fermentable adjunct syrups or boosting the content of fermentable sugars by using a long mash rest at temperatures around 140° F.

The Link Between Farts and Light Beer

A few years ago I was standing in line at the local grocery store and saw a bottle of Beano® hanging from the impulse-buy rack at the cash register. Recalling the lecture on farts from my Food Chemistry class, I became interested in how this stuff worked. As I read the ingredient label a light bulb flashed in my head! Beano® isn't just for flatuence — it's also the key to brewing light beer at home! Slip a couple Beano® tablets in the fermenter and the unfermentable carbohydrates will be converted to fermentable sugars and, voilà, light beer. The tablets could also be added during mashing, but it is easier and more effective to add them to the fermenter. The same sort of thing happens in sake production, during which *Aspergillus oryzae* (mold used to convert starch to sugar) secretes amylase enzymes, including AMG, as the yeast ferments the sugars produced by starch degradation. AMG in Beano® is derived from *Aspergillus niger*, a fungus used to produce a wide array of enzymes and acids, such as citric acid.

So for any homebrewer out there who is on a low-carbohydrate diet or has friends or family requesting a light beer, Beano® is the ingredient you have been searching for!

SIMPLY SLIP a couple of Beano® tablets into your fermenter. The unfermentable carbohydrates will be converted to fermentable sugars, and voilà! Light beer! Beano® is the ingredient you've been searching for!

Beano® Braü

(five gallons, all-grain)
OG = 1.042 FG = 1.004 IBUs = 12

Ingredients

5 pounds pale malted barley
1.25 pounds flaked rice
2.6 AAU Mount Hood hops
(2/3 ounce of 4% alpha acid)
2 AAU Mount Hood hops
(1/2 ounce of 4% alpha acid)
3 Beano® tablets
(150 enzyme units per tablet)
1 quart starter of American lager yeast (White Labs WLP840 or Wyeast 2035)
2/3 cup of invert sugar for priming

Step by step

Mash in malted barley and flaked rice with 2.25 gallons of 152° F water. Resulting mash temperature should be 140° F. Rest at 140° F for 30 minutes and increase temperature to 150° F. Rest at 150° F for 30 minutes and increase mash temperature to 158° F. Rest at 158° F for 45 minutes and then increase temperature to 168° F for mash-off. Transfer mash to lauter tun and allow mash to rest 15 minutes before beginning vorlauf. Recirculate wort until clear and transfer to brew kettle. Begin sparging with 168° F when grain bed has approximately one inch of wort above it. Collect a total of 6 gallons of wort.

Bring wort to a boil and add 2.6 AAU of Mount Hood hops. Boil for 55 minutes and add 2 AAU of Mount Hood hops. Boil 5 more minutes and stop boil. Chill wort to 52° F (if possible), aerate well, add yeast starter and Beano® tablets.

Ferment at 52° F until fermentation ends, about 10 to 14 days. Verify final gravity has been achieved with a hydrometer and rack beer to a secondary fermenter. Place secondary in a 38° F refrigerator and hold for one week and then cool refrigerator to 32° F (if possible). Let beer sit at 32° F for an additional 2 weeks before bottling. Transfer beer to bottling bucket, add 2/3 cup of priming sugar (dissolved in boiling water and cooled before adding), bottle and condition at room temperature for 2 weeks. Alternatively, transfer to a keg, carbonate and enjoy.

Extract Option: Substitute 4.5 pounds of pale malt extract for the malted barley and 1.25 pounds rice syrup for the flaked rice. Proceed as above from boil. ■

Ashton Lewis is the technical editor of Brew Your Own. He enjoys his Beano® Braü with a piping-hot bowl of five-bean, four-cheese chili, topped with sour cream.

By using a few Beano tablets in the fermenter, you can brew a light beer just like the big boys ... or embark on your own version of a low-carb diet.

BUILD  the PERFECT PINT

by Gretchen Schmidhausler

Celebrate St. Patrick's Day with a superlative stout! Tips, techniques and recipes for brewing this creamy, classic beer.

It's Saint Patrick's Day, a day when everyone is Irish. A day for the wearing o' the green and, of course, the drinking o' the beer. And not the drinking of any old beer, but a perfect pint of stout — whether your choice is Guinness, a draught from the local brewpub or a pint of your own homebrew.

What is stout? Stouts are ales, black in color and opaque. They typically have a burnt, coffee flavor that comes from the use of roasted malt, a specialty grain. Stouts are moderately hopped to complement the beer's rich, malty character, although much of the bitterness comes from the specialty malt. There are three main styles of stout: dry, sweet and Imperial (*for more on different stout styles and how to brew them, see page 27*).

Whether you are a beginning, intermediate or advanced homebrewer, you can create a superlative stout at home. Here are 17 steps to the perfect pint on March 17th.

PHOTO BY CHARLES A. PARKER

It's easy to build the perfect pint of stout at home. With a well-planned recipe, your stout will be deep ruby in color, full bodied, malty and roasty, with a creamy head.

1. Research Project

Don't let anyone convince you this is all about fun. You have to work hard at finding a stout you want to duplicate. Your mission: Find and drink all the stout you can. Good examples are Guinness, Murphy's or Beamish (dry stout), Mackeson's (sweet stout), Young's (oatmeal stout) and Samuel Smith (oatmeal and Imperial stouts). A number of American microbreweries, including Sierra Nevada, also make good stouts.

2. Hit the Books

Immerse yourself in anything and everything stout. All good homebrew books devote at least some space to various stout styles. For serious stout enthusiasts, "Stout" by Michael J. Lewis (Brewer's Publications) is especially comprehensive. Also excellent are "Michael Jackson's Beer Companion" (Running Press) and "The New Complete Joy of Home Brewing" by Charlie Papazian (Avon Books), for basic information and recipes.

3. Step into my lab

Strive for authenticity in your recipe formulation. Design a beer that embodies all the characteristics of a good stout — a full-bodied, malty, roasty beer with a long-lasting, creamy head. Seek out the freshest, most authentic English grains (including Muntons or Pauls pale, roasted, black and crystal malts), malt extracts (Edme, Muntons or John Bull), English hops (such as Goldings, Fuggles and Northern Brewer) and yeast (Irish or English ale).

Are you trying to create a Guinness clone? You'll want to use slightly more roasted malts and Goldings hops. A favorite local brew? Ask your local brewer what he uses in his stout and ask for some house yeast.

First choose your style, then plan your recipe accordingly. Typical original gravities are: dry stout, 1.035 to 1.050; sweet and oatmeal stouts, 1.035 to 1.066; and imperial stout, 1.075 to 1.095.

Typically, specialty malts make up only a small percentage of a stout recipe. There's a reason for that: Overuse of these grains can lead to fermentation problems and an unpleasant astringency in the finished product.

4. Don't believe everything you hear

Many people are surprised to learn that stouts, with the exception of Imperial stouts, are generally lower in alcohol than other ales. The alcohol by volume for a typical dry stout can be as low as 3 percent. Although stouts contain a number of specialty malts, these "extra" grains do little to boost the alcohol content, as they do not contribute fermentable sugars. The low carbonation and dry character of a Guinness, for example, makes it very drinkable session beer.

Also, stout is no more difficult to brew than any other ale. In fact, darker beers are more forgiving in terms of hiding flaws than lighter beers. Haziness, for example, is clearly not a problem in a stout. Also, the strong flavors of these darker beers tend to mask some off-flavors.

5. Hold Your Water

When stout breweries first sprang up in Dublin, they made good use of the local water, which was rich in calcium and magnesium bicarbonate. This hard water, like the water in Munich and Dortmund, is ideal for brewing darker beers. Hard water also improves hop utilization.

Although extract brewers shouldn't fret too much about the water they use, it's easy to mimic the desired water composition by adding a small amount of gypsum to the brewing water. About 2 to 3 teaspoons should be sufficient for a 5-gallon batch.

6. Hop to it

Your hopping schedule should be in sync with the style you've decided to brew. Don't be tempted to over-hop your stout. Stouts, with the exception of Imperial, are typically low in bitterness. The IBU range for dry stouts is 30 to 50; 20 to 40 for sweet stout; and 50 to 90 for Imperial. Stouts are not usually dry-hopped. Best bets: Classic English varieties such as Fuggles, Goldings and Northern Brewer.

7. Go with the Grain

Extract brewers should select a good English malt extract such as John Bull or Muntons. Dry or liquid malt may be used. Use a dark malt, or a combination of dark and amber if you are also using specialty grains. Beginners should seriously consider using a combination of specialty grains to enhance flavor and body. One recipe suggestion: 0.5 lb. roasted malt, 0.5 lb. crystal malt, 0.5 lb. flaked oats or barley, 0.25 lb. chocolate malt and 0.25 lb. black malt for a total of two pounds.

Attention extract brewers: It's always advisable to stir your brewpot as it comes up to a boil to avoid the extract sticking to the bottom and burning (especially if you have an inexpensive pot). Stirring the wort is even more important with the darker extracts because they have a tendency to stick more.

All-grain brewers will use pale malt as their base, along with the recommended specialty grains or a variation. Don't be tempted to over-do the dark malts, though. The result will be a harsh, astringent-tasting brew.

8. Last but not yeast

Choose an appropriate ale yeast. Irish ale yeast is a common choice for dry stouts, although English ale is also widely used. Both impart a crisp dryness, with some mild fruitiness. A liquid yeast is preferred; however, dry ale yeast will do.

9. Mashing tips

Whether brewing an all-grain or partial-mash batch, water temperature should be in the 150° to 154° F range. Stouts are generally made from single-infusion mashes. This is a good workable temperature.

10. Pot Boiler

As with any recipe, wort should be kept at a controlled, vigorous boil for at least an hour. This is important for several reasons including hop isomerization (or utilization) and color development, very important for a dark beer.

Add bittering hops at the boil or soon after; aroma hops should be added at the end of the boil, or a few minutes before the end. Consider the use of Irish moss in the boil to improve foam stability.

11. Fermentation Facts

Fermentation temperature should be around 68° F, slightly higher if desired for more prevalent fruity esters. Esters are typically low to medium in dry, sweet and oatmeal stouts, stronger in Imperial stouts. Fermentation should proceed on the same schedule as any other ale, with final gravities between 1.007 to 1.011 for a dry stout, 1.010 to 1.022 for a sweet stout, and 1.018 to 1.030 for an Imperial stout.

12. To Keg or Not to Keg

The ability to keg your own stout offers you a way to truly shine. Retire your carbon dioxide and instead have your canister filled with beer gas, a mix that's 60 percent nitrogen and 40 percent CO_2.

Using nitrogen to dispense your

A TRIO OF STOUTS: DRY, SWEET AND OATMEAL

Dry Stout

(5 gallons, extract with grains)
OG = 1.040 to 1.043
FG = 1.011 to 1.014
IBUs = 36

Ingredients

4.7 lbs. dark liquid malt extract (Muntons, John Bull or Edme)
0.5 lb. flaked barley
0.5 lb. roasted malt
0.25 lb. chocolate malt
0.25 lb. black malt
8.3 AAU Fuggles (bittering) (1.66 oz. of 5% alpha acid)
2.5 AAU Fuggles (aroma) (0.5 oz. of 5% alpha acid)
2 tsp. gypsum
2/3 cup corn sugar for priming
Irish Ale Yeast

Sweet Stout

OG = 1.042 to 1.046
FG = 1.011 to 1.014
IBUs = 25

Ingredients

5.75 lbs. dark liquid malt extract (Muntons, John Bull or Edme)
0.5 lb. crystal malt
0.25 lb. flaked barley
0.25 lb. roasted malt
0.25 lb. chocolate malt
5.6 AAU Goldings (bittering) (1.25 oz. of 4.5% alpha acid)
2 tsp. gypsum
2/3 cup corn sugar for priming
English Ale Yeast

Oatmeal Stout

OG = 1.042 to 1.046
FG = 1.011 to 1.014
IBUs = 24

Ingredients

5.5 lbs. dark liquid malt extract (Muntons, John Bull or Edme)
0.5 lb. flaked oats
0.5 lb. crystal malt
0.25 lb. roasted malt
0.25 lb. chocolate malt
5.5 AAU Fuggles (bittering) (1.1 oz. of 5% alpha acid)
2 tsp. gypsum
2/3 cup corn sugar for priming
English or Irish Ale Yeast

Step-by-Step for Extract:

Add gypsum to 2.5 gal. of water and heat to 150° F. Steep grains for 15 min. Remove and rinse grains over brewpot with 1 cup of warm water. Discard. Add malt extract and bring to a boil. Add bittering hops and boil for 1 hour. Add aroma hops 5 min. before the end of the boil.

Transfer cooled wort to fermenter, add cold water to 5 gal. Pitch yeast at around 70° F. Shake fermenter vigorously to aerate. Ferment at 68° F for 8 days or until target gravity has been reached. Bottle using 2/3 cup priming sugar, or keg and force-carbonate to 30 psi. Condition for at least 2 weeks.

Partial mash option:

Mash 3 lbs. of pale malt with specialty grains in 2 gal. of water at 152° F for 1 hour. Sparge with 2 gallons of water at 170° F. Add 3 lbs. malt extract and proceed as above.

All-grain option:

Substitute an equal amount of pale malt for the malt extract, plus 1 lb. additional pale malt. Mash grains in 2.75 gallons of water for a single-infusion mash temperature of 152° F. Hold 1 hour.

Sparge with 170° F water to collect 5.5 gallons of wort. Proceed as above.

stout adds a mellowness and balance to the beer and keeps the carbonation level low. Stout is at its best when poured through a specially designed stout faucet, but it's worth a try even if you plan to dispense through a cobra head.

13. Bottled Up

No keg? Not to worry. Prime and bottle your beer as usual. Allow two weeks minimum to condition and naturally carbonate your beer.

With stout, you're shooting for a low to moderate carbonation level. So if your beers tend to be overcarbonated, cut back on the amount of priming sugar you normally use.

14. Bottoms Up!

This beer deserves to be shown off in a pint glass. Not only is it historically associated with the English pub, but the shape allows the drinker to appreciate the aroma and bouquet. Serve stout at room temperature, not chilled.

15. Mix and Match

If your stout does turn out less than perfect (too roasty, too hoppy, under- or over-carbonated), serve it up with a lighter beer, such as Harp lager, and tell your guests you thought they'd enjoy a traditional black-and-tan — also referred to as half-and-half when Bass ale is used. Pour the lighter beer first, then pour the stout over the back of a spoon so it floats on top.

16. Enjoy!

Throw a party to showcase your stout. There should be no lack of St. Paddy's revelers looking to quaff a pint. If they're looking for green beer, they're in the wrong place!

17. Practice Makes Perfect

You have a year to think about and perfect your next batch of stout. Can you work in a trip to Dublin?

Gretchen Schmidhausler is the head brewer at Basil T's Brewpub and Italian Grill in Red Bank, New Jersey.

BY SAL EMMA

STOUTS BY STYLE

At-a-glance brewing guidelines for extract and all-grain batches

The beer that would eventually become known as "stout" owes its existence to porter, the dark beer of southern England that one legend holds was created quite by accident in the early 1700s, when a kiln fire roasted the barley malt to a dark chocolate hue. The thrifty brewer refused to discard the expensive malt and used it to brew as usual. The dark and roasty style that would later be known as "porter" was born.

Some historians dispute this folksy version of porter's genesis. The other popular theory holds that porter started out as "Three Threads," a blend of brown, pale and aged ale that got its name because it was tapped from three casks threaded into one spigot.

Whether spurred by Three Threads or a kiln fire remains a mystery — but in the 1720s, a British brewer named Ralph Harwood is credited with tinkering with his recipes to create the right flavor and color in one cask. He sold the resulting brew as "Entire Butt," which became even more popular than Three Threads — probably as much for its ease of handling as its flavor. The beer soon became known as "porter," reportedly because of its popularity with London's street laborers.

Porter eventually became so popular that breweries made huge vats of the stuff. On at least one occasion in 1814, a brewery vessel burst and flooded the streets with fermenting porter. Several people were killed by drowning and carbon-dioxide asphyxiation.

In 1759, when Arthur Guinness bought the old run-down brewery at St. James Gate, Dublin, porter beer, imported from England, was all the rage. Guinness saw an opportunity to make the beer at home and offer it to his countryman fresher than the English stuff. To identify their strongest, darkest porters, Guinness and other porter brewers used the terms "Stout Porter," "Porter Stout" or even "Stout Butt." (Now there's a marketing man's dream brand!)

Although Guinness also brewed pale ale, his porter eventually became so popular that he stopped making pale beer and instead concentrated his efforts on the black beer. By then, his customers had simply begun calling it "stout."

Several kinds of stout have evolved since those early days, and the style has spread around the globe. Stout is also brewed in Africa and Latin America — sometimes bottom-fermented with lager yeast, sometimes with adjuncts including rice and sorghum. Many tropical stouts are malty and sweet, with little hop bitterness or flavor.

The strangest of the bunch is oyster stout. In its original form, it did include oysters — whole or in essence — dumped into the brew kettle. The years obscure the origin of this strange brew. Thankfully, perhaps, stout with real oysters is no longer made in England. Marston's and Swale's of England and Schelde of Germany have experimented with stouts labeled "oyster," but as a reflection of serving suggestion, not ingredients.

Oysters aside, here's an overview of the three main styles of stout: dry, sweet and Imperial.

DRY STOUT

OG: 1.035 to 1.050 FG: 1.007 to 1.011
IBUs: 30 to 50 SRM: 35+
ABV: 3.2 to 5.5 percent

Ireland's Guinness, Beamish and Murphy's stouts fall into the category called "dry stout," due to a flavor profile dominated by hops, roasted barley and little sweetness. Dry or "Irish" stout is basically pale ale with a generous dose of roasted unmalted barley added to the grist and hopped well in the kettle. Roast gives stout its darkness and roasty, toasty, coffee-like flavor notes.

Stout is not really black. Hold your next glass up to the light and you will discover that it's actually deep ruby. That's the color of roast in the glass. Dark roasted barley has a fining effect, too. It helps keep your beer clear.

Irish stout's other key ingredient is raw barley, which you can also use in your stout recipes, if you mash your grains. The barley boosts the alcohol and also contributes to stout's trademark billowy head.

Irish stout exhibits moderate acidity, medium to high hop bitterness, dry finish, creamy mouthfeel, moderate to low fruitiness, medium to no diacetyl, low to moderate carbonation and medium body. The creaminess is often accentuated through the use of nitrogen dispensing. The style generally includes a sour note which has become the genesis of a homebrew legend: Some say stout brewers add a portion of soured, pasteurized beer to the brew for sourness. (Though this notion has been printed and reprinted in homebrew literature, Guinness unequivocally denies it.)

Commercial styles to try:
Guinness, Beamish, Murphy's.

Extract brewing guidelines for a five-gallon batch:
Malt extract: 6.5 lbs. light, unhopped malt extract.
Grains: 3/4 lb. roasted barley, crushed, steeped in 170° F brewing water for 20 minutes.
Hops: 10 AAUs high-alpha British hops for 60 minutes.
Yeast: Wyeast 1084; White Labs WLP-004; BrewTek CL-240.

All-grain brewing guidelines:
Pale malt: 70 percent.
Roasted barley: 10 percent.
Flaked barley: 20 percent.

Grist/Liquor ratio: 3:1.
Mash temperature: 152° to 155° F.
Follow hop and yeast recommendation from extract guidelines.

SWEET STOUT

OG: 1.035 to 1.066 FG: 1.010 to 1.022
IBUs: 20 to 40 SRM: 35+
ABV: 3 to 5.6 percent

Sweet stout refers to the English style of stout. It is made with a bit more crystal malt and bit less hops. Some examples are quite sweet, others are not, but they are still called "sweet" to distinguish them from their more bitter Irish cousins.

A substyle of sweet stout is milk stout, so called because it is made with milk sugar, or lactose. Beer yeast leaves lactose alone and it maintains some roundness and mild sweetness through fermentation.

In the 18th and 19th century, publicans made beer cocktails, sweetened with sugar, cream and eggs in the mug. The practice of sweetening beer before serving persisted in parts of England into the 20th century. Milk stout may have evolved as an attempt to exploit the sweet tooth. However, beer bard Michael Jackson reports that the first milk stout, Mackeson's, contained milk in name only — the brewery granted a dairy farmer permission to graze his cows in the brewery yard, which led passersby to infer that the stout was made with milk. Later, stout brewers added milk byproducts to increase the beer's nutritional value, just as candy makers had done with the introduction of "milk chocolate."

Cream stout is another sub-style that may or may not include lactose. Most modern cream stouts are simply sweet stouts — that is, lightly hopped — that take advertising advantage of their naturally creamy stout texture.

Dark roasted grains and malts dominate the flavor of sweet stouts, with medium to high sweetness. The style is moderately hopped, full-bodied and creamy. Carbonation is low to medium.

The addition of other adjuncts created other styles, such as oatmeal stout. This is brewed sweet in England, but in any number of varieties by American microbrewers.

Commercial examples to try:

Mackeson's XXX, Watney's Cream, Tennent's Milk.

Extract brewing guidelines for a five-gallon batch:

Malt extract: 6 lbs. light, unhopped extract.
Grains: 1/2 lb. roasted barley and 3/4 lb. British crystal malt, crushed, steeped in 170° F brewing water for 20 minutes.
Hops: 8 AAUs high-alpha British hops for 60 minutes.
Yeast: Wyeast 1028 or 1098; White Labs WLP-002; BrewTek CL-160.

All-grain brewing guidelines:

Pale malt: 85 percent.
Roast: 7 percent.
British crystal: 10 percent.
Grist/Liquor ratio: 3:1.
Mash temperature: 152° to 155° F.
Follow hop and yeast recommendation from extract guidelines.

To make oatmeal stout (all-grain only) add 1.5 lbs. quick-cooking oatmeal to the grist bill. To make milk stout, add 1 lb. lactose to the kettle.

IMPERIAL STOUT

OG: 1.075 to 1.095+ FG: 1.018 to 1.030+
IBUs: 50 to 90+ SRM: 20 to 40
ABV: 8 to 12+ percent

Imperial stout got its name from the Czars of Russia. In the 1780s, the Anchor Brewery of London began shipping stout to Russia and it became popular in the Imperial court. The beer also was exported to other Baltic states.

To survive the long ship journey, it was brewed strong in alcohol and aggressively hopped. Imperial stout is England's dark, cold-climate version of India Pale Ale, in that regard. Guinness makes "Foreign Extra Stout," a special bottled stout, for its continental customers. FES could loosely be regarded as a variant of imperial stout. It's alcoholic and intensely malty, but not as hoppy as some imperial examples.

Imperial or Russian stout is intensely fruity, complex and malty, balanced by aggressive roastiness, hop bitterness and flavor. Warming alcoholic strength is typical. Carbonation is relatively low.

Commercial examples to try:

Samuel Smith, Courage, Brooklyn Black Chocolate, Rogue.

Extract brewing guidelines for a five-gallon batch:

Malt extract: 9 lbs. light, unhopped extract.
Grains: 1 lb. British crystal, 1/4 lb. roasted barley and 1/4 lb. chocolate malt, crushed, steeped in 170° F brewing water for 20 minutes.
Hops: 12 AAUs high-alpha British hops for 60 minutes. 1.5 oz. British Goldings or Fuggles hops for 5 minutes.
Yeast: Wyeast 1028, 1098 or 1728; White Labs WLP-002, WLP-028 or WLP 099; BrewTek CL-130, CL-170 or CL-200.
Note: To boost flavor and alcohol, add 1 pound dark brown sugar to the brew kettle.

All-grain brewing guidelines:

Pale malt: 88 percent.
Roasted barley: 3.5 percent.
British crystal: 6 percent.
Chocolate malt: 2.5 percent.
Grist/Liquor ratio: 3:1.
Mash temperature: 154° to 156° F.
Follow hop and yeast recommendation from extract guidelines. ■

CULTURE IN YOUR KITCHEN

BY CHRIS WHITE

PUT ON YOUR LAB COAT and grab a petri dish: Here's a step-by-step guide to growing your own yeast strains at home

Homebrewers go through many stages in the hobby. A typical path is to buy a kit and make a beer with malt extract, sugar and dry yeast. My first few homebrews had more corn sugar than malt!

But since we are trying to craft the best beer possible, many go to the next stage: We buy more equipment and try different kinds of malt extract and yeast. We use specialty grains to add color and flavor, or even plunge into all-grain brewing. One direction some homebrewers take is yeast culturing.

What is yeast culturing? First we have to know the role of yeast in beer fermentation. Yeast ferments sweet wort into alcohol, carbon dioxide, flavor and aroma compounds. During beer fermentation, yeast undergoes a growth cycle in which they multiply by approximately five times the number of starting cells. Therefore, a beer fermentation can be thought of as one large yeast culture.

Brewers control fermentation, balancing good yeast health and minimal off-flavor production. Each strain of yeast will produce different flavor and aroma compounds. The amount and ratio of compounds determine an individual yeast strain's signature. Natural yeast found in the wild (on plants, in the air) do not usually produce acceptable-tasting beer. It is generally phenolic, yeasty and dry. So the particular culture (called a strain) of yeast used is very important. Thousands of individual strains of yeast are stored in many yeast banks and breweries worldwide. White Labs has over 300 strains of yeast stored in a cryogenic freezer. Breweries that depend on yeast for their beers' signature character heavily protect them. When growing yeast cells from small quantities, we call this yeast culturing.

WHY CULTURE YEAST?

Homebrewing is an adventure, a quest for knowledge. The more we can learn about the hobby, the better we will understand the process. Also, yeast culturing is fun.

Do you need to do it? Not really — there are many sources of pure yeast cultures today, including my own company. But you might not be close to a source of yeast; you may brew larger quantities than economically feasible to purchase; you may want to use strains of yeast that are not commercially available; or you may just want to try it.

Possible disadvantages of home yeast culturing are planning, learning the skills, and the possibility of contamination.

This article describes yeast culturing from an at-home point-of-view. It borrows methods used in the professional laboratory, but is limited by equipment differences and environment. (You can buy all of the equipment I mention in this article — such as test tubes, petri dishes and alcohol lamps — from most homebrew shops.)

WHERE CAN I CULTURE?

You can culture yeast almost anywhere, if you take the necessary cleaning steps and are aware of potential contamination sources. If culturing in the kitchen, be aware that it's one of the largest sources of microbial life in the house.

Microorganisms, such as bacteria and wild yeast, are everywhere, but can be controlled. Drafts, blowing fans and dirty countertops are all threats to pure yeast culturing. Work surfaces should be cleaned thoroughly, and drafts eliminated. Drafts create a wave for bacteria to ride throughout the house on.

Microorganisms are constantly descending in the air. By lighting a flame, such as an alcohol lamp, in the work area, you effectively put up a barrier that pushes them up and away from your culture area. (Be careful when working with alcohol lamps, as it's always dangerous to work with an open flame.)

Alcohol is also used to clean and sanitize surfaces. A 70-percent isopropanol solution is commonly available and works very well. Just pour some alcohol on the counter and wipe up with a paper towel. Again, be careful when working with flammable alcohol.

KEEPING THINGS CLEAN

Sanitation is very important in the brewing process. A beer's flavor is delicate, and can be thrown off by bacteria or wild yeast. In yeast culturing, sanitation is critical. Sterile conditions and sterile media are required to isolate and propagate yeast from small colony sizes.

There is an important difference between sterile and sanitized. To be sterile is to be free of all microbial life. The killing of all living things — sterilization — is achieved with a high pressure-temperature autoclave in the laboratory, or at home with a pressure cooker. To be sanitized is to be mostly free of microorganisms. Sanitation can be achieved by methods such as boiling, chemical treatment or pasteurization. In yeast culturing from single cells, if the starting material is not sterile, other organisms can be propagated along with the yeast.

In summary, brewing beer, starting with a large population of healthy yeast, requires only sanitation. The yeast will out-compete other organisms, and quickly create an inhospitable environment. But in yeast culturing, sterile conditions are required because of the small initial population of cells.

SLANTS AND PLATES

Slants and plates are commonly used in all yeast and bacteria culturing. A semi-solid media (we'll just call it agar, even though agar is just one ingredient) is put into a test tube (called a slant) or a petri dish (a plate). Agar is derived from the cell wall material of red seaweeds (the algae *Gelidium* and *Gracilari*). Agar is a gelatin-like material that is liquefied at temperatures over 107° F and forms a gel under 99° F. Yeast will grow on the semi-solid agar surface, and provide a means of semi-long-term storage.

Yeast grow in globs or in single colonies (each colony contains millions of cells) as round creamy-white domes on the agar surface. Wild yeast can look similar to brewers' yeast, but there can be clues to wildness. For example, if you want to collect yeast from a bottle-conditioned beer, it's best to "plate" it first, to check for purity. Even when the results appear to be pure yeast, there can be "blisters" around the yeast colony, a sign of wild yeast formation. If any foreign growths occur, your plate is contaminated and should be discarded.

A slant is your "mother" culture, which should remain pure due to its infrequent usage. A blank slant is made by pouring liquefied agar into a test tube and cooling at an angle, creating a large surface area.

Once inoculated with yeast, the mother culture should be used to create a "working" culture. A plate serves as your working culture, which in turn provides the yeast for the "starter" culture that you pitch into a batch of beer. The plate serves two functions — it's a work-

1.

To grow a starter culture, first take a loopful of yeast from a slant (test tube) or plate (petri dish, shown above). A creamy white color indicates healthy yeast.

ILLUSTRATIONS BY DON MARTIN

ing store of your yeast culture, and it offers a look at the purity of your yeast. Most contaminants grow and become a visible colony. This allows the average person without a microscope to identify possible contaminants with the naked eye.

Contaminants will look different on plates than normal brewers' yeast. Molds are common contaminants and are easily spotted as they look similar to those that grow on bread, cheese and fruit. Bacteria are harder to identify. They may at first look like yeast, but are usually more translucent and often colored or slimy. Bacteria can appear clear, white or reddish-pink.

If you contaminate a plate, you can make a new one from your pure slant. But if you contaminate a slant you lose your mother culture. You may make backups or new slants from older ones by following the sterile technique of transfer. Yeast on slants last longer because it has a screw cap, and does not dry out. Yeast continues to grow on plants and slants, just very slowly, since they are kept cold.

If yeast grows, they will mutate. Mutations can occur on slants in as little as two months. At White Labs, our method of long-term storage is cryogenic freezing, which reduces the likelihood of mutation.

To prolong the life of your plates and slants, store them in the fridge. A plate will last several months, stored wrapped in parafilm with the agar side up. Slants are the best possible semi-long-term storage. They should be re-cultured every 4 to 6 months before they start to mutate and die. Note color changes, indicating cell death. Healthy yeast should be a creamy white color.

SOURCES OF YEAST

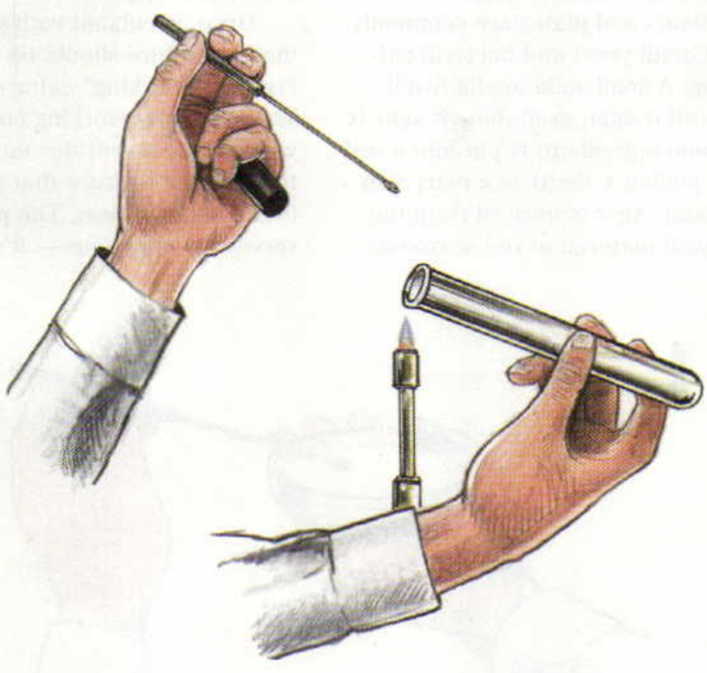
There are many primary sources of yeast for your plates and slants. Yeast is everywhere, on plants and in the air. Throughout history, it has been selectively cultivated by brewing and good brewing strains have been naturally isolated. Once pure culture techniques were developed in Europe during the late 19th century, yeast strains from all over the globe were banked in newly created "yeast banks."

Yeast can be bought from these yeast banks today, but it is expensive for the average homebrewer. Typical costs are $100 per slant. The most affordable sources of homebrewing yeast are a vial of liquid yeast, a bottle-conditioned beer, a dry yeast pack or the sediment at the bottom of your carboy. Each source has its own advantages and disadvantages.

Yeast from your carboy, for example, is good because it is a plentiful source of yeast, and if you follow good, sanitary brewing procedures, it should be easy to purify. The disadvantage is that the yeast may be in poor condition following fermentation. Yeast from a bottle-conditioned beer is difficult to obtain, and in most cases you will also find wild yeast and bacteria. Separating that mix and selecting the appropriate brewing strain can be a challenge! But that's what makes yeast culturing fun, and it's especially rewarding if you can capture a rare yeast strain.

Once you select a source of yeast, making a mother culture is easy. The mother culture will be a slant. It is best to "plate" your source of yeast first (see step-by-step directions for "streaking a plate" below), inspect the colonies and replate if necessary. You want to obtain isolated colonies, free from contaminating bacteria, wild yeast and mold. You can streak from any yeast source onto plates: Simply dip an inoculation loop (see below) into a sample of yeast — the bottom of a bottle, yeast slurry in a jar — and streak the yeast onto a plate. Once you have obtained an isolated, healthy-looking colony,

2.



Boil DME and water to make 10 ml of sterile wort; cool in a test tube. Flame the opening of the test tube, then insert the loop with yeast and stir yeast into the sterile wort. Flame cap and tube, then snug cap. Unscrew the cap slightly to allow for oxygen transfer. Hold the cap in your hand as shown to avoid contamination.

take a colony or two and spread on a slant. Grow the slant for two days as explained later in the article, and then grow up the colony to make a starter culture for brewing. Make sure your test-brew yeast comes from the new slant, so if the yeast works well, you know you already have it "banked." If it does not ferment correctly, or has off-flavors, the slant can be discarded, and you start all over again.

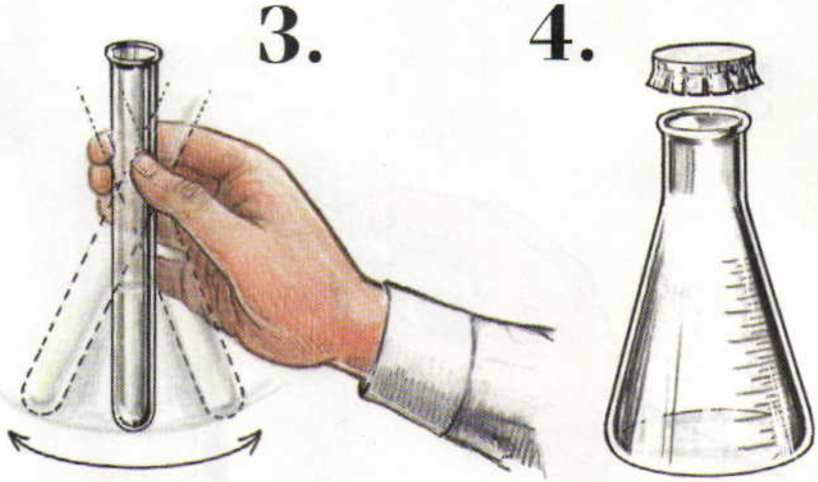
INOCULATION LOOPS

Inoculation loops can be disposable or metal. Disposable loops usually come sterile, and are easy to work with. The problem is they are wasteful, since they can't be reused. Metal inoculation loops need to be sanitized by flaming prior to any transfer. You should hear it sizzle, and always get the loop red-hot prior to cooling. Metal loops require cooling prior to transfers, which can be done by immersing the loop in sterile water (sterilized in a pressure cooker or boiled) or by touching the hot loop to an agar surface prior to picking up a colony.

STREAKING A PLATE

Streaking an agar plate is a quick and easy way to isolate yeast, to check for purity, and to re-culture yeast from aging plates or slants. A sterile inoculation loop is dipped into a sample of yeast and streaked over the agar surface in a pattern of decreasing cells. The last cells to rub off the loop are wide-enough apart so that they grow into isolated colonies.

To begin, clean an area and light the alcohol lamp. Place the plate near the flame, agar side up. If streaking from a slant, open slant and pass opening through flame. Lightly dip the inoculation loop into the yeast and remove a tiny bit. Re-flame and close slant. Pick up agar side of plate and turn over near flame. Run the loop back and forth several times in a small 1/4-inch section. Streak the loop through this section and re-streak a new section. Repeat this step about three times.



Shake starter to aerate and mix yeast into suspension. Your wort starter will grow over a period of 24 to 48 hours at room temperature (70° F). The next step: boil 400 ml of water and 4 tablespoons of DME and add to a sanitized flask.

Grow the plate for two to three days at room temperature (70° F), agar side up. Dense yeast will grow in the initial area, getting more diluted in the later streaks. If isolated colonies are not obtained, a new plate can be re-streaked. If you don't get individual cells, you're transferring too many cells each streak. Take a smaller portion for re-streaking, or flame the loop and cool between each re-streak. After growth period wrap edges with parafilm and refrigerate.

MAKING A STARTER CULTURE FOR BREWING

Yeast has a creamy white color. Plates usually have many colonies growing on them, while slants usually have a slick of yeast. This is typical of a healthy sample.

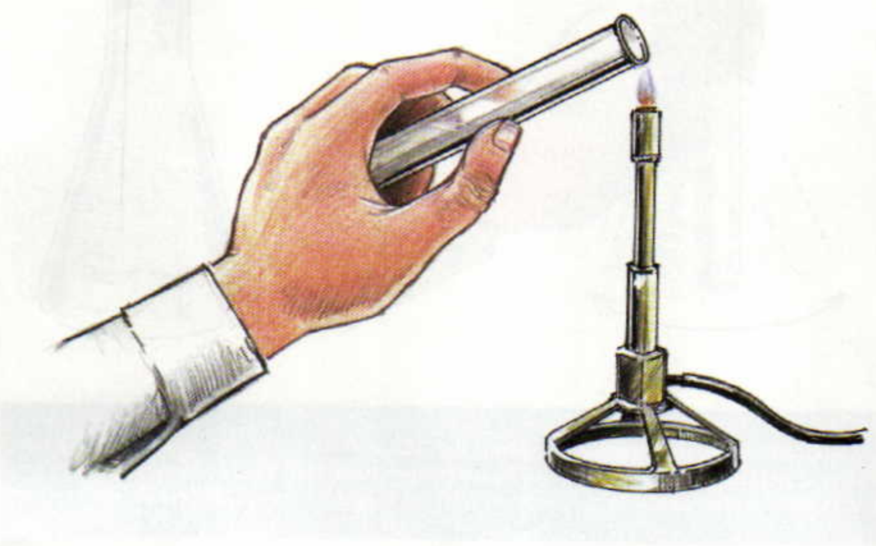
Each dot on a plate is a colony or group of colonies of yeast, any of which can be selected to make a starter culture. A starter culture is the yeast that you'll pitch into a batch of beer.

To make a starter culture, first make a sterile wort starter by boiling dried malt extract and water, adding it to a test tube and letting it cool. Then pick either a single colony (small white disc of yeast) from a plate or a loopfull from a slant. It's better to select single colonies, grown from single cells, as they are the purest form of yeast identifiable.

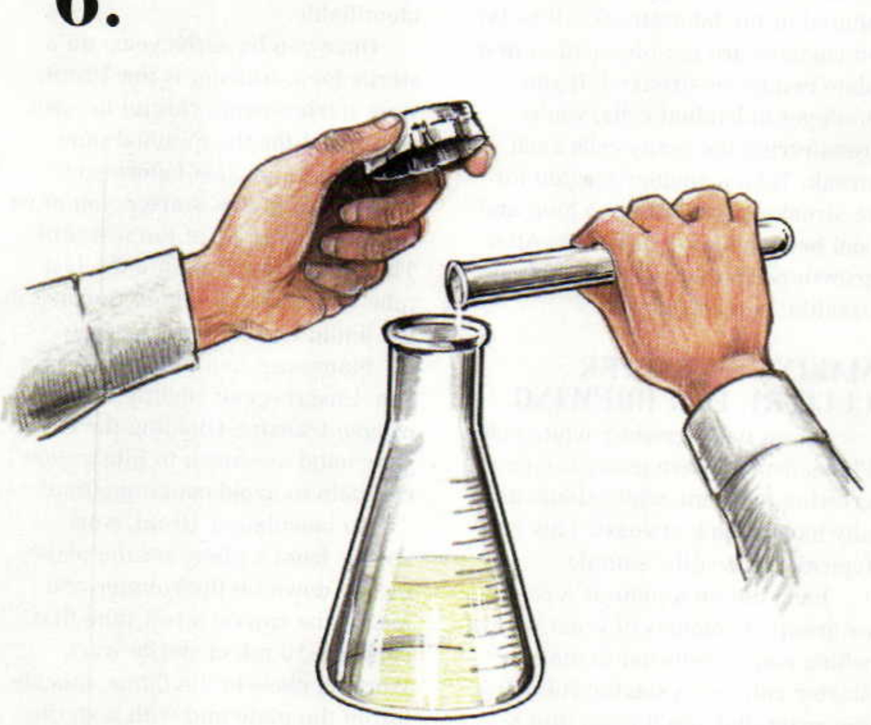
Once you have the yeast on a sterile loop, transfer it the 10-mL wort starter, being careful to open containers for the minimal time required. Note: Just before you inoculate the wort starter, you must flame the opening of the test tube. Then insert the loop into the test tube and shake the tip of the loop in the liquid to transfer the yeast.

Flame cap and tube, then snug cap. Unscrew cap slightly to allow oxygen transfer. (Holding the cap in your hand as shown in Illustration 2 can help to avoid contamination).

To inoculate a 10-mL wort starter from a plate, set the plate upside down on the counter and loosen the cap on a test tube that contains 10 mL of sterile wort. Working close to the flame, quickly lift up the plate and with a sterile loop select a colony by scraping the surface of the yeast with the small end of the sterile loop. Replace the cover and open the test tube, flame the lip, dunk and shake the end of the loop holding the tiny amount of yeast into the liquid. Flame opening, 5.



6.



You are now ready to add the 10-mL wort starter to the Erlenmeyer flask. Flame the opening of the test tube while removing the foil cap from the flask. Flame the opening of flask and dump in contents of 10-mL vial, quickly replacing foil cap.

screw on cap snug, shake, then unscrew slightly, permitting the transfer of gas for optimum growth.

Shake starter to aerate and to mix yeast into suspension. Leave upright in a warm place (70° to 80° F). Your 10-mL wort starter is now inoculated and will grow over a period of 24 to 48 hours. It won't look like a normal fermentation, because very little action will be seen at the top. A white sediment will appear on the bottom, assuring you that growth has occurred. You should use this starter after approximately two days. It will keep if refrigerated, after growth has occurred, up to seven days. Warm it to room temperature before proceeding to the next step.

When you are ready to grow your starter, boil 400 mL of water with four tablespoons of dry malt extract and some dry yeast nutrient. Add mixture to your sanitized Erlenmeyer flask. If you use a one-liter Erlenmeyer flask, you can boil directly in the flask. If you use a 500-mL flask, it is preferable to boil separately, in order to avoid boilover. There are two acceptable methods of sanitizing your flask. You may make up a chlorine solution of 1 tsp. bleach, add to Erlenmeyer and fill to top with water. Allow flask to soak for 15 minutes, then rinse with hot water and cap top with aluminum foil. Another method of sanitation is to place the flask, with a foil cap tightly molded around lip of flask, in the oven at 350° F for two hours. The bake method is preferred and may be done days in advance. Once you have filled the Erlenmeyer with your hot boiled media, quickly place foil over the top, creating a cap. Allow to cool to room temperature, or cool to touch. You are now ready to add the 10-mL wort starter to the Erlenmeyer flask.

Tighten cap on 10-mL vial and shake to re-suspend yeast into solution. Unscrew cap slowly as there may now be pressure in the 10-mL vial, then flame opening while removing foil cap from flask. Flame opening of flask and dump in 10-mL vial, quickly replace foil and form tightly around opening. Shake Erlenmeyer flask to aerate and to mix yeast into solution. Allow this to sit at warm temperature (70° F) for one to two full days before use. Activity should be present within 12 to 24 hours. Again, activity will only be slight and will not produce the vigor of a five-gallon fermentation.

After 24 to 48 hours, swirl flask to mix yeast into solution, remove foil, flame lip and pour into five-gallon batch. Shake fermenter to aerate, then leave at recommended temperature. Activity should be present in 6 to 24 hours. Ferment ales at 65° to 75° F, and ferment lagers at 48° to 55° F.

PLANNING AND TIMING

Creating your own yeast starter requires planning. Each step is not very time consuming, but yeast requires a growth period in order to build up to a size sufficient for use in five gallons of wort.

Suppose you want to brew on a Sunday. A sensible time frame would be as follows:

WEDNESDAY
Inoculate 10-mL sterile wort starter from plate or slant.

THURSDAY
Growth begins in 10-mL starter. Keep in a warm place (70° F).

FRIDAY
More growth, followed by the transfer to Erlenmeyer flask starter to build additional cells. Keep at 70° F.

SATURDAY
Growth occurs and visible signs of fermentation. Keep at 70° F.

SUNDAY
Pitch starter culture into five-gallon batch of beer!

Although this schedule seems regimental, performing each task, such as inoculating a 10-mL starter, can be done in a few minutes. Growth occurs with little attention and preparing the pitchable starter takes about 30 minutes. The suggested temperature for growth is approximately 70° F. Don't worry if you are a few degrees off.

Allowing a total of four days from inoculating to brewing should provide an adequate cell count to pitch into a five-gallon batch. If you go to a higher volume than 400 mL in an Erlenmeyer flask, then you will have to add one to two days for each additional transfer. If you're brewing a high-gravity beer or a lager, it is best to make a one- to two-liter starter for five gallons.

QUALITY CONTROL

How do you know your culture is pure, and not contaminated? There are many methods available to check the purity of your yeast. In most cases, homebrewers do not do these procedures and instead rely on experience, smell and luck. Smell the contents of the used test tube and other containers of yeast culture. It should not smell sour, but should smell like good, clean yeast.

Methods to test your yeast cultures include anaerobic plating, aerobic plating, wild yeast plates, and microscope. Details of these testing procedures are better left for other articles. It takes two to four days after the yeast is ready in order to do the tests and interpret the results. At White Labs, it takes three laboratory technicians to test all of the yeast we produce.

AND IN CONCLUSION...

There are many good references to investigate these procedures in more detail. A very good resource is Pierre Rajotte's book, "First Steps In Yeast Culturing." Joining a local homebrew club is also a good way to meet people who can teach the skills described in this article.

Many of these yeast culturing techniques can be used in other parts of homebrewing, such as making a starter and saving yeast from batch to batch. The quality (health, viability, purity) may not be the same as laboratory grown yeast kept under constant conditions, but it will be very good. And it's fun! ■

After 24 to 48 hours, pour solution into 5-gallon batch. Shake well to aerate.

Chris White holds a doctorate degree in biochemistry from the University of California, San Diego. He is the founder and president of White Labs Inc., a yeast and fermentation laboratory for craft and homebrewers. Chris is a member of the American Society for Brewing Chemists and the Master Brewers Association of America, as well as a lecturer in the Chemistry and Biochemistry Department at the University of California, San Diego.

Some material in this article is excerpted from "The Fungus Among Us, 2nd Edition," by Chris White and Yuseff Cherney, published in 1997. "Fungus among Us" is out of print, but the authors are updating the pamphlet and expect to have a new version out shortly.

The Extract EQUATION

by Chris Colby

These days, there is no shortage of beer recipes for a homebrewer to choose from. Entire books are devoted to beer recipes; magazines like *BYO* publish them every issue. And Web sites like the Cat's Meow (hbd.org/brewery/cm3/index.html) and Gambrinus Mug (brewery.org/gambmug/) are home to hundreds of recipes submitted by homebrewers. Unfortunately for extract brewers, many of these recipes are all-grain and don't include an extract version. Luckily, there is a straightforward way to convert almost any all-grain recipe to an extract recipe. And sometimes you can reverse the steps to convert an extract recipe to all-grain.

Converting a recipe is only part of what you need to do to brew a beer similar to the one in a recipe. In order to closely match the flavor of the original beer, you may need to modify some of your extract brewing procedures to match all-grain methods, such as performing a full wort boil. The closer your brewing procedures match those of the recipe's author, the less you'll have to alter the original recipe.

In this article, I'll take you step-by-step through how to convert an all-grain recipe to an equivalent extract recipe. I'll point out where all-grain brewing procedures will require alterations to either the extract recipe or to your extract

ILLUSTRATION BY BUD PEEN

With a calculator and a little know-how, you can convert any all-grain homebrew recipe to an all-extract version.

brewing procedures. I'll also discuss how to make your extract beer as similar as possible to the original all-grain beer.

Step One: Converting Volume

The first step in converting any recipe is to scale the volume of the all-grain batch to the size of your batch. To do this, simply divide the size of your extract batch by the volume of the all-grain batch. Then multiply the amount of each ingredient in the all-grain recipe by this number to obtain the amount you need in the extract recipe.

For example, if the all-grain recipe is for 15 gallons of beer and you plan to brew a 5-gallon batch, multiply the amount of each ingredient by (5/15 =) 1/3.

Step Two: Converting Hops and Spices

Converting Hops

All other things being equal, you should add exactly the same amount of hops to your extract recipe as are called for in the scaled all-grain recipe. Unfortunately, all other things are rarely equal. Even if you use the same variety of hops and boil the hops for the same length of time, you may need to compensate for two important variables: the alpha-acid ratings of the hops and the density of the wort during boiling.

Hops With Different Alpha Acids

Alpha-acid ratings measure the bitterness level of the hops. Different hop varieties have different alpha-acid levels. And different crops of the same variety may also vary in levels of bitterness. So five ounces of Hallertau hops from one source may provide a different level of bitterness than five ounces of Hallertau from a different source.

To compensate for hops of different alpha-acid ratings, divide the alpha-acid rating of your hops by the alpha-acid rating given in the recipe. Multiply the amount of hops used in the recipe by this number.

For example, if the recipe gives 3 ounces of Saaz hops at 3.5% alpha acid (AA) and the hops at your homebrew store are rated at 4% AA, you need to add ((3.5/4) x 3 =) 2.6 ounces of the 4% AA hops.

If you're math-phobic, pick a similar style of hops with an alpha-acid rating as close as possible to the hops in the recipe.

Differences in Wort Density

One way that extract brewing typically differs from all-grain brewing is in the density of the wort as it is boiled. Some extract brewers boil a concentrated wort, then dilute the wort to working strength by adding water to the fermenter. All-grain brewers, however, have to boil their worts at or near working strength. For a 5-gallon batch, the extract brewer may boil 2 gallons of wort, then dilute it in the fermenter. The all-grain brewer may boil 5.5 to 6 gallons and end up, after losses to evaporation, with 5 gallons.

There are two important consequences of this difference in brewing procedure. First, the amount of bitterness extracted from the hops decreases in thicker worts. So the extract brewer boiling a concentrated wort will extract less bitterness from the same amount of hops. Secondly, the amount of carmelization that occurs during boiling increases with wort density. So an extract brewer will produce a darker beer when using an equivalent "grain bill" as an all-grain brewer. This will be especially noticeable if you try to brew a light-colored beer.

To compensate for the difference in hop bitterness extraction for worts of different densities, divide the hop extraction expected from the density of your wort by the hop extraction expected from the density of the wort in the all-grain recipe. You will have to calculate the density of your wort, then look up the expected extraction on a hop extraction chart such as the one in Table 1 (*see page 38*). Use the original gravity of the all-grain recipe to look up the second number.

To estimate the density of wort, divide your batch size by the number of gallons of wort you will boil. Multiply this number by the number of gravity points expected. (Gravity points are the decimal portion of the beer's expected original gravity.) For example, let's say you are going to brew 5 gallons of pale ale with an original gravity of 1.048. You plan to boil 3 gallons of wort, then add water in the fermenter to make 5 gallons. Your wort density is ((5/3) x 48 =) 80. This means the specific gravity of your wort during the boil is 1.080.

So, to calculate how much hops you would need, divide the hop extraction for your thick wort by the hop extraction from the working strength all-grain wort. Then multiply this number by the amount of hops. From Table 1 we can see that for a wort of 1.080, hops boiled for 1 hour should yield 18.7% of their AA. Hops boiled for 1 hour in a wort of 1.048 should yield 22.5% of their AA. Thus, if the all-grain recipe called for 3 ounces of hops you would need ((22.5/18.7) x 3 =) 3.6 ounces of hops.

To avoid having to do this calculation, boil your entire wort just as the all-grain brewer did.

Converting Spices

Like hops, spices vary in their potency. The heat of chili peppers, for example, is rated in Scoville units. Unlike hops, however, it's unlikely that you'd see such a rating for spices in a homebrew recipe. (I've never seen one.) So, when adding spices or flavorings to a homebrew, the best you can do is

Table One: Typical Hop Utilization vs. Boil Gravity

Specific Gravity	1 hour boil	45 minute boil	30 minute boil
1.040	22.5%	20.0%	14.0%
1.050	22.5%	20.0%	14.0%
1.060	21.2%	18.8%	13.1%
1.070	19.5%	17.4%	12.2%
1.080	18.7%	16.6%	11.6%
1.090	17.3%	15.4%	10.7%
1.100	16.6%	14.8%	10.4%
1.110	15.9%	14.2%	9.9%
1.120	15.3%	13.6%	9.5%

Table Two: Extract Potential of Extracts and Adjuncts

Ingredient	Typical Extract Potential*
Dried malt extract	45
Liquid malt extract	38
Corn syrup	38
Corn sugar	37
Cane (table) sugar	46
Honey	33
Molasses	36

* Extract potential is listed in gravity points per pound per gallon

add the same amount as specified in the scaled all-grain recipe. Also, be sure to use the freshest spices available and use whatever procedure was used in the original recipe (adding the spice to the secondary, for example, or making an extract with alcohol). After you finish your first batch of the beer, you can taste it and adjust the spices as desired.

Step Three: Converting Specialty Grains

Specialty grains add both fermentables and flavors to beer. When converting an all-grain beer to extract, it's best to temporarily forget about the fermentables and focus on the flavors. When handled in a similar manner, one ounce of a specialty grain in an extract beer should impart the same amount of flavor as an ounce of the same specialty grain in an all-grain beer.

There are two broad classes of specialty grains, stewed and roasted. After malting, stewed grains are heated in a closed environment so that moisture cannot escape. The end result is the starch in each kernel is partially to mostly converted to sugar inside the husk. Roasted grains are heated with hot air after mashing and are dried in the process. Most of the starch is not converted to sugar. A third type of grain is roasted barley; roasted barley is unlike stewed or other roasted grains in that roasted barley is not mashed prior to roasting.

When brewing an extract beer, stewed grains can be steeped in hot water or mashed. Most roasted grains, especially those with a high starch content, should be mashed so that they do not contribute starch to the wort. For simplicity's sake, it is best to make a partial mash with all your specialty grains, even those that could be steeped. A partial mash is only slightly more involved than steeping. And, the flavors you get from the specialty grains in the partial mash will more accurately reflect the original recipe.

To prepare for your partial mash, measure out the same amount of each specialty grain as called for in the (scaled) all-grain recipe. Add the specialty grains to a nylon mesh bag. Add an amount of pale malt equal to the amount of specialty malt to the nylon bag. (Record the amount of pale malt used in this step. You will need to account for it later.) All of the grains in the bag should be crushed. If you don't have access to a malt mill, be sure to get the grains crushed at your homebrew shop.

To perform your partial mash, heat some water to between 150° and 158° F. You should have enough water to completely submerge the grains. Add the bag of crushed specialty grains and pale malt to the water. Let the bag soak undisturbed for an hour. Try to keep the temperature between 150° and 158° F. It is more important to ensure the temperature doesn't rise above 158° F than it is to ensure that the temp doesn't fall below 150° F.

After an hour, remove the bag and place it in a large kitchen strainer. Hold the strainer over your partial mash water. With a large cup, scoop mash water and slowly pour water over the grain bag to rinse the grains. (It really helps to have a brewing partner for this step — one person holds the strainer with the grain bag in it, the other pours the water through the bag.) Keep rinsing until the water falling from the strainer is the same color as your brewing water. When you are done, take a fine kitchen strainer and strain out any husk material. Add this water to your brew kettle.

Step Four: Converting Adjuncts

Adjuncts come in many forms, but to a brewer they fall into two classes, sugary or starchy. Adjuncts comprised mainly of sugar, such as honey or molasses, can be added directly to beer after the mash, during the boil or secondary fermentation. For these adjuncts, add the same amount of the adjunct as the scaled all-grain recipe calls for. Follow the directions regarding their use in the original recipe.

In all-grain beers, starchy adjuncts must be mashed to convert

EXTRACT MATH

A STEP-BY-STEP EXAMPLE OF CONVERTING A SIX-GALLON ALL-GRAIN PORTER RECIPE TO A FIVE-GALLON ALL-EXTRACT VERSION.

All-grain recipe	Scaled recipe	Extract recipe
6 gallons	5 gallons	5 gallons
OG: 1.055	OG: 1.055	OG: 1.055
11.5 lbs. pale malt	9.52 lbs. pale malt	4.5 lbs. dried malt extract + 0.92 lb. pale malt (partial mash)
0.75 lb. crystal malt	0.62 lb. crystal malt	0.62 lb. crystal malt
0.25 lb. chocolate malt	0.20 lb. chocolate malt	0.20 lb. chocolate malt
0.125 lb. black patent malt	0.10 lb. black patent malt	0.10 lb. black patent malt
12 oz. molasses	10 oz. molasses	10 oz. molasses
1 inch brewer's licorice	0.83 in. brewer's licorice	0.83 in. brewer's licorice
12 AAU bittering hops	10 AAU bittering hops	13.5 AAU bittering hops
(2 oz. Fuggles at 6% AA)	(1.7 oz. Fuggles at 6% AA)	(2.7 oz Fuggles at 5%)
Wyeast 1056	Wyeast 1056	Wyeast 1056

Step 1. Scale the recipe

The size of the original batch is 6 gallons, but we want to brew 5 gallons. Multiply the amount of every ingredient by (5/6 =) 0.83. For example, 11.5 lbs. pale malt times 0.83 is 9.52 lbs. of pale malt.

Step 2. Non-fermentables

Let's start with the easy part, the licorice. That scales 1:1 (for spices and flavorings, you simply compare the scaled recipe with final extract recipe and add the same amount).

The hops will not scale in a 1:1 manner. Let's say the Fuggles we buy at our homebrew shop are rated at 5% alpha acid. Let's also say we plan to boil 2.5 gallons of wort, then dilute to 5 gallons.

First we'll correct for the different alpha-acid ratings of the Fuggles. To do this we'll multiply the amount of hops (1.7 oz.) times the recipe's hops AA% divided by our hops AA%. This is (1.7 x (6/5)) = 2. Therefore we need 2 oz. of Fuggles at 5% AA.

Next we'll compensate for the boil gravity. We plan to boil 2.5 gallons of wort. Our batch size is 5 gallons and our OG will be 1.055. So our boiling gravity will be (55 x (5/2.5) =) 110; in other words, our boiling gravity will be 1.110.

Looking at Table 1, we expect to get 15.9% utilization of our hops at a gravity of 1.110 compared to about 21.8% utilization at 1.055. So, we need (2 x (21.8/15.9) =) 2.7 oz. of Fuggles.

Step 3. Specialty Grains

The amounts of specialty grains we use are the same amounts as in the all-grain recipe. Together, they total 0.92 lb. of grain. So, we make a partial mash of these along with 0.92 lb. of pale malt.

Step 4. Adjuncts

The molasses gets added on a 1:1 basis. It does not need to be mashed.

Step 5. Pale malts

Lastly we need to convert the pale malt to malt extract. In this example, we plan to use dried malt extract. The scaled recipe contains 9.5 lbs. of pale malt, but we used 0.92 lb. in the partial mash. This leaves (9.5 - 0.92 =) 8.6 lbs. of pale malt remaining.

To get our conversion factor, we need to calculate my extract efficiency. Since I have adjunct in my beer I use the second formula I gave. From Table 2 the EP of molasses is 36. So, my EE is: EE = [SGP x V - (Wadjunct x EPadjunct)] / Wgrain=[55 x 5 - (0.62 x 36)] / 10.5 = 24.2.

(Ten ounces is 0.62 lb. as there are 16 oz. in a pound. 10.5 lbs. was the total weight of the grains.) Why is my EE so lousy? Mostly because I have a one-gallon space under the false bottom of my mash tun.

Now that we have my efficiency we can convert the remaining pale malt to dried malt extract. We know from Table 2 that the extract potential of dried malt extract is 45, so the remaining 8.6 lbs. of malt extract converts to (8.6 x (24.2/45) =) 4.5 lbs. dried malt extract. That's it. *—Chris Colby* the starches to sugars. Left unconverted, starch can cloud beers. It can also be a carbon source for spoiling bacteria and wild yeasts. Extract brewers have two options when dealing with an all-grain recipe with starchy adjuncts. First, they can see if an extract version of the adjunct is available. Alternately, for small amounts of the adjunct, they can perform a partial mash. If the all-grain recipe calls for a large amount of an adjunct for which there is no extract equivalent, you may not be able to convert the recipe to an equivalent extract recipe. If you know something about the flavor of the adjunct, think about possible substitutions.

In light American lagers, 30 to 40 percent of the mash is either flaked corn or rice. These adjuncts don't have the enzymes to convert their starch to sugar on their own. So, they are mashed with grains, which have enough enzymes to convert their own starch plus starch from other sources. In order to have enough enzymes to mash starches, a good rule of thumb is to use an amount of pale malt in the mash equal to the amount of starches.

For an extract brewer to use a partial mash for a light American lager, his mash would have to provide 60 to 80 percent of the fermentables. In this case, why not just go all-grain? Fortunately, popular styles of beer with large amounts of adjuncts are often available as liquid malt extracts. For this example, light malt extract designed for American, Canadian or Australian light lagers would be a good substitute for a recipe that called for pale malt and corn or rice. See the later sections for how to calculate the appropriate amount to use.

To perform a partial mash, follow the same procedure as in the section on specialty grains. If the recipe has both a starchy adjunct and specialty grains, combine these ingredients in a single partial mash. For example, let's say you are brewing a stout with flaked oats (a starchy adjunct) and roasted barley (a specialty grain). Use the same amounts of oats and roasted barley as the scaled all-grain recipe calls for. Add an amount of crushed pale malt to equal the combined weight of the other two ingredients and perform your partial mash.

Step Five: Converting Base Malts

Pale Malt

Up to this point, the conversions from all-grain to extract have been simple. When converting the malt portion of the all-grain recipe, things get a bit more complicated.

So far, we've converted the specialty grains and adjunct portion of the all-grain recipe and made a partial mash with some pale malt. At this point, we will make a simplifying assumption. We'll assume that our extraction efficiency in the partial mash is equal to the original brewer's efficiency. Now, all we need to do is convert the remaining pale malt to malt extract and we're finished with the recipe conversion.

Is this a good assumption to make? Well, no and yes. It's not really likely that your extraction efficiency is going to be exactly the same as the original brewer's efficiency. But it's likely to be similar, so — considering that the partial mash is a small percent of the total fermentables — the difference in gravity is likely to be small.

Now, all we need to do is convert the remaining pale malt to an equivalent amount of malt extract. Unfortunately, there is no single conversion factor you can use to get the correct amount of malt extract, because pale malt yields a different amount of fermentables in the hands of different brewers. So first you have to calculate how much the all-grain brewer got from his malt; then you can convert his pale malt numbers to extract.

There are three steps to converting an amount of pale malt used in a recipe to an equivalent amount of malt extract. The first is calculating the extraction efficiency of the original brewer. The second is using the brewer's efficiency and the potential extract rating of the malt extract to come up with a conversion factor. The final step is to multiply those two numbers together. Extraction efficiency is calculated using the following equation:

Equation 1: EE =[SGP x V]/W

SGP is specific gravity points, the decimal portion of specific gravity. A wort with a specific gravity of 1.043 would have 43 specific gravity points per gallon. V is the volume of beer produced, in gallons. W is the weight, in pounds, of the grain. Extraction efficiency gives you the number of gravity points you obtained from each pound of grain. For simplicity, add the weights of all your grains and mashed adjuncts together for this calculation.

For an example of how to calculate an extraction efficiency, let's say you brewed a 5-gallon batch of pale ale using 7.5 lbs. of pale malt and 0.5 lb. of crystal malt and your original gravity turned out be 1.040. Your extraction efficiency would be:

EE = (40 x 5)/8.0 = 25 gravity points/lb. grain

As shown in Table 2 (*see page 38*), dried malt extract yields 45 gravity points per pound of grain. Liquid malt extract yields 38 gravity points per pound of grain.

A note on the extract-potential figures in Table 2: These are typical figures, taken from a variety of sources that all agreed within a few points. Actual extract potential per pound varies depending on how the manufacturer made the product (malt extracts contain different amounts of water). You can check to see if information is available for the specific malt extracts you use, but as the saying goes, these figures are definitely good enough for government work!

So, to calculate the amount of dried malt extract to substitute for pale malt, multiply the amount of pale malt times the original brewer's extraction efficiency divided by 45 (EE/45). To calculate the amount of liquid malt extract to substitute for pale malt, multiply the amount of pale malt times EE/38. For example, using numbers from the previous example, 8.0 lbs. of pale malt equals ((25/45) x 8.0 =) 4.4 lbs. dried malt extract or ((25/38) x 8.0 =) 5.3 lbs. of liquid malt extract.

If you want to skip the EE calculation, assume an extraction efficiency of 30. Unless the brewer gets exceedingly great or exceedingly poor extraction, you will be close.

If the all-grain recipe contains unmashed adjuncts, you will need to use the following formula: EE = SGP x V - [Wadjunct x EPadjunct] / (Wgrains). You can look up the extract potential of the adjunct (EPadjunct) in Table 2.

Wheat or Munich Malt

What if the recipe contains a substantial portion of Munich malt or wheat malt? If the recipe contains Munich malt, malt extracts made from 100% Munich are available. Simply convert the Munich malt to Munich malt extract as you would convert pale malt to pale malt extract.

If the recipe contains large amounts of wheat, you're not so lucky. Malt extracts for brewing wheat beers are made from mixtures of wheat malt and pale malt. If you know the percentage of wheat malt to pale malt in the extract, you can add a mix of wheat malt extract and pale malt extract to match the all-grain recipe's mix of wheat malt and pale malt.

There are four steps to doing this. First choose a malt extract that contains a higher percentage of wheat than the recipe. Second, calculate the total amount of wheat malt extract you need. Third, calculate how much wheat malt extract you need to add to get that amount of pure wheat malt extract. Finally, calculate how much pale malt extract needs to be added to establish the original balance.

Let's say the all-grain recipe calls for 5 pounds of wheat malt and 5 pounds of pale malt, a 50:50 mix. Let's also say that you find a wheat beer malt extract made from 70% wheat and 30% pale malt. You calculate that you need 4 pounds of wheat malt extract and a corresponding 4 pounds of pale malt extract. To get 4 pounds of wheat malt extract from the 70% mixture, you need 4/0.70 or 5.7 pounds of the wheat beer malt extract. This means you also have (5.7 x (.30) =) 1.7 pounds of pale malt extract along with the wheat malt extract. Subtract this 1.7 from the 4 pounds total you needed. You would need to add (4-1.7 =) 2.3 additional pounds of pale malt extract to end up with a 50:50 mixture of extract from wheat malt and pale malt.

Yeast

The extract beer from your converted recipe should taste very similar to the original beer if you follow the instructions as closely as possible. But the most important variable may be the yeast. Use the same yeast as specified in the all-grain recipe, pitch enough yeast (this means making a starter) and control your fermentation temperature. Two beers made from the same wort, but fermented under different conditions, can taste very different.

What About Extract to All-Grain?

You can convert most all-grain recipes—except those with large amounts of unusual starchy adjuncts—to an equivalent extract recipe. But can you do the reverse? In many cases, the answer is no. If the extract beer uses a malt extract made from a mix of grains, and the mix of grains isn't specified, you can't convert from extract to all-grain. For example, if an extract brewer used 5 lbs. of stout malt extract, you may have no idea what mix of grains were used to make the stout malt extract. (You could, however, use the hopping schedule the extract brewer used.)

If the extract brewer has formulated an "all-grain-like" recipe, a recipe where the fermentables are supplied by pale malt extract and the darker colors are supplied by steeping or partial-mashing specialty grains, you can convert the recipe to all-grain. Basically, you just "reverse" the equations in two steps. The other steps are the same. For example, you will end up using fewer hops than an extract brewer would use if he boils a concentrated wort. To calculate the correct amount to use, multiply the amount of hops used in the extract recipe by hop extraction rate for your all-grain wort gravity by the hop extraction rate for the concentrated wort gravity. To convert from malt extract to pale malt, you would multiply the amount of extract by either 45 divided by your extract efficiency for dried malt extract, or 38 divided by your extract efficiency for liquid malt extract.

Can You Really Clone a Beer?

Using these steps you should be able to calculate an extract equivalent recipe for almost any all-grain recipe. But, will the beer taste exactly the same? Well . . . no. An experiment published in *Brewing Techniques* showed that different breweries could not produce identical beers even when they used identical recipes, ingredients and procedures. However, your beer should be similar in taste. And after a few rounds of brewing your beer, it may be better than the original! ■

Chris Colby is a science editor and a contributing writer to BYO.

Mash Hopping

Bored of the routine? Put a little hop into your mash

by Chris Colby

Mash-hopping, adding hops to the mash, is considered by some brewers to be a replacement for dry hopping.

NEW IDEAS IN HOMEBREWING come from many sources. Sometimes a new homebrewing idea is actually an old brewing idea that has been discovered through historical research and revived. First-wort hopping is an example of this. Often a new homebrewing idea comes from the practices of commercial brewers. The current concern about hot-side aeration is an example of an idea that filtered down to homebrewing from commercial brewing. And sometimes, as seems to be the case with mash hopping, the idea comes from within the homebrewing community itself.

Mash hopping is yet another way to add hops to your beer. Adding hops during the boil has always been an option for homebrewers. Later came dry hopping, adding hops to your beer during the secondary fermentation. Lately, the idea of first-wort hopping — adding hops to your wort before bringing it to a boil — has been explored *(see "First-Wort Hopping," February BYO)*. Now, some homebrewers are even adding hops to their mash.

Similarities to First-Wort Hopping

In some ways, mash hopping is similar to first-wort hopping. For example, in mash hopping and first-wort hopping, the hops are added prior to the boil. In other ways, mash hopping is different from first-wort hopping. First-wort hopping is seen as a replacement or partial replacement for hops added in the boil. First-wort hopping contributes slightly more bitterness per amount of hops used than traditional hopping does.

Mash hopping, on the other hand, is seen as a replacement for dry hopping. Little or no bitterness is imparted to the beer, but the hop flavor and aroma of mash hopping are considered by some homebrewers to be highly desirable.

Mash hopping shares one other similarity with first-wort hopping — some homebrewers don't think it works. Discussions of mash hopping in various homebrewing chat rooms are fairly evenly split between people who believe in mash hopping and people who have tried it and claim that the hops added to their mashes couldn't be tasted. For example, one homebrewer, Mike Karnowski, reported to the *Home Brew Digest* that he added 6 ounces of Cascades pellet hops to his mash and they yielded no hop bitterness, flavor or aroma.

Even among mash hoppers, there are some differences of opinion as to what, exactly, mash hopping does. Some mash hoppers claim that it imparts an excellent hop flavor, but no aroma, while others say that hop aroma remains. The jury is still out.

The Variables that Affect Mash Hopping

That mash hopping yields little hop bitterness is not surprising. Hop bittering compounds need to be isomerized in the boil and the temperatures of the mash are not high enough to do this. The hops are left behind in the mash tun when the wort is recirculated and run off so they are never boiled.

What is surprising, is that flavor and perhaps aroma are carried over all the way from the mash to the finished beer. Most of us homebrewers were taught that late hop additions were needed to preserve hop flavor and aroma. If you added hops too early, these compounds would boil off. Through experimenting with mash hopping and first-wort hopping, however, many homebrewers are finding that this just isn't always true.

Some hop flavor and aroma remains even for early hop additions, including first-wort hopping and mash hopping. Paddock Wood Brewing Supplies, on their homepage (www.paddockwood.com), speculate that hop flavor and aroma compounds may somehow get bound more tightly to other wort compounds at typical mash pH's than at boil pH's. Why this binding process doesn't reverse itself during the boil when the pH drops is left unexplained.

Pellet hops are believed to work better than leaf hops for mash hopping. This makes sense because leaf hops need the agitation of the wort to break open their oil glands. The glands won't be broken open just sitting in the mash. In contrast, the oil glands in pellet hops are ruptured in the pelletization process. In the mash, the pellets are free to break apart, releasing the oils.

Thinner mashes bring out more hop flavor than thicker mashes. This is consistent with what we know about the solubility of hop compounds in wort. The thicker the wort, the less hop bitterness is extracted from hops added during the boil. A thicker mash should likewise extract fewer flavor and aroma compounds as well.

Mash hopping supposedly works better in soft water values than in hard water. This is partially consistent with brewing theory. Beers brewed in hard water are perceived as having a harsher bitterness than beer brewed in soft water. Proponents of mash hopping claim that hard water produces a better hop flavor. However, hard water supposedly also contributes to a perception of more hop bitterness. Critics of mash hopping who have brewed in hard water claim that they can't taste the hops. This is the opposite of what would be expected.

Noble hops supposedly work well for mash hopping, while American hops work poorly or not at all. It seems strange that some hops should work and others shouldn't. If one provided better flavor than the others, that could be understood. But that one type of hops simply wouldn't work at all is hard to understand. Obviously more research needs to be done.

Putting Mash Hopping to the Test

I decided to see for myself if mash hopping worked, and if so, how it stacked up to other hopping techniques. I performed a quick, "semi-scientific" experiment to test the differences between mash hopping, first-wort hopping, and traditional hopping (adding hops during the boil). In the experiment, I did not test every possible permutation of mash thickness, water hardness, or hop type. I used conditions that proponents of mash hopping claimed were most favorable to the technique. Since mine was the only palate in the experiment, this should be taken more as a test trial than any source of scientific proof of the effects of mash hopping.

I made four identical mashes with one pound of pale malt. The mashes were contained in four identical beer pitchers and incubated for one hour at 150° F in my oven. After mashing, I transferred each mash to a nylon mesh bag and placed the bag in a large kitchen strainer. I sparged with enough 170° F water to yield a wort with a specific gravity of about 1.048.

I added a mixture of noble hops to each of the treatments. The amount of hops was equivalent to 14 HBU (boiled for one hour) in a 5-gallon batch. For the mash hopping treatment, hops were added immediately after mashing-in. For the first wort hopping treatment, hops were added to the wort just prior to boiling.

I boiled all of the worts for one hour. I added the same mix of hops to the traditional hopping treatment at the beginning of the boil. The final wort was a negative control and I didn't add any hops. After boiling I cooled all the worts to room temperature.

I tested each treatment for hop bitterness and flavor by tasting each wort. Due to time considerations, I didn't make beer from the wort. (This ruled out expanding the experiment to include dry hopping.) Fermentation reduces the overall level of hop bitterness, but it should affect each of the treatments equally. For each treatment, I tried to assess the quality and the relative quantity of the hop flavor and bitterness. To compare the relative quantity of hop bitterness, I used unhopped wort to dilute the most bitter wort to the levels of the less bitter worts. The proportion of hopped wort to unhopped provided the basis to make the assessment (at least semi-) quantitative. The results of the hopping experiment are given above in Table 1.

Table 1.
Hop Bitterness and Flavor vs. Hopping Technique

Treatment	Hop Bitterness (relative ranking)	Hop Flavor (relative ranking)
Mash hopped	1	4
First-wort hopped	9	10
Boil hopped	10	10
Unhopped	0	0

The Results

My preliminary experiment suggests that mash hopping works as claimed, but be prepared to add a lot of hops to your mash tun. The mash-hopped wort had a small but noticeable amount of bitterness. There was somewhat more hop flavor and aroma present.

The bitterness of the first-wort hopped and traditionally-hopped worts was very similar, and much higher than the mash-hopped wort. In my experiment, the traditionally-hopped wort was the most bitter, but not by much. Since it didn't take long to heat these worts from mash temperature to boiling, it isn't surprising that the first-wort hopped and traditionally hopped treatments were so similar. The first-wort hops were only in their wort slightly longer than the hops from traditionally hopped treatment were. (Why the first-wort hopped wort was slightly less bitter is a mystery.)

The hop flavor and aroma from the first-wort hopped and traditionally-hopped worts was over twice as high as the mash-hopped wort. (See Table 1 for how these compared.) However, I thought the qualities of the hop flavor and aroma were a bit more refined and pleasing in the mash-hopped wort. This perception remained after I diluted the other worts with unhopped wort to equalize the amount of flavor and aroma among the treatments.

These preliminary results suggest that hop flavor and aroma are extracted in the mash and survive the boil. But to get normal levels of these in your beer, you'll need to add larger amounts of hops.Try replacing your usual amount of flavor hops with 2 to 2-1/2 times that amount of hops.

Mash hopping is a very new idea and there is no published research on the procedure at this time. All the available information about mash hopping comes from homebrewers exchanging information about their brewing experiences and experiments.

Like many new and mostly untested ideas, opinions about its merits vary wildly. Many proponents of mash hopping have an almost evangelical fervor about getting the word out about mash hoping. Others claim there is absolutely nothing to support the claims of mash hoppers.

You have a couple options if you are curious about mash hopping. The first option is to sit back and wait until more is known about the procedure. The second option is just to dive in and try it. The worse thing that can happen is you might end up with a too-sweet batch of beer. Given the hop-pleasant flavor from my experimental wort, I definitely plan to try mash hopping in my next batch of beer.

What Next?

By now, we homebrewers have just about exhausted our options of when to add hops to beer. We can add them to the mash, to the first wort, to boiling wort and in secondary fermentation. Some brewers even add hop cones directly to finished beer in their glasses, and there are others infuse their brewing and sparge water with hops. I suppose we could try malt hopping, adding hops to the barley as it is steeped, germinated and kilned. Or maybe farmer's-field hopping, sowing the ground of the barley field with hops. Who knows what the future holds? ■

Four $5 Filters

Cheap, easy-to-build filters for your kettle and racking cane

by Thom Cannell

EVERY TIME I MAKE BEER, I have trouble with sediment. If I'm boiling, I have to deal with the hot break and the hops. If I'm racking, it's the yeast. And many recipes say to "leave an inch of beer" when siphoning or racking to help maintain clarity. One inch in the brew kettle is more than two beers. An inch in my fermenter is almost 18 ounces. That's a lot of wasted beer!

To remedy this problem, I've been using a copper "Choreboy" as a filter. It's cheap and handy and easy to manipulate into odd shapes and small spaces. But it's hard to find pure copper sponges (the last batch of "copper" sponges I bought were copper-plated iron!) Stainless-steel sponges work nicely in the kettle but won't fit down the neck of a glass fermenter.

So I sat down and started sketching ideas for useful, easy-to-build filters. Here's what I came up with. Each of these designs works well and costs less than $5.

Kettle Filter One: The Simple Stainless Sponge

In the brew kettle, you'll have plenty of trub to filter: several ounces of hops, sometimes spices and even the occasional wayward grasshopper. (Hey, it happened to me; it could happen to you!)

Assuming you have a drain spigot at the bottom of your kettle, the easiest solution is a bent tube and a stainless sponge (see photo 1). If you have a siphon tube in your kettle, just bend it so the stainless sponge fits beneath the entry port and install it before anything else goes into the kettle.

This solution works, but it lacks elegance — and, as I mentioned, it assumes that you have a kettle with an attached ball valve. If you don't, no problem. In my first years of brewing, I simply plunged my racking tube through the middle of a copper sponge. It was attached with a twist of brass wire and worked fine for kettle racking as well as moving beer from the fermenter. I advise using stainless-steel sponges in the kettle and copper in the fermenter. Copper sponges will fit through the neck of a glass fermenter but stainless is way too big.

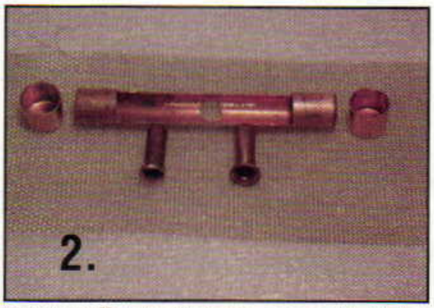
Kettle Filter Two: The Tube and Screen

My next idea involved using a bronze screen as the filter. I pierced a 1/2-inch by 6-inch pipe with a 3/8-inch drill bit. Instead of soldering the siphon tube into this hole, I chose to solder in 1 inch of 1/4-inch tube. In the photo (see photo 2), you'll see two small tubes: one slit and expanded, the other with a flared end (both designs work well). This produces a fitting that I can slip-fit into the siphon tube, solder in or even add another mechanical fitting to.

After soldering on two end caps for support, I cut out about 50 percent of the tube lengthwise with a Dremel tool cut-off wheel (see photo 3). The final step was wrapping a screen around the tube and soldering it (see photo 4).

Another option is to leave one or both end caps unsoldered (do solder the 1/4-inch connector) and just roll up a length of screen and insert it. This is much simpler and involves less clean-up.

If you have a spigot, an easy solution is a bent tube and a stainless sponge.



Two small tube designs: one split and expanded, and one with a flared end.

The author uses a Dremel tool cut-off wheel for cutting his tube lengthwise.

For the final step, wrap a screen around the tube and then solder it.

Woven stainless-steel sheathing was forced over this copper "T" connector.

The best solution to hold the sheathing is to use stainless-steel crimp clamps.

Kettle Filter Three: Stainless-Steel Sheathing

My next idea was to use some of the woven stainless-steel sheathing that covers my dishwasher hoses (and similar hoses for high-pressure installations). I cut the ends from a scrap of 3/8-inch sheathed water pipe and discarded the fittings and interior. Then I forced one woven end over a 1/2-inch copper "T" connector. Half-inch sheathing would have been a better fit, but I used what scrap I had (see photo 5). Then I clamped it with a bit of brass wire in preparation for soldering.

The next thing I did was the wrong thing. I soldered stainless to copper using ordinary non-toxic solder and flux. The easiest solution would have been to use brass or copper wire to hold the sheathing in place. All it requires is a mechanical fit, a bit of friction, and the ability to withstand 212° F. But the best way hold it in place appears to be stainless-steel crimp clamps (see photo 6). Next time around I'll buy Oetiker "ear" crimp clamps and the special tool for them. These are sold by Grainger (www.grainger.com), St. Patrick's of Texas (www.stpats.com), and other homebrew shops as well as industrial and automotive supply houses. St. Pat's has affordable prices and offers a comprehensive chart that tells what size clamp goes with what size tube.

To seal the open ends, I clamped the flexible tubing, cut and soldered the end. Now I had two new prototype kettle filters. Both designs are easy to sanitize in boiling water or the oven, both are rugged, both are inexpensive. Each filter cost less than $3 for parts and material (see photo 7).

The Racking-Tube Filter

My next idea was the racking tube filter, one designed to fit either a typical plastic cane or one made

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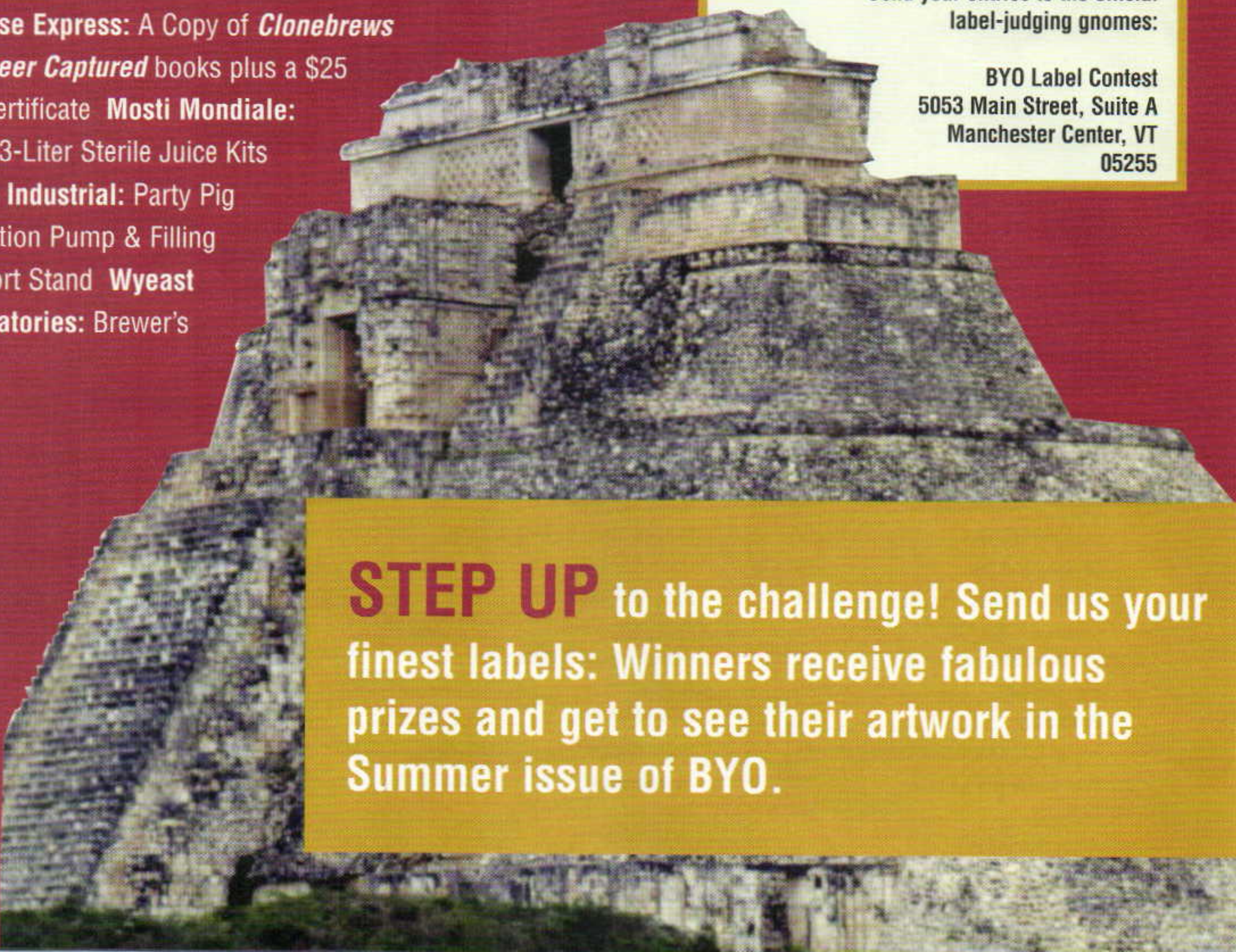

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Two prototype kettle filters, both easy to sanitize in boiling water or the oven.

The adapter is bored out to fit the racking cane. Note cane inside the screen.

from copper tube (*see "Five Easy Projects," September 2000*).

To get started, I needed a 1/4-inch to 1/2-inch adaptor at the top and a 1/2-inch end cap at the bottom, plus some bronze screen. When racking, it's nice to be able to put the inlet of the racking cane very near the bottom of the carboy to suck up all the liquid. If I attached the adaptor to the end of the cane, I would still be "leaving the last inch" of beer!

So I bored out the adaptor to a very tight friction fit for the racking cane (you can see the cane inside the screen in photo 8). Next I cut the end cap in half so I could position it more precisely. Then I simply rolled up some screen and slipped it inside the fittings. I did not solder it. To secure the screen, I'll use some food-grade high-temperature silicone sealant.

A length of woven stainless sheathing would do the trick, too. You wouldn't have to curl it into a tube — it already is a tube — or seal any seams. Just cut, anoint with silicon seal, and slip into the caps, pushing a bit to expand the metal weave.

The cost for each of these filters, not including the scrap stainless sheathing, was about $3. You should be able to make any of these projects for less than $5. A piece of stainless sheathed pipe costs about $10 and would make a kettle filter and a racking-cane filter. Crimp clamps are about 50 cents each.

If you use stainless for all the connections (which is necessary if you use acid cleaners), try www.movingbrews.com. For products made of woven sheathing, see www.zymico.com. Fermentap (www.fermentap.com) sells its own filtered siphon tube. ■

Thom Cannell is an automotive writer living in Lansing, Michigan.

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BREWER'S MARKETPLACE

Pit Crews and Homebrews

Uncovering the link between fast cars and bubbling carboys

by Mark Henry

PHOTO COURTESY OF MARK HENRY

A judge soberly examines one of forty entries in the Coopers and Le Mans homebrew contest.

A YEAR AGO, THE COOPERS Brewery decided to put some of the world's best automotive mechanics, engineers and drivers to the homebrewing test. Why? We all know that drinking and driving don't mix, but how about brewing and auto racing?

It all began over a few beers to toast the sponsorship deal between Coopers and the legendary Le Mans auto-racing series. At this meeting, Glenn Cooper and Don Panoz, the "driving" force behind the American Le Mans series, hit on the idea of a homebrewing competition between the racing teams. Homebrewers and auto enthusiasts are world-renowned tinkerers, but how would car racers fare with a carboy and a hydrometer?

The contest began at "Le Petite Le Mans" in Atlanta in September. All forty teams were presented with a Brewer's Best equipment kit, a Coopers Lager beer kit and a list of other possible ingredients. In four weeks, the results were to be judged at the Las Vegas Grand Prix.

The stakes were high, with the winning team getting free run of the Coopers Brewery located in Adelaide, Australia, after the Adelaide Le Mans race in January. The buzz at the Las Vegas Speedway was thicker than last year's Old Woolly. Besides earning the privilege of abusing the Cooper family's hospitality, this had become a contest with national-honor implications. Most of the teams hail from Germany, Italy, France and Canada, all countries with proud beer traditions.

The panel of judges included head brewers of local brewpubs and myself. On "judgment day" the panel was seated, the spectators hushed and the beers presented. Wow! These guys really were serious. Each label was worthy of the "BYO Label Contest" hall of fame. I don't think they put this much effort into the painting and decaling of their cars.

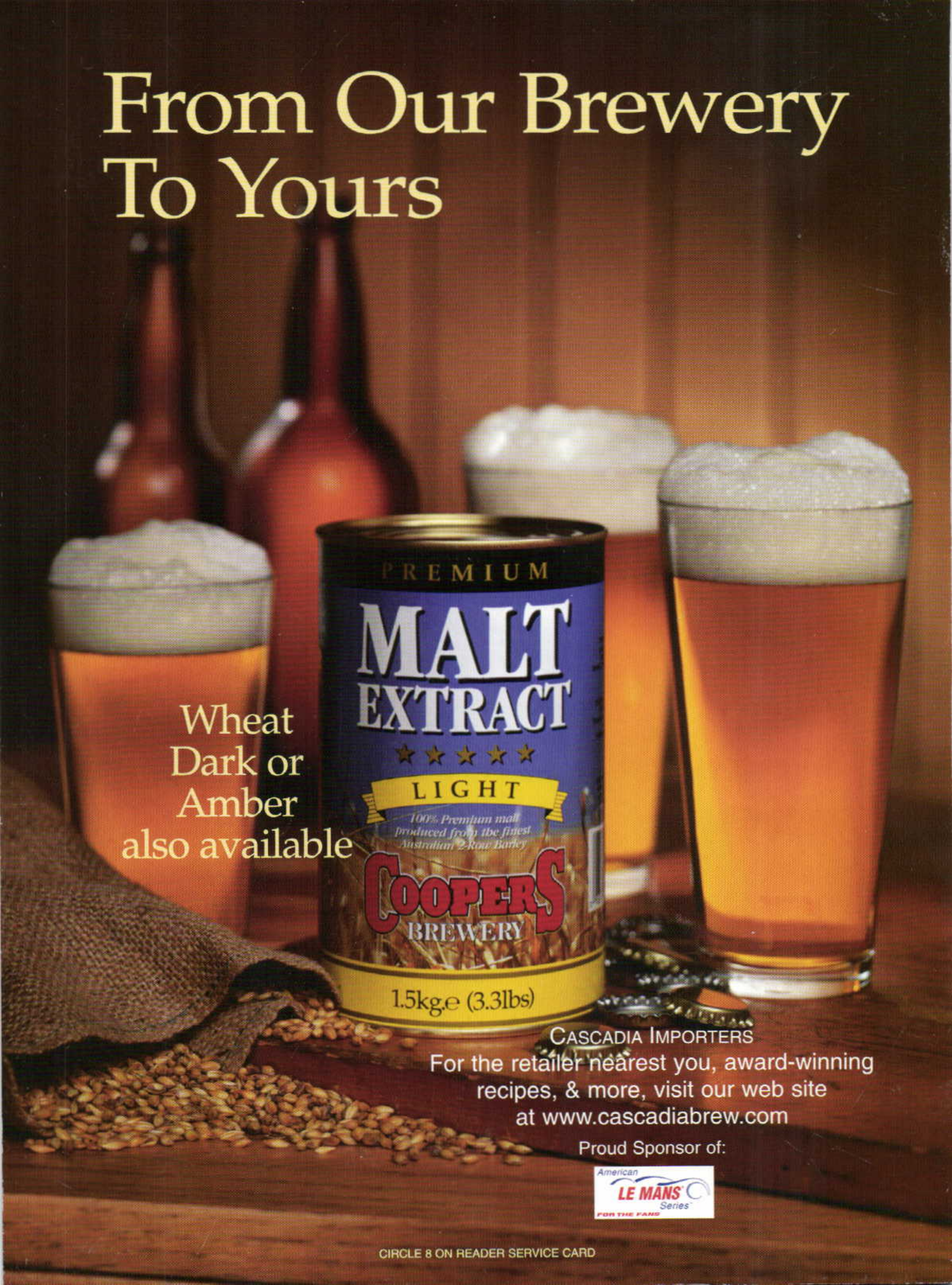
The first beer was presented by the Kyser Racing team, based in Canada. A worthy effort, fairly clean, definitely the product of a "well-oiled" production team. The next beer was one of two beers produced by the U.S. BMW Performance Team. This entry had an excellent body and a hoppy Cascade finish. Beer number three was a product of the BMW Prototype Team, based in Germany. "Hmmmm," said Tim Etter, head brewer at Tenaya Creek Brewery after tasting the beer, "I didn't know you could make a Warsteiner pilsner clone with a Coopers Lager beer kit." I didn't either. The judges smelled a rat.

After intense grilling of Jorge Mueller, a driver for the BMW team, we discovered that they had sent the kits back to Germany to some friends at a local brewery. In all likelihood, they put the bottles on the assembly line and filled them up, all the while thinking that we "American Budswillers" wouldn't be able to tell the difference. They were disqualified, but we did let Jorge know we thought his local brewery made a fine pilsner.

In the end, the "Best of Show" went to the U.S. BMW Performance Team's "Check the Splitter Bitter." The "splitter" is the aerodynamic swoop on the front corners that are often damaged when a driver takes a turn a bit too tightly. It turns out that the lead mechanic on the team is an accomplished (American) homebrewer. The secret was to add some Coopers light malt extract with a bit of Cascade hops.

In the end, a great time was had by all, and everyone is excited about doing it again next year. Many came away surprised at the quality of the beers that can be made at home. Jorge even took a sample kit home with him to make an honest attempt to brew his own beer. Another homebrewer is born. ■

Mark Henry lives in California and drives a mini-van. He's a partner in Cascadia Importers, North American importer for Coopers.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