Beer Brewing 101 – Fun with Sugar, Hops, and Yeast

By: Oliver Gray

I fell into my homebrewing hobby as a side effect of growing up in a household that consumed and appreciated a lot of alcohol. My dad used to make what I can only call odd wine: carrot, rhubarb, banana, and other things you won’t find at the local liquor store. Our basement was a menagerie of white buckets, glass carboys, empty green wine bottles, and a utility sink over flowing with sodium metabisulfite and thick bristled white brushes.

I learned how to brew the same way a kid learns how to use a Q-tip; through a lot of painful trial-and-error. One of my first batches ended up at about 2% alcohol because I added four gallons of water to a single gallon of actual brew. An early batch of English style pale ale had the delicious added flavor of rotten-eggs sulfur because I did the entire main boil with the lid on the pot. I never made anything undrinkable, but I certainly made a lot of beer only its brewer could love.

So you want follow in the footsteps of Jim Koch, Ken Grossman, and Sam Calagione and make some beer? It’s a very noble pursuit, but one that requires significantly more patience than skill. Before we dive into the pool of bubbly knowledge, it’s important to know a little bit about the process, and how everything works the way it does.

What is homebrewing?

Without sounding dense, homebrewing is brewing that is done at home, without commercial equipment. It usually means brewing on a significantly smaller scale (5-10 gallons as opposed to say, 7,000,000 gallons) with significantly less control and consistency in the final product. It encompasses beer, wine, cider, and any sub-genre therein, but does not include distillation, as that is illegal and should be left to those few (with even fewer teeth) in the Appalachian foothills.

Fritz Maytag, former owner of Anchor Brewing Company, may have come up with the most accurate way to describe the process of brewing beer when he said, “We brewers don’t make beer, we just get all the ingredients together and the beer makes itself.”

Brewing is the foreplay that leads to fermentation (or the process of yeast digesting sugars to create alcohol and CO2); a process as natural as seed germination, plant pollination, and fruit maturation. Yeast has been finding its way into sugary waters and creating primal beers and wine for nearly all of man’s recorded history (and we have to assume before that, too).

Despite popular belief, homebrewing is pretty safe. There are some minor threats that come from over-filling or over-sugaring, but for the most part, it’s a less-than-dangerous hobby. A few years ago, in a poor attempt at humor, Buffalo Wild Wings lampooned home brewers with a less than flattering commercial. The truth is that most homebrew, even the poorly sanitized or drunk-too-early, isn’t going to send you to the ER with GI issues.
And if you don’t believe me, believe science! Yeast eats sugar and poops out carbon dioxide and alcohol, which has the added bonus of sterilizing the liquid. Alcohol disrupts the natural equilibrium of water outside of any bacteria cells, killing them as osmosis forcefully pushes water out of the cells to reestablish the balance. Thermodynamics are awesome. The only obvious health concern is mold, which aside from being visible and gross, usually makes the beer so foul tasting that not even the most self-destructive frat boy could stomach enough to make him sick.

**What is beer?**

Beer is fermented barley water with hops added as flavoring and preservative. Sounds appetizing, huh?

Beer as we know it was first defined by the German Purity Laws, or Reinheitsgebot, in 1487. These laws mandated that a traditional beer should only contain the following:

- Water
- Barley
- Hops
- Yeast (added in the 19th century when our boy Louis Pasteur discovered yeast)

Obviously, there are many other things that can be added to beer, all of which are called “adjuncts.” These can range from whole fruit (like cherries in a Belgian lambic or kriek) to corn and rice (in many American lagers, like Miller and Bud Light).

While there are hundreds of styles of beer, there are only two types of beer: lager and ale. Some styles you might recognize fall under the ale umbrella (stout, porter, IPA), which lagers are home to a subset you might not recognize as readily (bock, dunkel, pilsner). The main difference between the two types is the yeast used. Ale yeast ferments on “top” of beer at warmer temperatures, while lager yeast ferments on the “bottom” of beer at colder temperatures. Ale is typically served as soon as fermentation process is finished, while lager (which means “to store”) is traditionally left to sit for ~6 weeks to mature and clarify.

As a general rule, ales tend to be heavier, meatier, with more robust flavors, and lagers tend to be lighter, crisper, and more refreshing.

**How does brewing work?**

Like Fritz noted earlier, brewing isn’t about creating something from constituent parts (like cooking), it’s more like creating the perfect environment for a natural process to occur. I’d suggest it’s a lot like pregnancy, but I think that might creep people out.
To brew a beer you have to create sugar water (more technically known as wort) raise it up to a temperature that will kill any living bacteria, add hops, cool it back down to room temperature, add yeast, and then wait for a while.

Figure 1 shows an overview of the very basic brewing process, as it happens in a commercial brewery:

Homebrewing uses the exact same principles, just scaled down to much smaller volumes. Most new brewers use malt extract instead of using all-grain to create their wort, partly because it’s easier, partly because it’s less technical.

What do you mean you don’t understand these words?

Veteran homebrewers like to throw around a lot of jargon and hardly ever qualify any of it. It’s like they expect us to figure these things out, as if there were some kind of widely available, magical book that contained definitions of things.

This is list of the things I had to discover on my own, but it is not nearly exhaustive:

- **Wort (beer)** – a mixture of grain sugars and waters that will be fermented into beer
- **Must (wine)** – the same as wort, but with different sugars, including fruit pulp
- **Yeast** – eukaryotic microorganisms that are obsessed with eating sugar and produce alcohol as a byproduct
- **Sugar** – alcohol is formed in beer and wine based on the amount of added sugars, which are introduced to the brew via fruit, grain, honey, or other sources
- **Krausen** – the layer of brown foam made as the yeast ferments
- **Sparge (beer)** – the process of removing sugars from cracked grain using very hot water to create wort
- **Fermentation** – the process of yeast converting sugars into alcohol
- **Primary fermentation** – the initial conversion of the sugar into alcohol after yeast is first introduced to the worst/must
- **Secondary fermentation** – the secondary conversion that removes extra sediment and allows time for the brew to settle/clear/mellow
- **Priming** – adding extra sugar after secondary fermentation to promote carbonation in bottles/kegs/growlers (only applicable if you want to carbonate your beverage)
What will you need?

Before I get into the actual equipment that is necessary, I’m going to point out a few things you should have that often get overlooked by newer brewers:

- Experience drinking what it is you’re brewing (know, at least roughly, why you like certain styles and what they’re made of)
- Basic cooking skills (if you can’t boil water without scalding yourself or manage temperatures on the fly, you’re going to struggle to brew anything)
- Upper body strength (seriously, a gallon of liquid weighs about eight pounds, so a five gallon batch will weigh 40+)
- Patience, commitment, and persistence (a full brew can take most of a day, and can’t really be hurried)

As for the gear (you can buy all of this stuff online, but be a good member of the community and pick it up at a local homebrew store, if reasonable):

- A stove (like the one you usually make pancakes on) or a stand boiler
- A sink (like the one you usually leave dirty dishes in)
- Towels (and not your wife’s good towels; don’t even look at them)
- Your ingredients (this is going to vary wildly per type of brew and recipe, think of it as the “food” part of your recipe)

- 1 x brew boil pot w/lid (large aluminum or stainless steel, 5.5 gallons at minimum for five gallon batches)
- 1 x plastic brew pail (these are the infamous “white buckets” used for primary fermentation – 5.5-6 gallon)
- 1 x lid for your brew pail (if you seal it, they will brew)
- 1 x air lock w/rubber bung (there are several styles of air locks, but any will work)
- 1 x glass carboy (this is for your secondary; the brew will sit and clarify in this)
- 1 x big metal spoon (for all the stirrin’ you’s gonna be doin’)
- 1 x container of a no-rinse sanitizer (never use soap, try not to use bleach)
- 1 x large thermometer (or just get an infrared temperature gun already)
- 1 x auto-siphon (this will save you a ton of headaches and sticky spill spots on your kitchen floor)
- 6 x gallons of water (distilled, spring, anything clear and tasty)

You’ll also need bottles, growlers, or a keg for your finished brew, but that’s up to you (as I won’t be including bottling in this overview).
The Process:

1. Find the recipe of the beer you want to brew
2. Buy all the necessary ingredients
3. Clean everything thoroughly
4. Ensure you have enough water to finish your brew
   a. While you can add water after the boil to make up lost volume, this can introduce bacteria and other contaminants and waters down your wort, so it’s recommended you brew with the total volume you plan to ferment
5. Double, then triple check you have everything you need, because you can’t stop once you’ve started.
6. Bring your water up to boil with the lid off (otherwise, the DMS compounds will absorb into the beer and taste bad)
7. Add malt extract and any specialty grains
8. Boil for ~60 minutes (or whatever the recipe calls for)
9. Add hops to the boil as per the recipe
10. Add clarifying agent (irish moss or whirlfloc)
11. Cool wort down to ~75-80 degrees (the faster you get it cool, the better)
12. Stir the wort like crazy
13. Pitch yeast
14. Seal bucket and fill airlock with clean water/vodka
15. Wait one week
16. Rack the beer from the primary vessel to the secondary vessel
17. Wait one more week
18. Add priming sugar, fill bottles
19. Let bottles sit minimum of 4 days, maximum of 3 months
20. Drink!
21. Enjoy!
22. High five someone near you!
23. Cheers!

Tips and Tricks:

A. Before brewing
   1. Clean! Sanitize!

   One of the keys to successful brewing is cleanliness. Yeast is a very tough eukaryote once it’s established in a beer, but while it’s growing it can be interrupted or even killed by other, competing microorganisms. All items that come in contact with the beer should be cleaned and sterilized using a food-grade cleaner before coming into contact with wort or pre-fermentation beer. It’s important all buckets, kettles, bottles, and other vessels be so clean you’d be willing to lick them. For real.
Off-flavors in beer are often the result of poor sterilization – some beers can taste buttery or astringent or sour which means the yeast either didn’t finish fermentation, or was impeded by some other bacteria. It can be handy to keep a spray bottle full of sanitizer liquid for any last minute/emergency cleaning jobs

2. Prepare your Recipe

Much like cooking, knowing what you’re going to brew, and how you’re going to brew it is very important to a good finished product. If you just decide to throw whatever in your kettle and hope it works out, don’t be shocked if the beer tastes like an old barnyard. There are many factors that go into a recipe, but ask yourself these basic questions

- What style do I want to brew?
- What kind of malt/extract do I need?
- What kind of hops do I want to use?
- What kind of yeast do I need?
- Do I have free time ~2 weeks from now to bottle thing batch?

There are dozens of great websites with full recipes, but Beersmithrecipes.com is by far my favorite.

3. Off-gas your water

Water is 90%+ of your beer, so you want to make sure you’re using the best quality water possible. You can use spring water (never used distilled water, as the minerals naturally in water are integral to the brewing process), but that tends to get expensive, quickly. Most municipal water is perfectly fine if you fill your buckets the night before and let any chlorine or other gas evaporate before using it for brewing. It’s as easy as filling up buckets and leaving them outside for a few hours.

B. During brewing

1. Pay attention

It’s easy to wander off during the boil, since it’s not exactly thrilling to stare at boiling brown water for an hour. But boiling wort can overflow, spill, the fire on your boiler can go out, and you want to be there just in case. I usually read or do some nearby gardening during the boil, never straying too far from the kettle until the boil is done.

2. Take your time

The whole process can seem overwhelming at first, and many people scramble and rush to make sure everything is done perfectly. Brewing on a commercial scale requires close monitoring to maintain consistency, but homebrewing is much more forgiving. If your
boil goes under or over by a few minutes; no big deal. If you spill or accidentally dip an unsanitized spoon into something, it’s not the end of the world. The process is supposed to be fun and exciting, so sit back, enjoy yourself.

As Charlie Papazian, author of *The Joy of Homebrewing* says, “Relax, don't worry, have a homebrew.”

C. After Brewing

1. Don’t open the buckets!

It can be very tempting to open up your buckets and take a look at the yeast going to town on all that wort, but I strongly recommend against it. Opening the buckets during primary fermentation can stall the yeast, and introduce unwanted oxygen/bacteria. You’ll have plenty of time to admire the beer when it’s done, so leave it alone for now.

The only time you might need to open the buckets is if there is little or no airlock action (a sign of a stuck fermentation). If you do open them, make sure to sterilize the lid/rims of the bucket thoroughly, just in case.

2. Store the beer in a dark, cool place

Temperature fluctuations and direct sunlight can both mess with fermentation and create weird off-flavors in your beer. It’s best to keep the beer in an area with a stable temperature (not next to a furnace or AC unit/vent), that gets very little direct sunlight. It doesn’t need to be pitch black, just no direct beams, if possible. This will let the beer ferment quickly and efficiently, giving it the best chance for a full and clean fermentation.