

## 8 Brewing TCP/IPA; or, A Useful Skill for the Zombie Apocalypse

by Ron Fabela of Binary Brew Works

Hacking is a broad term that has too many negative and positive connotations to list. But whichever connotations you prefer, it is a skillset, and a skill is all about things or services that can be exchanged for currency or bartered for goods. While this fine journal excels in sharing scattered bits of useful hacking knowledge, the vast majority of publications repeat ad nauseam the same drivel of the cyber world. But when the zombies come—and they will come!—what good are your SQL injections for survival? How will you exchange malware for fresh vegetables and clean drinking water? What practical skills do you have that can enable your survival?

What hacking shares with making is their common ground of curiosity, skill, and patience—and these intersect on a product that is universally recognized, suitable for barter, and damn tasty. Of course, beer as we know it today differs from the ancient times, where it was a part of the daily diet of Egyptian Pharaohs and Greek Philosophers through the ages. Today's beer and its varieties have acquired a broader tradition, each with a unique background and tastes. But in that variety there is a center, one that pulls together people from all races, cultures, and economic statuses. Modern day philosophers and preachers discuss the world's challenges over beer. Business deals and other relationships are solidified at the bar, by liquid camaraderie!

Why do I blivate on all of this? Because there comes a time in every hacker's life when you wish for more, when you wish to create something of intrinsic value rather than endlessly find faults in the works of others. For me, that was turning grain, water, hops, and yeast into something greater than the sum of its parts. It's an avenue to share, to serve others, to create.

(It's also something to trade for milk and bread when the zombies come!)

### 8.1 Ingredients

Beer, like most things in life, can be as simple or as complex as the reader wishes it to be. But at its core, this beverage started with four primary ingredients, each just as important as the next: grain, water, hops, and yeast.

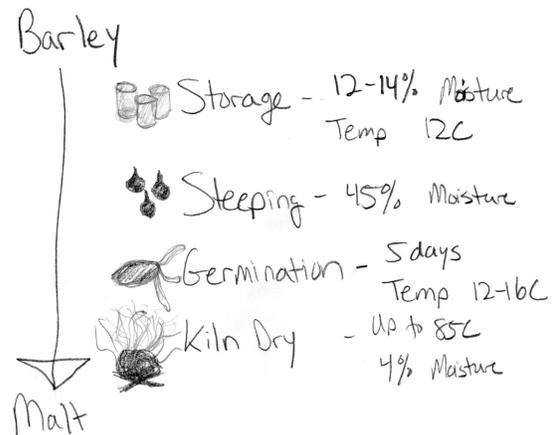


Fig 1: Malting Process

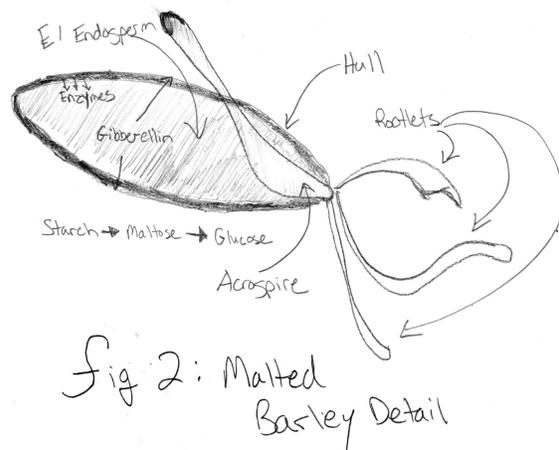


Fig 2: Malted Barley Detail

**Grain** Or even more generally, any cereal where its grain can be cultivated and finally sugars can be extracted. But more than just simple grain, grain that has undergone the malting process. Grains are made to germinate by soaking in water, and are then halted from germinating further by drying with hot air, as shown in Figure 1. By malting grains, the enzymes are developed that are required for modifying the grains starches into sugars. This is important to know, as not just any grain will do for the beer brewing process. These sugars extracted from the

malted grains will eventually be turned to alcohol during fermentation, as in Figure 2.

**Water** Arguably the most critical component, water makes up 95% of the final product and can contribute as much to the taste and feel of the brew as do the grains, hops, and yeast. Books have been written and rewritten on the subject of brewing water and will not be rehashed here. The key water properties are: clean, chlorine free, and plentiful.

**Hops** Starting in the 9th century, brewers began using hops in place of bittering herbs and flowers as a way to flavor and stabilize their brew. Hops are the female flowers of the hop plant with training vines that set forth like ivy or grapes. The hop cone itself is made of multiple components, but most important to brewing are the resins that are composed of alpha and beta acids. Alpha acids in particular are critical due to their mild antibiotic/bacteriostatic effect that favors the exclusive activity of brewing yeast over microbial nasties swimming about. See Figure 3.

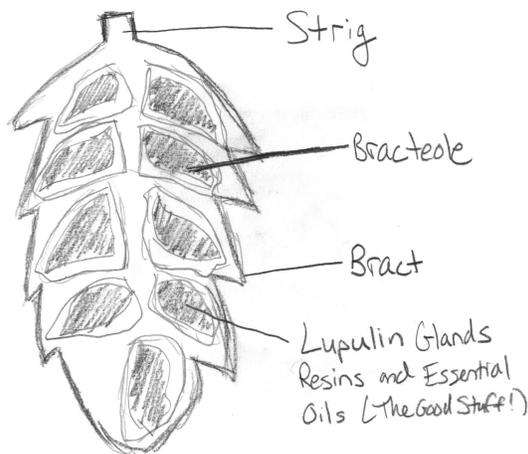


Fig 3: Hop Cross-Section

Beta acids contribute to the beer's aroma and overall flavor. These acids are extracting during the brewing process via boiling, which will be expanded upon in the following sections.

<sup>20</sup>git clone <https://github.com/BinaryBrewWorks/Beer/>  
unzip pocorgtfo09.pdf beer.zip

**Yeast** Single-celled organisms with an amazing ability to convert carbohydrates (sugars) into CO<sub>2</sub> and alcohol, yeast is the literal lifeblood of beer, as fermentation changes sugary and otherwise boring sugar water (wort, or young beer) into glorious brew.

For brewing there are 2 main types of yeasts: “top-cropping” where the yeast forms a foam at the top of the wort during fermentation and is more commonly known as “ale yeast” and “bottom-cropping” where the yeasts ferment at lower temperatures and settle at the bottom of the vessel during fermentation, commonly known as “lager yeast.”

Yeast can be cultivated from the wild or known/safe sources. Yeast can even be collected and nurtured from bottle-conditioned brews (Belgian varieties in particular).

## 8.2 Brewing Process

The brewing process is often 15 minutes of frantic activity followed by 60 minutes of drinking, cleaning, or otherwise conversing with your neighbor. Simplistically, the steps are: extract fermentable sugars from the malted grains with hot water (mashing); boil and reduce the fermentable sugar water (wort) while adding hops at specific timing intervals; reduce the wort to a safe temperature and move to a fermentation vessel; pitch yeast and store at a consistent temperature, allowing the fermentation process to occur; pack and condition the beer for future consumption and enjoyment.

There is much science and wizardry that takes place in these five steps. I would like to take you through this process with one of our own recipes at Binary Brew Works. These days you can't have a brewery without an India Pale Ale (IPA), a beer that at its origin was heavily hopped to make the journey by ship from England to India. This heavy-handed hop addition creates a highly bitter, but hopefully aromatic and balanced brew that is popular today.

**Gathering the Ingredients** For our IPA, appropriately named TCP/IPa, the following ingredients are used and scaled for a 30 gallon (114 liter) batch. Scaling at this volume is 1:1; so halving the numbers for a 15 gallon (57 liter) batch will yield similar results.<sup>20</sup>

TCP/IPa		
FERMENTABLES:		
2Row		70 lbs
Caramel Malt 60L		6 lbs
Flaked Wheat		6 lbs
HOPS:		
Cascade	8 oz	@ 60 mins
Citra	16 oz	@ 15 mins
Yeast:		
Wyeast 1056		

**Preparing the Mash Water** In a brewing kettle of your choosing, bring the appropriate amount of water to what is known as strike temperature. The volume of water needed depends on other parameters such as grain absorption rates, equipment losses, and evaporation. As such, using a brewing water calculator is recommended. For this recipe, approximately 45 gallons (170 liters) of strike water is needed to get the desired 30 gallons (114 liters) of finished product. Your striking temperature is typically 10–15°F (5–7°C) higher than your target mash temperature. (In this case, 170°F (77°C) for a target 160°F (71°C).)

**Mashing** In a separate vessel called a mash tun, the prepared grains are waiting for inclusion of the strike water. The mash tun is often a modified cooler or other insulated vessel that can contain the volume of both the grain and the striking water. In single infusion mashing, water is added to the grains, stirred, and typically left to sit for 60 minutes to allow for the extraction of fermentable sugars. 15 minutes of frantic moving of water, stirring, and cleaning is then followed by 60 minutes of drinking your last batch of beer.

**Boiling** Once the mashing is complete, the sugar water or “wort” has to be extracted and placed into the boiling kittingling (oftentimes the same kettle used to heat the strike water). This can be accomplished in a number of ways, mostly through the use of mesh false bottoms or other straining mechanisms to prevent, as much as possible, solid grain matter from entering the boiling kettle.

Once extracted, the wort is brought to a boil and held there for 60–90 minutes. The addition of hops through the boiling process adds to the bitterness and flavor of the beer, so it is critical to follow hop addition timings as this has a huge effect on the final product. For TCP/IPa, two hop additions are used. Cascade hops are widely used in the industry and therefore readily available to the brewer. Cascade hops provide the bittering required for an IPA while imparting the characteristic spicy and citrus flavor expected for the style. Citra hops are added towards the end of the boil to add the strong citrus and tropical tones of flavor and aroma. Remember, the earlier the hop addition, the more bittering oils are extracted from the hop. Later additions provide more flavor and aroma without adding bitterness.

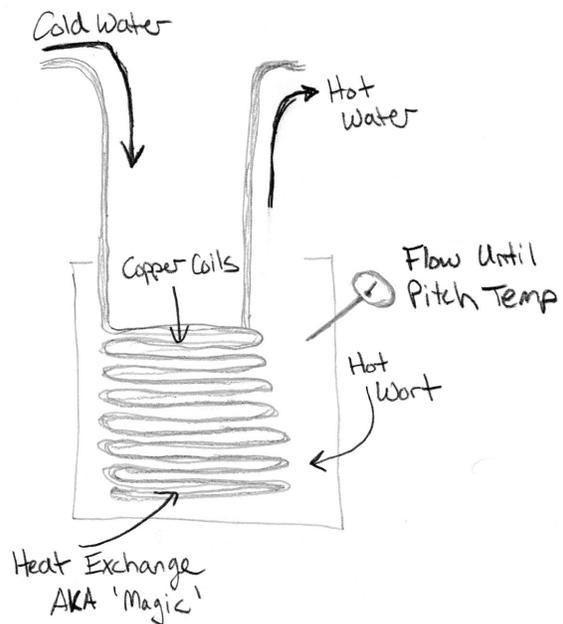


Fig 4: Wort Chilling

**Cooling** You now have a boiling pot of wort that must be cooled down to pitching temperature as quickly as possible. This is the most critical stage of the process! At 212°F (100°C), all types of nasties that can ruin your beer are boiled away. But as the wort is cooled, there is an increased risk of bacteria or other infections. Cleanliness of the brewery and its equipment is key from this point forward.

Cooling can be accomplished by a number of heat transfer methods. At smaller volumes, coiled

copper tubes shown in Figure 4 are submerged into the boiling wort to sanitize, and the cold water is passed through, cooling the wort to the target temperature. At larger volumes, heat transfer equipment gets bigger and beefier, but serves the same purpose. Most ale yeast pitches at a temperature between 70 and 75 degrees Fahrenheit (22°C).

**Fermentation** Yeast are beautiful little creatures. Through a metabolic process, yeast convert sugars into gas (CO<sub>2</sub>) and alcohol. This process must take place in a sanitary vessel where no interference from other microbes can ruin our wort. Temperature control of the vessel and the surrounding room is critical to the overall taste and feel of the final product. Some styles, such as the saison, are purposefully fermented at the highest temperatures (80–85°F, 27–29°F) allowed by the yeast. Fermentation at this temperature produces a “spicy” profile.

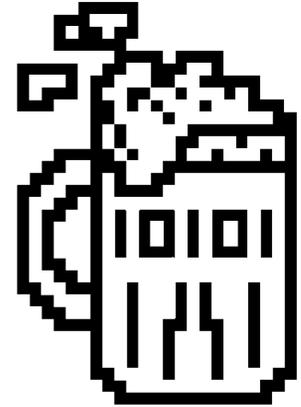
For lagers, yeast ferment at lower temperatures common to basements and cellars and produce a funky flavor. Not my preference, but fun nonetheless if you have the equipment or climate to ferment at this temperature.

And like magic, our sugary wort is churned, eaten, and converted into glorious beer.

**Packaging** Once the fermentation process is nearly complete, the beer can be stored and chilled. Carbonation comes next, with various methods available to the home brewer. Bottle conditioning is the process of introducing a priming sugar back into the wort just prior to bottling. Take careful

notes and measurements at this point, as too much sugar can create explosive “bottle bombs.”

Investing in a used kegging system can help tremendously. Not only does this simplify cleaning, it also allows the brewer to force carbonate the keg. Attaching a CO<sub>2</sub> tank and selecting the appropriate PSI level can quickly and more evenly carbonate your brew to the target levels. Plus there’s nothing like having fresh, cold beer on tap.



Creating a final product from raw ingredients is a very fulfilling process. The basic process of extracting sugars from grain, adding hops, fermentation, and drinking is just the surface of a complex, diverse, and creative industry. For the homebrewer, not only serves as a way to make and enjoy beer, but also as a social tradition where drinks and conversations are had over a boiling pot of wort. Go forth, become a brewer, and enjoy the miracle of your own beer!

