Home Brewing

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Equipment
For our first brew, we will consider the brewing of a 5L batch. Check at home what you already have, and then go shopping for the remaining materials. You can easily find these materials in a local or online brewing store.

- Cleaner (e.g. soap, sodium percarbonate, sodium hydroxide or others).
- Sanitizer (e.g. iodophor, Star San, SaniClean, bleach or others).
- Pot with a maximum capacity of 6L or more (filled to the top).
- One or more pots with a combined capacity of minimally 5L.
- Big spoon (or something else to steer with) and a perforated spoon.
- Thermometer (glass or digital, range up to minimally 80 °C).
- Timer (your mobile phone will do).
- Kitchen Sieve (fine holes).
- Cooling elements or ice (cubes) in the freezer.
- One or more fermentation vessels (e.g. ton, flask or similar) of a combined capacity of 5L or more (consider that there should be enough headspace, but also not too much).
- One or more air locks (depended on the number of fermentation vessels used).
- Something to connect a fermentation vessel and an airlock, e.g. a bored rubber bung, rubber cap or similar (depended on type of vessel used).
- Something to transfer the beer with, e.g. a syphon, funnel and/or measuring cups. A tap at the bottom of your fermentation ton will also do.
- Bottles. Choose either:
  - flip-top bottles (no extra materials needed) or,
  - crown cap bottles, with accompanying crown caps and sealer.
For your first brew you could use some bottles that you have lying around. Keep in mind that some bottles remain property of the brewery, in which case we cannot recommend you use those.

Note, that the type of materials is different for the amount of beer you want to brew: more beer means bigger materials. With above materials, the volume of your biggest pot is the limiting factor. If you have a pot lying around that can hold maximum of 11L, you could easily double the recipe if you wish (brewing 10L instead of 5L). Mind that the fermentation vessel also needs to be bigger.
In your first brew, it is nice to keep it simple. Online (section 1.5.4) you find a few simple recipes containing only one type of grain and one type of hop (also known as SMaSH).

Specify your recipe below.

Recipe: 

Malt: _____ kilogram

Strike water Temperature: ~ _____ °C

Mashing scheme:
_____ °C for _____ minutes
_____ °C for _____ minutes

Hops: _____ gram

Boiling time: _____ minutes

Hop scheme:
_____ grams in the beginning
_____ grams in the last _____ minutes
_____ grams in the last _____ minutes

Yeast: ____________________________________________

Attribution to multimedia used:
Grain by Laymik from the Noun Project
Hops by David Lamm from the Noun Project
Yeast by Christopher T. Howlett from the Noun Project
Use the App!
During this Fun Assignment, you will use the “WageningenX Online Courses App” to share your experiences with fellow learners! The assignment is to upload a picture of every processing step. Besides, some questions are included which allow you to specify your brewing results. More information is given online in section 1.5.5.

Process Overview

**Timeline**

**Processing Steps**

1. **Milling**
   - Milled malts
   - Water

2. **Lautering**
   - Water
   - Sieve
   - Perforated spoon

3. **Boiling**
   - Hops
   - Pot
   - Timer
   - Hop scheme

4. **Cooling**
   - Cold water
   - Sink
   - Cooling elements/Ice
   - Warmer water

5. **Transferring and Separating**
   - Transferring and Separating
   - Fermentation ton, Filler, (Sieve)
   - Hop residues

6. **Fermenting (2 weeks)**
   - Yeast
   - Fermentation ton, Air lock

7. **Transferring and Mixing**
   - Sugar water
   - Pot, (Syphon)
   - Trub

8. **Bottling**
   - Bottles
   - Caps
   - Filler, (Sealer)

9. **Maturing (3+ weeks)**
   - Home brewed beer

*High risk zone: Sanitize well!*
**Part 1 - Brewing**

So, do you have all ingredients and materials ready? Then we can start! The procedure assumes you use the recipe for 5 L, so adjust the values if you brew a larger amount.

*Share Your Experiences*

Don’t forget to do the assignments in the app! Make sure to take notes and pictures during the brewing. Notes will enable you to exactly remake a successful beer.

**Step 1 - Preparation**

The secret behind brewing your own great beer is **hygiene**. As you saw in the quality chapter all kind of bad microbes will grow in your beer if you don’t have it. This will cause off-flavours, different mouthfeel and altered visual appearance, eventually making your beer undrinkable. But worst of all, the beer can even make you sick if some really nasty microbes enter your beer.

To prevent these undesired effects, you need to **sanitize your equipment and working space** well. Especially the equipment after the boiling step. This is your high-risk zone! If your beer gets infected after this step, you will definitely taste it. So: everything that touches the wort needs to be sanitized. For this, of course we need a sanitizer. Follow the instructions on the package and when indicated, do not forget to rinse your equipment thoroughly: the last thing you want is to have toxic sanitizer ending up in your beer.

It is important to realize that good sanitizing takes two steps: cleaning and disinfecting. During the cleaning, you use for example the same cleaner that you use for dish washing. During the disinfecting, you use the sanitizer. If you do not clean well, the dirt residues can potentially alter the working mechanism of the sanitizer or provide a safe shelter for nasty microbes… So remember to **first clean, then disinfect**.

After cleaning your working space and equipment, you are almost ready to go. Before you begin, weigh all the ingredients according to the recipe and make sure you have everything within reach. Read the instructions on the yeast pack, because often the yeast needs to be activated, which might take some time.

**Tip:** keep a pail of sanitizing solution available during brewing for anything you might want to sanitize

**Tip:** during the boiling step you will have enough time to sanitize all the equipment that will touch the boiled wort. It is preferred to sanitize during this step, because there is less time between sanitizing and usage.

**Step 2 - Mashing**

The goal of this step is to activate the enzymes in the milled malts, which will convert the starch to sugar. When tasting the wort during the mashing process, you will notice it becoming sweeter and sweeter. Different temperatures are used to activate different kinds of enzymes, resulting in different flavour development. The final temperature is used to inactivate all the enzymes.

1. Measure 4L water in a big pot.
2. Heat the water to the striking temperature.
3. Add the milled malts to the hot water.
4. Follow the mashing scheme. Turn the heating source off when the temperature is too high and turn it back on when the temperature has decreased too much. Mind to stir regularly in order to have a homogenous temperature in the pot.
Step 3 - Lautering

The goal of lautering is to remove all particles of spent grains. If the hulls are present during the boil, they will stew undesirable flavours into the wort. Once the wort is free of debris, you are done.

1. Pre-heat ~1L of water (approximately same temperature as wort). The wort should be in total at least 5L. Pre-heat extra water if you suspect that this is not the case.
2. Use the perforated spoon to build a filter bed on the sieve.
3. Pour the remaining wort in the second pot.
4. Rinse the first pot and place the sieve on top.
5. Pour the wort over the sieve. Use a spoon to lower the damage to the filter bed. Also, do not press the filter bed, otherwise its function is lowered.
6. Flush the filter bed with the pre-heated water
7. Repeat step 3-5 until the wort is free of debris. It is not a huge problem if the wort is not entirely clear.
8. Rinse the second pot and place the sieve on top of it. During the boiling step you can add the last bit of wort to the first pot.

Step 4 – The Boil

The goal of the boiling step is to extract the flavours from the hops and to kill all microbes while doing so. Due to the heat, some proteins will denature. After a while, you will notice the formation of small particles, which will eventually sink to the bottom.

1. Heat the wort until it boils.
2. Slowly add the first hops to the boiling wort. Don’t add everything add once, because the addition of the hops may cause vigorous foaming.
3. Follow the hop scheme. You can keep a lid on the pot, but it is recommended not to completely cover the pot in order to allow some undesired aromas to evaporate. During the boiling, some water will evaporate and this can be compensated by the addition of hot water. In the last minutes, only add extra water that has boiled sufficiently.

Step 5 - Cooling

The goal of the cooling step is to cool the wort as quickly as possible after the boiling step.

1. Fill your sink or bath tub with a layer of cold water.
2. Make sure the lid completely covers the pot and place the pot in the water.
3. Keep stirring the cold water to increase the speed of cooling. Make sure the cooling water does not get too warm and it does not accidently infect the wort. Add ice or replace the water to keep the temperature difference between the inside and outside of the pot as large as possible.
4. When the wort has cooled down, remove the pot from the cooling water and make sure to keep the lid on the pot.
**Bonus – Spent Grain Bread**

I hear you thinking: what to do with all this spent grain left over after lautering? No way, there should be something better...

There is! I present you the recipe that will change your spent grain into a delicious beer bread! It is not only delicious, but also very sustainable: you are turning a ‘waste’ stream into a ‘rest’ stream. This bread is so mouth-watering that you’d want to turn all your spent grain into bread. Luckily, spent grain is readily frozen, so you can store some for later!

You will need:
- 400 g (whole) flour
- 250 g spent grain
- 200 ml beer/water
- 50 mL olive oil
- ~7 g dry baking yeast
- 2.5 g salt (or less)
- Optional: spices

Instructions:
1. Mix the dry yeast with the beer/water and leave it for ~10 minutes. The beer/water should be no warmer than 37 °C.
2. In the meantime, mix ~350 g flour and the spent grain. Mix the rest of the flour with the salt and put it aside.
3. Mix the yeast mixture and olive oil through the spent grain mixture. Then mix it with the flour mixture to form a dough.
4. Knead the dough for ~10 minutes. If the dough is too wet, you can add more flour and if the dough is too dry you can add more beer/water. The dough should be a bit sticky, only then you will get the most delicious bread.
5. Leave the dough to rise for 1.5 hour or more. Cover it and give it enough space to rise (e.g. in a mixing bowl). The bread volume should have duplicated after this rising step.
6. Knead the dough and leave it to rise once more but this time for 30 minutes or more.
7. Pre-heat the oven to 200 °C and cover a baking tray with parchment paper.
8. Place the dough on a baking tray in the desired shape (e.g. one large bread or multiple smaller breads). Remember to leave enough space for the bread to rise.
9. Bake the bread for approximately 60 minutes. Check after 40 minutes and optionally turn the bread upside-down. Continue baking until the bread gets some colour. One method to check whether the bread is done, is by piercing it with a steel pin: if nothing sticks to the pin, the inside is fine. Another method is by knocking on the bread: if it sounds hollow, it is perfect. If you cut the bread and the insight is still wet insight, you can also place it back in the oven.
**Step 6 - Transferring and Separating**

It is time to get the wort into the fermentation vessel. This means the wort is going to get in contact with other equipment. **It is crucial that this equipment is sanitized!** During the cooling, all the trub has sunken to the bottom, which helps with the separation. However, hops that are added in the last minute of boiling, might still float on top of the wort.

1. Make sure all the equipment that touches the wort is sanitized.
2. If there are hops floating on top of the wort, remove them with a perforated spoon or use a sieve during transferring.
3. If you separate the wort over multiple fermentation vessels, it might be handy to add the yeast at this point (follow step 1 under fermentation below).
4. Slowly transfer the wort into the fermentation vessel(s). Stop when the fermentation vessel is half full.
5. Shake the fermentation vessel in order to aerate the wort (splashing is necessary). Aerating the wort, will give your yeast a kick-start.
6. Add the rest of the wort to the fermentation vessel(s). Make sure that the trub at the bottom remains in the pot.
7. To increase the yield, you can add the last bit of wort with the trub in an extra fermentation vessel, for example a wine bottle. It is a nice experiment to taste the difference between the beer fermented with and without trub. If you do not have an extra air lock lying around, a sanitized balloon with a tiny hole (from a needle) will also do.

**Step 7 - Fermentation**

The aim of the fermentation is to convert all the fermentable sugars into alcohol. Two weeks should be enough time to accomplish this. During the conversion of sugar into alcohol, also carbon dioxide gasses are produced. The gas production is visible with the naked eye and is therefore a good indication of the activity of the yeast. At the end of fermentation, the gas formation should be minimal, indicating that the yeast has done its job. If the gas formation is still on a high level, later the pressure in the bottle might become too high. When this happens, **the beer bottle will explode**, with all of the sharp glass pieces flying around. So make sure to be patient!

1. If the yeast has not been added yet, add it to the fermentation vessel(s) now (make sure that to follow the instructions on the yeast pack). Adding more yeast than indicated on the instructions is not a problem, but you can also store some. Dry yeast is easily stored, whereas wet yeast is harder to store.
2. Seal the fermentation vessel with the airlock.
3. Be patient for the coming two weeks.
Part 2 - Bottling
Once the fermentation has finished, it is time to bottle. We are currently only a few weeks away from the moment that your lips will touch your freshly home-brewed beer... Before continuing however, make sure that the gas production has really minimized, because we do not want exploding bottles!

Share Your Experiences
Don’t forget to do the assignments in the app! Make sure to take notes and pictures during the brewing. Notes will enable you to exactly remake a successful beer.

Step 8 - Preparation
The secret behind brewing your own great beer has always been and still is: hygiene. It is very important that everything that touches the beer is sanitized. Remember that you are still in the high risk zone!

Step 9 - Transferring and Mixing
Before bottling, transfer the beer to another vessel/pot, leaving the sedimented yeast behind. Add a sugar solution to it. The sugar solution is used to carbonate the beer, while they are in the bottles. However, adding too much sugar will cause too high pressure, resulting in exploding bottles. Most home brewers add between 4-8 grams of sugar per litre of beer. To be safe, we advise to add 5 g/L.
1. For 5L beer, dissolve 25 grams of sugar in ~50 mL of water (amount of water is not very important). Make sure to boil the solution to kill microbes.
2. Transfer the beer to a pot with a minimum capacity of 5L. Leave the last part behind in order to keep the sedimented yeast cells separated from the beer.
3. Mix the sugar solution with the beer in the pot

Step 10 - Bottling
The procedure of bottling differs with different bottle types, but is pretty straightforward. Use either flip-top bottles or crown cap bottles. Do not used normal wine bottles, because they are not produced to withstand the pressure and are likely to explode.
1. Transfer the beer from the pot to the bottles.
2. Seal the bottles.

Step 11 - Maturation
As mentioned several times: if the pressure will get too high, the bottles will explode. Do not worry: if you did everything correct, this is very unlikely to happen. However, as a precaution, we recommend to put the bottles in a place where they can do the least potential damage as possible. Preferably, this place is able to contain the potential blast (such as a closet), minimizing the potential damage. At least, make sure the bottles are stored out of sight in the first weeks: this way you are at least sure they will not explode in your face.
1. Be patient for two weeks to mature the beer.
2. Place the one or two beers in the fridge and remain patient for another week. Storing in the fridge inactivates the yeasts and helps making the beer clearer. Leave the other beers at room temperature. Sometimes, the beer needs a longer time to mature!
Part 3 - Tasting
Ready for some tasting? Don’t forget to share your experience via the assignments in the app!

Step 11 - Tasting
Three weeks have gone by: time to taste your own beer. But, beware: don't drink the yeast layer on the bottom of the bottle! Interested to see how the others’ beer turned out? Make sure to check the app.

If the beer tastes great, you can place the rest of the beer in the fridge and it is ready. But you can also wait. Storing the beer for a longer period allows the flavours to develop further. A nice experiment is to try one beer each week (or other period of time) and notice how the flavour develops. Another nice experiment is to watch how the flavour development can differ due to storing at different temperatures (warm room vs. colder room or inside vs. outside the fridge).

Improvements
If you have feedback on this fun assignment, please give it on the discussion page online. It is highly appreciated :)