Making real beer can be easy

V1.0

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1 Introduction

Over the years, I've tried a wide range of “kits”. So far I have never been happy enough with them to actually drink the beer and it has all gone down the drain.
So I'm not sure why or where I got the idea from, but for some reason when we once ordered some organic grains we also ordered malt. After a lot of research about what to do with the malt and how to convert it to sugars, I started to play around with it and made a couple of small test test brews. More or less parallel to this, the shire of Darton was selected to host May crown 2008. As the test beer was drinkable, there was only one way forward. Free beer for everyone at May crown 2008! The event was successful and close to 200 litres of beer were consumed at the event so I must have done something right.
A half cubic meeter of beer and a year and a half later, I have simplified the process enough to now encourage others to try making real beer.

2 Target audience

The target audience for this document are people with some basic understanding of brewing. For example you are expected to know what a gravity meter is and how it works. You also need to know what a brewing bucket or demijohn is...

3 What is beer?

The question may sound trivial but when thinking about it, it is actually a complex question. What defines wine, mead, beer etc? There are beers which are made from honey, beers using grapes and fruits, there is wine made from barley. This document is not intended to clarify this question. The beer we are looking at in this document is what we would today call a dark ale, or as it would have been defined in the dark ages, “Beer”...
“English brewers produced good-quality ale for centuries before hopped beer appeared. English beer was good enough to be thought a worthy present for a king of France in the late twelfth century as part of a diplomatic mission. Still from the thirteenth and in to the fifteenth century, a reputation of poor quality hounded the drink. At the later date it may be that English ale, made without hops was perceived in France as not being up to the calibre of good beer.”[1]
The two main types of beer we are coming across today are ale and lager, where pilsner is a variation of lager. There are a couple of distinct differences between lager and ale that will be highlighted later on in this document.

4 What is in beer?

For the purist, there are only 4 components to a pure beer, water, malt, hops and yeast. Most modern recopies include syrup (sugar or maize to mention a couple). Those beers taste nice, but to pursue a beer that could/may have been drunk during the medieval time, we need to stick to the 4 basic components.

4.1 Malt

Malt is, simply put, dried and cured sprouted barley. The earliest finds of barley are from the north-east Mesopotamia about 7000BC and the earliest pictograph for beer from about 2800BC.[2] There is limited information about what precise type of barley was grown in the Middle ages although it is possible that different varieties were used in different parts of Europe[3]. Today, there are a wide range of different combinations of malting method and barley cultivar available.

1 From Beer in the Middle Ages and the Renaissance, Chapter 6
2 From Beer in the Middle Ages and the Renaissance
3 See Wikipedia “Barley”

4.1.1 Sprouting

Malt is basically kiln dried sprouted barley. The picture below shows a couple of sprouted barley grain (probably a bit over sprouted).

“Having selected his grain, the malter sifts out any foreign bodies and soaks the barley in water for some hours. This is to soften the grain and increase the moisture content so that the necessary enzymes can develop. He then lays the seeds out several inches deep on the warm floor of his maltings. Once or twice a day he turns them over so that each grain gets an equal amount of warmth and begins to sprout at both ends – once producing a tiny hairlike roots, the other the embryonic stem.”[4]

4.1.2 Drying

Both Pilsner and pale ale malts are dried in a kiln at 40-45 Celsius with a lot of ventilation. Once the moisture is below 10% the malt need curing. To speed up and ensure an efficient drying (and prevent roasting) good ventilation is important.

4.1.3 Curing

When the malt is dry the temperature is raised to about 85C for a few hours. Curing the malt will improve quality and ensure a better beer.

4.1.4 Crystal malt

Crystal malt (a commercial name) is typically done by combining the drying and curing. It seems to be common to dry the malt in 60-70C and then bring the temperature up to about 150C until the desired level of roasting is achieved. However, then making crystal malt, you don't have any ventilation and you may even inject some moisture during the roasting.

It is easy to make your own “crystal malt” by roasting/toasting pale malt. It will not be exactly the same as commercial crystal malt but it is fun to play with.

4 Easy Beer Making, by Hamlyn

4.1.5 The mix

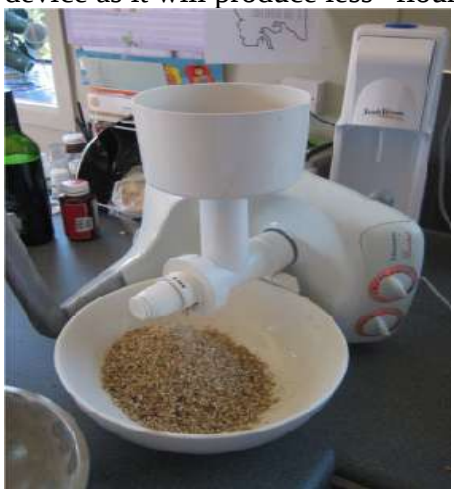
The most popular beer I've made so far is a dark ale. The dark ale is a mix between pale and crystal malt. The mix is often in the range of 20-25% crystal malt. This gives the beer a dark colour and a “caramelly” flavour.

4.2 Water and Mashing

Whether you have made your own malt or bought the malt, it must be converted to sugars before it can be fermented. Mashing is done by soaking the malt in 65C water for 2 hours. The enzymes in the malt and the hot water will slowly convert the starch to sugars. The temperature will alter the taste of the beer so keeping track of temperature is important. The quality of the water you use is incredibly important and will affect the flavour of your beer – it's worth experimenting with this.

4.2.1 Crushing

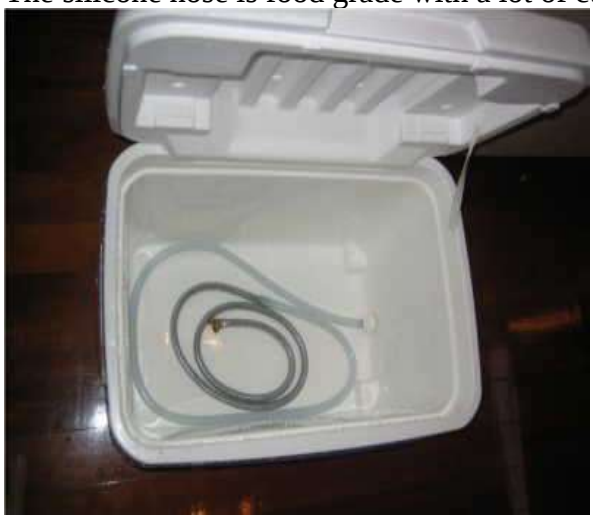
Before the mashing the malt must be crushed. Crushing devices/machines are expensive. Most brewing shops will crush it for free or charge a symbolic fee. In the beginning I used a meat grinder and sent the malt through it a couple of times. It was hard and annoying, but it did work. At the moment I'm using a grain mill from Electrolux but in the long term I want to get a proper crushing device as it will produce less “flour”.



4.2.2 Mashing

The easiest way to do the mashing is in a chilly bin that has a tap at the bottom. As a rule of thumb,

you will get a similar volume of beer as the mashing volume. My chilly bin is about 55 litres and I typically make 50l batches.
The picture below shows my chilly bin with a couple of hoses connected to the tap at the bottom. The silicone hose is food grade with a lot of cuts in it to make it work like a drainage pipe.



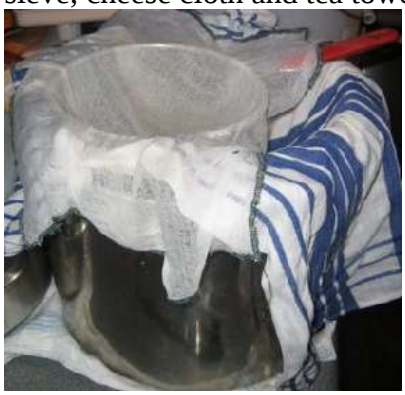
To improve the filtering and reduce dust and other impurities, I put a cheese cloth and a weight over the hose.

Next, it is just a matter of adding the malt to the bin.

Once you have added all the malt you need, you add water, typically at 70C or just there over. The chilly bin and the malt will bring down the temperature a bit so you have to monitor the temperature. You may have to add some boiling water later on to keep the temperature at 65C. I.e. don't fill the chilly bin all the way up. If you have too little water it will all turn into porridge and not drain. If you have too much water you may get a lot of dust and a worse quality beer later on. I tend to fill my chilly bin to about ½ or 2/3 with malt and then almost fill it up with water. After an hour, you should stir the mash. When the two hour mark is up, you can check if the conversion has worked by taking a teaspoon of the liquid and add a drop of iodine to it. If it turns purple, it is not done. If the colour remains reasonably unchanged (yellowish) it is done.

4.2.3 Draining

In the early days of my brewing I did the mashing in a pot on the stove. If you do that you can use a sieve, cheese cloth and tea towel to do the draining. See picture below.



This is a very messy and time consuming process and you can not strike the beer (see below). You will have to repeat the mashing several times (but only soak for 10-15 minutes each time). This is why I'm pushing for the usage of chilly bins. When using chilly bins, it is easy to do the draining. All you have to do is to open the drain. See the picture below.

4.2.4 Striking/Sparging

(Sparging is the same as Striking.)
When draining your mash, do not let the liquid level go below the malt. Striking is simple; constantly add/sprinkle hot water (about 75C) to the mash. It is important to not stir the mash at this point. If you cannot sprinkle then put a lid or something flat on top of the mash and slowly pour the water carefully on to the lid. Striking will slowly wash out all the remaining sugars in the malt. Keep monitoring the sugar levels with a gravity meter but be careful, it is hot water.
I often have about 1.060 in the beginning with a progressive decrease of sugar levels as I strike. Once the sugar levels are below 1.010 or 1.005, you may want to stop the process. The stronger the brew you want, the less of the “low sugar” content you want. After boiling and cooling, I typically target a gravity level of 1.045 that will give ~ 6.8% strong beer[5].

4.3 Boiling and hops

The next step is boiling. Apart from the wort you get from the mashing process, you also want some additives in the beer.

4.3.1 Additives

Today, we most likely just add hops to the brew. In medieval times we get more and more unsure what they added to the beer the further back in time we get. We know vikings had access to hops (finds at Hedeby from about the 10th century). Whether the hops were smoked, used for medicinal

5 One of may formulas to calculate alcohol content, (Start gravity – end gravity)/0.0074 → (1.045-.995)/.0075=6.76%

purposes or for brewing we may never know for sure. We do know that hops were used in beer by 1200; “The novelty of the years after 1200 was that brewers in Bremen, Hamburg, Wismar, and elsewhere in northern Germany made hopped beer for export.”[6]. However, the main additive in that time was “Gruit”.

4.3.1.1 Gruit

“Gruit must have been a combination of dried herbs, including wild rosemary, with the most prominent ingredient being bog myrtle.”[7] Like hops, bog myrtle has an antiseptic aspect. I have not yet managed to get hold of bog myrtle to brew with instead of hops. I have tried some brews with hyssop and other herbs, but the beer goes off within a couple of weeks. Hops will preserve the beer for months, and presumably bog myrtle may preserve the beer to some degree too.

4.3.1.2 Hops

At the moment, my hop plants are small and will not produce the amount of hops I need. Therefore I have to use commercial hops. There is a huge range of hops available. One of the main aspect of hops you have to be aware of is the “alpha acid” level. The alpha acid level will vary a huge amount not only by variety but by crop. You may need almost twice as much hop from a 2.5% alpha acidic hop compared to a 5%. I have seen hops go up to 8-9%. I would recommend you use something in the middle range, about 5-6% alpha acid level.

4.3.2 Boiling

Bring the wort (the end result of the mashing process) to a boil. Note down the time it starts boiling. Add your hops. Warning: hop pellets can cause the brew to foam a lot. Add a little at the time.

4.3.2.1 Hot Break

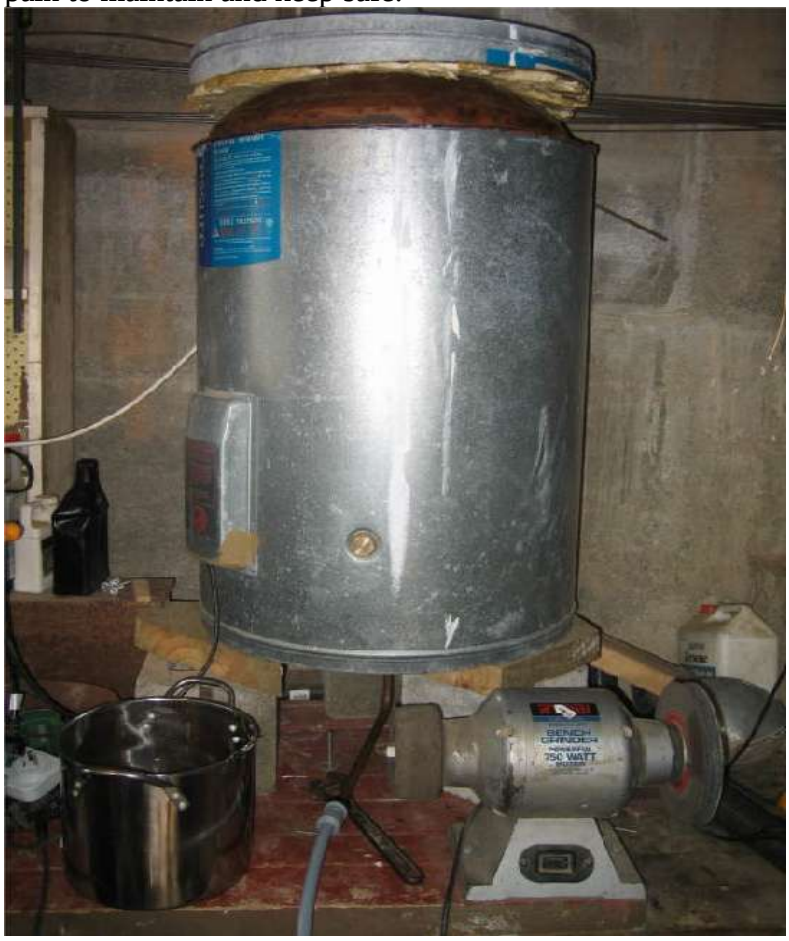
Apart from extracting the goodness from the hops, one of the key functions of boiling the wort is to get rid of some proteins. The brew must boil well for a minimum of one hour. One of the purposes with the boiling is to reach the hot break. You know you have reached the hot break when “clouds” are forming in the brew (take some off the boiling brew and add to another bowl and look). The picture below shows a classical example when the hot break has been reached.

To ease the reach of hot break, you can (should) add a pinch of Irish moss after about 45 minutes of boiling.

6 Beer in the Middle Ages and the Renaissance
7 Beer in the Middle Ages and the Renaissance

4.3.2.2 About boilers

If you are making small batches, 25 litres or less, you can easily do the brewing on the cooktop. If you are doing larger batches you may want to invest in a big boiler. I can make just over 100 litres at a time in my boiler. The picture below shows the converted hot water cylinder I'm using as a beer boiler. If you are looking at doing something similar, invest in a stainless steel boiler! Copper is a pain to maintain and keep safe.



Under the boiler you can see a copper pipe connecting to a hot water rated plastic water pipe going to the cooler. What you can not see is the valve between the boiler and the copper pipe. This valve will ensure your brew is not lost.

4.3.3 Cooling

Cooling is less important, but can have a huge impact on what the beer will look like. To improve the clarity and visual look of the brew you should strive for a cold break.

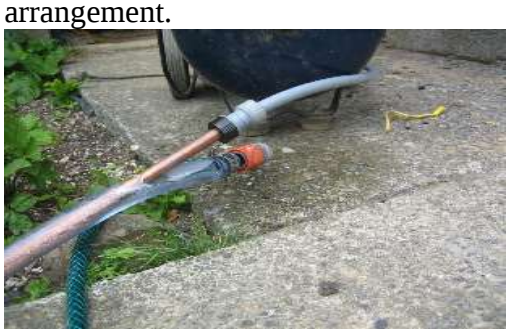
4.3.3.1 Cold Break

When rapidly cooling the brew, you can achieve a cold break. If you don't reach the cold break you will most likely get a “chill haze” in your beer. I.e. as the beer gets cold it will be hazy, and as it slowly heats up it will go clear again. If you do get a cold break, more proteins will coagulate and be removed from the beer.

4.3.3.2 Cooling equipment

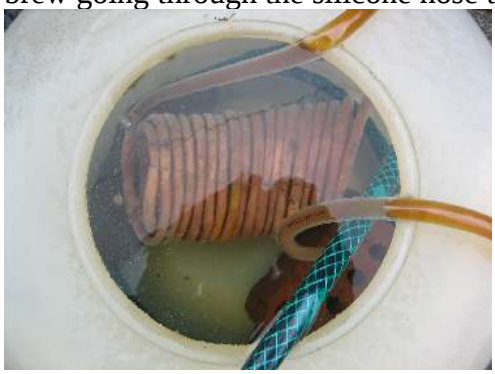
When working on the cook top you can simply put the hot pot in the sink with cold water. You probably have to run the tap with cold water to constantly replace the waster in the sink as it is warmed by the pot. You can also use dry ice etc.
When doing bigger batches, you need to build some kind of cooling device. I managed to get hold of a big copper coil that I send the beer through. The series of pictures below shows my cooling

arrangement.

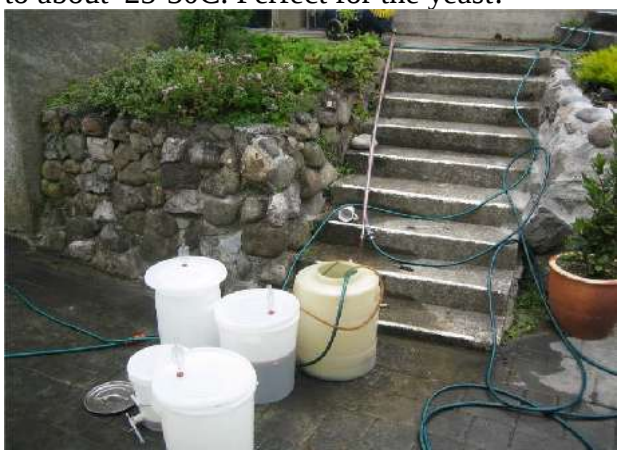


The picture above shows the plastic hose from the boiler connecting to a copper pipe. The copper pipe is inside a big silicone hose. The silicone hose is connected to a cold water tap and the water constantly cools the copper pipe. This arrangement I call “pre cooling” as it only brings down the temp from 100C to about 70C.

The picture above shows the bottom part of my pre cooler. At the time of the picture, there was a brew going through the silicone hose that connects the pre cooler with the main cooling coil.



The picture above shows the main cooling coil submerged in cold water. The silicone hoses are transparent so you can clearly see what is going on and ensure that your brew is clear with no hops and/or proteins. You can also see a garden hose constantly pushing in cold water to the bottom whereas hot water is overflowing at the top. This cooling arrangement brings down the temperature to about 25-30C. Perfect for the yeast!



The picture above shows my entire cooling arrangement. The picture also shows one of the

fermentation buckets half full and still filling up via the small silicone hose going from the cooing barrel to the fermentation bucket.

4.3.4 Discarding

When using a cooling arrangement like the one illustrated above you have the ability to discard the hops and a lot of the proteins. Once the boiling is done you simply power off the boiler and leave it for 30 minutes. When you are ready for the cooling, open the valve under the boiler and discard everything that comes out until you are getting a clear brew. At first there is a lot of “gunk” made up of hops and proteins. Towards the end of the cooling there will be another rush of gunk coming. As soon as you start to see the gunk between the pre cooler and the coil, simply disconnect the hose from the cooling coil and discard the gunk. (And quickly hose out the boiler to clean it and to get rid of the last of the hops and proteins in the boiler.)

4.4 Yeast and fermentation

The yeast is probably the most radical difference between lager and ale. The main difference between the two types is where the fermentation takes place. Lager yeasts ferment at the bottom of the vat and is therefore called bottom fermenting yeast while ale yeast is top fermenting yeast. Regardless of type, both will create a thick foam on top that must be removed every day. The foam, or 'scum', will include a lot of dead yeast that can create an off flavour. It is also important to ferment in the right temperature range. Lager should be fermented in the temperature range 7 – 13C, while ale should be fermented in the temperature range 14 – 25. (I typically ferment ale sub 20C.) All going well, the fermentation will take between 2 and 3 weeks. When the brew has finished fermenting (stopped bubbling), you can leave it for a couple of days or so. Check with a gravity meeter that all the sugars have fermented, I.e. the gravity is 1.000 or below. Don't leave the beer in the fermentation bucket too long. If you want to store the beer in a bucket for a longer period of time, transfer the brew to a new sterile bucket and top it up with some CO2 to protect it from foreign yeasts and alegar organisms. (If you don't have CO2, just add a spoon of sugar to create a little more fermentation that will generate new CO2).

4.4.1 Pilsner

Fermenting pilsner requires a few specific words. First, don't sniff the fermentation bucket! The smell is revolting. Most of the gas is CO2, but there are also some other gases and particles that follow the CO2. Don't get put off by the smell. Let it finish fermenting and then bottle as per normal. You will probably find that when you do the bottling and have a taste of the brew, the smell is more or less gone.

5 Bottling

When you are bottling you want to prime the brew. Priming means the addition of sugar or un-fermented wort to the brew for a secondary fermentation in order to generate CO2 (I.e. the bubbles in the beer). Now, in period this may or may not have happened (depending on whether the beer was brewed for immediate consumption or for export) but it seems the modern taste cannot cope with a non-bubbly beer too well.

5.1 Priming with wort

If you want a “pure brew” you don't want to add sugar to the beer. Instead, before adding the yeast to the brew you would put away between 5 and 10% of the brew in a clean sterile bottle and leave it in the fridge or freezer. So if you have made 10 litres of beer and want to have a fair amount of carbonisation you take 1 litre of your brew and put it in the fridge. Once the fermentation is done and it is time for bottling, divide the brew from the fridge equally into the bottles.
10 Litres of wort

Put away 1 litre for the priming.
Ferment 9 litres
6 * 1.5 Litres coke bottles = the 9 litres
1L/6 ~ 1.6DL of priming wort into each bottle
The secondary fermentation will take about a week. The darker and hoppier a beer you have made, the more time you want to give it to mature. Most beers are drinkable about a week after the priming, but may have their peek after a month or two. With a reasonable amount of hops in the brew, beers should keep for about 6 months. Some of the beers I have made have been quite drinkable after a year, but clearly past their "best by" date by then.

5.2 Priming with sugar

When brewing in large quantities it is not practical to use the wort for priming in my opinion. For May crown 2008 I made about 300 litres of beer and there was no way I could realistically store 30 litres of wort in the fridge or freezer. Even when working with 50 or 100 litres, I tend to "cheat" with sugar. (For a happy marriage, always leave the kitchen cleaner than you found it and don't hijack too much fridge space!)
In theory, it is possible to do a specific beer batch for priming but the amount of extra work is in my view simply not worth it. As I invert the sugar it is more or less impossible to taste the difference anyway.
The way to improve the effect of sugar and to reduce the risk of taste impact from the sugar is to invert the sugar (converting the sucrose to fructose and glucose). Simply boil it for 20 minutes with water and a little citric acid. I use about 12g of sugar per 1.5 litres of beer.
To make it simple I always use 30ml of priming solution per bottle. So, by adding 90ml of priming solution to my 100ml test tube I can prime 3 bottles at time. To minimise the amount of measuring etc, I tend to follow the following formula.
Nr of litres / 1.5 litre = nr of bottles
Nr of bottles * 12g sugar = total sugar
Add the boiled sugar solution to a bottle and top it up to level the that equals "nr of bottles * 30ml". It is often a good idea to "add" a couple of bottles for safety's sake.

An alternative formula for larger volumes (max 75 litres).
Base = 50 bottles
50*12g=600g sugar
50*30ml=1.5 litres
Add the priming solution to a 1.5 litre coke bottle and top it up with water. (Mix well). Finally add 30ml to each bottle.
P
riming with sugar will also increase the alcohol content a little as we are adding more sugar/ml liquid compare to the wort.

6 Drinking

Thumb of rule with temperature:
Lager = cold v.s. ale = just below room temp
A lot of people tend to chill the beer to much. Cold tends to suppress a lot of flavour in a "rich" beer, that is to say "modern ale" and dark beer such as Guinness etc.

Finally, don't forget the most important ingredient in drinking beer: good company!

7 Some recipies

7.1 C1

8.3Kg pale malt
3KGr crystal malt
170Gr 5.6% hops
Ale yeast
This made 50 Litres of 1.048 (just over 7% strong) beer.

7.2 C2

8.3Kg pale malt
3KGr crystal malt
190Gr 5.6% hops
Ale yeast
This made 52 Litres of 1.044 (about 6.7% strong) beer.

7.3 C3

8.3Kg pale malt
3KGr crystal malt
150Gr 5.6% hops
Ale yeast
This made 55 Litres of 1.044 (just over 6.7% strong) beer.