

Mashing

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Definition – In mashing we continue the process that was started in malting. Enzymes break down proteins and starches into a range of sugars and other materials. The yeast can ferment many of the sugars. The other materials produced survive to produce the desired characters in beer. This is achieved by several different enzymes during a series of rests at specific temperatures.

Mash Controls – Temperature, pH, and thickness

Enzymes and their pH and temperature ranges

Phytase	5.2	95-120°F
β -glucanase	4.5-5.0	120°F
Proteases	4.6-5.7	120-145°F
β -amylase	5.1-5.3	131-149°F
α -amylase	5.3-5.7	158°F

Thickness affects enzyme stability. 1 quart per pound of grist is a pretty thick mash and 1.75 quarts per pound of grist starts to get thin. A thick mash results in high temperature stability for β -amylase, which is the more sensitive of the enzymes. A thicker mash can also cause “product inhibition” meaning that the concentration of the enzyme product gets too high for the enzyme to continue to do its job, leading in the long run to a less fermentable wort. Thin mashes can produce highly fermentable wort, but will take longer to do so because the relative concentration of the enzymes is diluted. They are also more likely to change in temperature rapidly because the malt is not providing as much of its heat capacity to the overall mixture.

What is going on at these different rests?

Phytase at 95-120°F is the acidification rest. At 115° lactic acid bacteria naturally present on the malt are at their peak performance level.

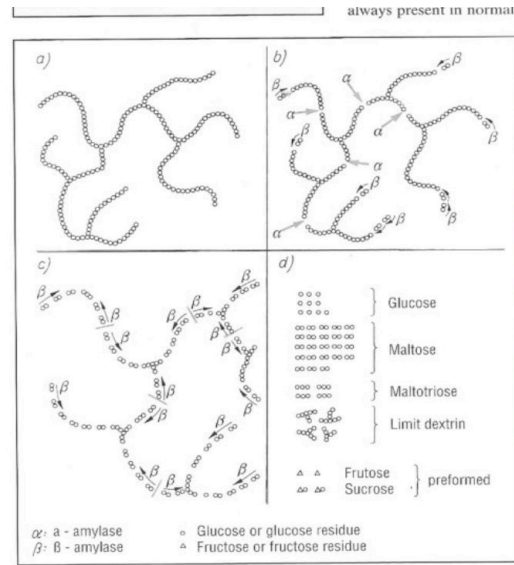
β -glucanase breaks down various gums that could form hazes and cause problems filtering. High kiln temperatures during malting frequently denature β -glucanase so there is the chance that they are not even present in the mash.

Proteases break down proteins during malting but are not very important in mashing because most of them are denatured by the heat of kilning. The idea is to break down high molecular weight proteins into lower molecular weight ones, that is the job of the maltster in any well-modified malt. A rest here is only important if using under-modified malt. Otherwise as Kunze says, “a long rest at 50°C (122°F) always results in a poor foam.”

The diastatic enzymes β -amylase and α -amylase are the ones that create the sugars we will feed the yeast with. β -amylase works from the end of long chain polysaccharides

breaking off maltose and maltotriose until it can go no further. It is making fermentable sugars, therefore this is the “fermentability enzyme.” α -amylase cuts up long chain polysaccharides in the middle of their chains. It therefore produces more ends for the β -amylase to work on and lowers the viscosity of the wort. Because it is not just creating maltose and maltotriose, but sometimes leaving behind limit dextrins this is the enzyme that produces a less fermentable wort.

- A) Amylopectin, a branched long chain polysaccharide.
- B) β -amylase breaks off two glucose units at a time creating maltose while α -amylase breaks the chain at random points creating new ends.
- C) β -amylase continues its work, here we can see the new sugars that have been formed.
- D) The different sugars created during saccharification.



Different Types of Mashes

Single step infusion mash is the most common and is the traditional British method. It consists of one water addition to obtain the desired saccharification temperature and then proceeds to lautering.

Multiple step infusion mashing involves several additions of water, so you have to start with a pretty thick mash because it will be getting thinner as you go. Some people will use direct heating of the mash in order to reach the different temperatures necessary for the enzymes to work.

The double mash method is used by American macro brewers because the adjuncts such as corn or rice need to be cooked separately in order to be gelatinized prior to saccharification. The adjuncts are heated separately and then added to the main mash in order to reach the saccharification rest.

Decoction is the traditional German method of mashing and is very well suited to the use of under-modified malts. The mash is raised through its temperature steps by pulling off a portion of the mash and boiling it. This portion is then added back to the main mash to raise the temperature to the next step.

What do I need to start mashing?

A rectangular cooler with copper pipes in the bottom works wonderfully, I made mine based on John Palmers design if I recall correctly. A round cooler works too, find a screen for the bottom of it for the mash to rest on. Or big stainless contraptions are

always fun despite the price tag. In Belgium many of the old (but still used) mash tuns are made of cast iron, but don't forsake a good dutch oven for a mash tun, we need the food from them too!