

Mashing/Lautering

Mashing – Complete breakdown of starches and proteins to sugars, etc. from a combination of malted and unmalted grains mixed with hot water. This process began with the malting of the grain producing enzymes and beginning to break down starch to sugar.

Single Step Infusion Mashing – Heating a mash to a single sacchrification (sugar-making) temperature with the addition of hot liquor (water). Best with fully modified malts.

Step Mashing – Mashing at more than one temperature in an upward direction produced by introducing heat into the mash. Can be introduced by direct heat, water infusion, decoction, RIMS or HERMS.

Decoction Mash – raises the temperature of the mash by removing the thick part of the grist and boiling it and returning it to the mash and incorporating by stirring. Enhances perceived malt character, increased malanoidans, and generally results in improved extraction rates due to the boiling reducing the size and complexity of malt starch. Is particularly beneficial to undermodified malts.

RIMS/HERMS – raises the temperature by recirculation, either of wort through a heater chamber containing an electric element, or through a coil of copper tubing in the Hot Liquor Tank.

Enzyme	Optimum Temp.	Optimum pH	Function (ranges overlap, but a particular temp can produce a compromise of enzyme activity)	Common name
Phytase	86-126 F	5.0-5.5	Lower mash pH	Acid Rest
Debranching	95-113 F	5.0-5.8	Solubilization of starches	
Beta Glucanase	95-113 F	4.5-5.5	Best gum breaking rest for unmalted wheat, rye, oats, barley	Gum Rest
Peptidase	113-131 F	4.6-5.3	Produces Free Amino Nitrogen (FAN) from proteins, serving as nitrogen source for growth of yeast	Protein Rest
Protease	113-131 F	4.6-5.3	Breaks up large proteins (peptones and albumins) that form haze	
Beta Amylase	131-150 F	5.0-5.5	Produces Maltose – favors thinner body and more fermentable	Sacchrification rest
Alpha Amylase	154-162 F	5.3-5.7	Produces sugars including maltose – favors more body, residual sweetness	Sacchrification rest
None	168-172 F		Denature all enzymes and reduces the viscosity of the wort for easier rinsing from the grist	Mash Out

Lower pH values render large proteins more soluble and reduce hot break, an undesirable occurrence.

Utilizing anything more than a short **protein rest** on fully modified malts tend to remove most of the body of the beer and result in poor head, as some proteins are essential to head production and retention.. However, a protein rest should be used on undermodified malts, or with a large percentage (>25%) unmalted grains, i.e. rye,

¹ Table from “How to Brew” by John J. Palmer, Defenestrative Publishing Co., 2001

oats, barley. Extract efficiency is enhanced by a protein rest. Breakdown of high molecular weight proteins (17,000 – 150,000 m.w.) produces peptides and amino acids (500 – 12,000 m.w.) which are useful for head retention, and further to 400 – 1500 m.w. for proper yeast nutrition.

A starch conversion or sacchrification rest cannot begin until the grains have become gelatinized which takes place between 130F and 150F for barley malt. Beta amylase lowest temperature is consistent with sufficient heat to gelatinize the starches and make them available for conversion to sugar.

Time and temperature variations favor various enzymes and allow the brewer to control the sugar/protein makeup of the final product to a high degree. Enzymes are slower at lower temperatures, work fastest towards the high end of their temperature range and denature above their temperature range. Ranges overlap between enzymes and desirable byproducts vary depending on which enzymes are favored for how long. The types of grains also make a large difference as they supply more or less of the necessary chemical building blocks. Many of the variables can be controlled independently, but sometimes favoring one chemical end product gives you too much or too little of another end product. Lower sacchrification temperatures favor less body and drier finish, higher temperatures favor more body and sweeter finish because of dextrans being produced, which are not fermentable.

Mash thickness changes the end product. Thin mash dilutes concentration of enzymes slowing conversion, but leading to a more fermentable mash because the enzymes were not inhibited by a high concentration of sugar. A stiff mash is better for protein breakdown and results are faster, but the sugars are less fermentable and will result in a sweeter, maltier finish. A thick rest is better for a multi-rest mash because the enzymes are not denatured as quickly by a rise in temperature.

Completion determination can be done with starch iodine test – no change when iodine is added, blue-black indicates presence of amylose starch.

Lautering/Sparging – Rinsing the resulting sugar out of the spent grain (grist) and into the kettle for the boil. This can be done in a combination mash/lauter tun, or the mash can be transferred to a separate lauter tun. Sparge water should not cause the mash or the sweet wort flowing to the kettle to rise above 168-170F, or leaching of tannins from the grain husks will begin. Sparging can be done continuously (fly sparging) or can be done in batches of several additions of hot water, or even no-sparge can be done, merely putting sufficient water in the mash to begin with to not have to add any later on. No sparge can favor a more fermentable wort (see Mash Thickness above). Sparging should be stopped when the gravity of the sweet wort gets below 1.010 or the pH rises above 6.

Vorlauf – Taking the first runnings out of the lauter tun and returning them to the top of the mash gently to not cause channeling, and continuing until the runnings are clear. RIMS and HERMS, due to their continuous recirculation do this automatically unless the system does not have a combined mash/lauter tun. The vorlauf causes the mash bed to become its own filter and the very small solid particles are filtered out. These particles called draff, contain proteins, lipids, silicates, tannins and unconverted starch. They contribute to fermentation disorders, haze, poor head retention and astringency. Not all the lipids should be removed because they have value as yeast nutrients.

The sparge should be done very slowly to enhance extraction efficiency.

The Lauter Tun can be in many configurations: cloth bag in a colander, Zapap bucket in a bucket, bazooka screen, slotted copper manifold, perforated stainless steel false bottom, etc.