The Magic of Mashing

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Introduction

- Malt, Hops, Water, and Yeast are the base for any of a number of similar fermented beverages we generally call “Beer”
- Grains are malted, ground, and mashed with hot water.
- The mash is strained and drained to create “wort”
- The wort is boiled and hops are added.
- The wort is cooled and yeast is “pitched” to start a fermentation.
- Bottle it, keg it, share it, and drink it! Cheers

Introduction

- This session talks about the magic of mashing.
  - Grain preparation
    - What exactly is malt?
    - What can the malting house do for our brews?
  - How are carbohydrates converted into the sugars we need?
    - Different enzymes in barley that do all the work.
  - What methods can we employ to get the most out of our grain bill?
    - Why grinding gains matters.
    - What can adjuncts do?
  - How to measure a successful mash.
    - Why bother with the hydrometer at all?

Introduction

- These topics are beyond the scope of this session
  - Hops - There are many varieties of hops, each with different characteristics. Different hops are desirable for different brews.
  - Yeast - There are many varieties of yeast, each with different characteristics. Different yeasts are desirable for different brews.
  - Water -There are many varieties of wa... no, that's not right! BUT, how water is treated does make a difference. How hard or soft and what the pH of the water is matters.

Agenda

Why Barley?

Two vs Six Row Barley

Wheat, Oats, and other adjuncts

The Lovibond Scale

Malting, Mashing, and Enzymes

Single Infusion vs. Step Mashing

Step Mash Schedule

Why Barley?

Many grains, among them rice, millet, corn, and sorghum, are used to make beers in different areas of the world, and all can be malted.

But the key grain used in brewing the western-style beers that most of us drink is barley. *'This is not just a matter of historical coincidence: barley has what you might call an enzymatic toolbox that makes it the perfect brewing ingredient.'*[Desalle]

Two vs Six Row Barley

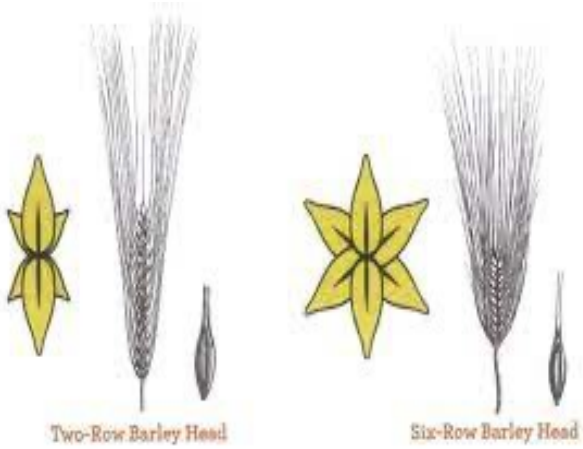
There are two main types of barley: two row and six row.

Two-row barley kernels tend to be symmetrical; they're also easier to grind in two-roller mills.

Six-row barley has a symmetrical center, but the two lateral rows of kernels are a little shorter, thinner, and twisted slightly.

Two row barley has lower enzyme content, lower protein, greater starch content, and thinner husk make it better suited to higher extract. There are enough enzymes to convert the starches to sugar, and the lower protein content helps reduce hazing.

More six row barley should be used in recipes with a larger amount of adjunct grains. This will provide more enzymes to work on the carbohydrates from grains that lack them.



Wheat, Oats, and other adjuncts

- What is an “adjunct”?
  - adjuncts are unmalted grains or grain products used in brewing beer which supplement the main mash ingredient – malted barley.
- What do these adjuncts bring to the beverage?
  - Corn – mouthfeel, additional alcohol
  - Wheat – flavor, lightness, and head retention
  - Oats – texture (smoothness – think Oatmeal Stout)
  - Rice – lightness
  - Rye – flavor and head retention

Malting

What is malting?

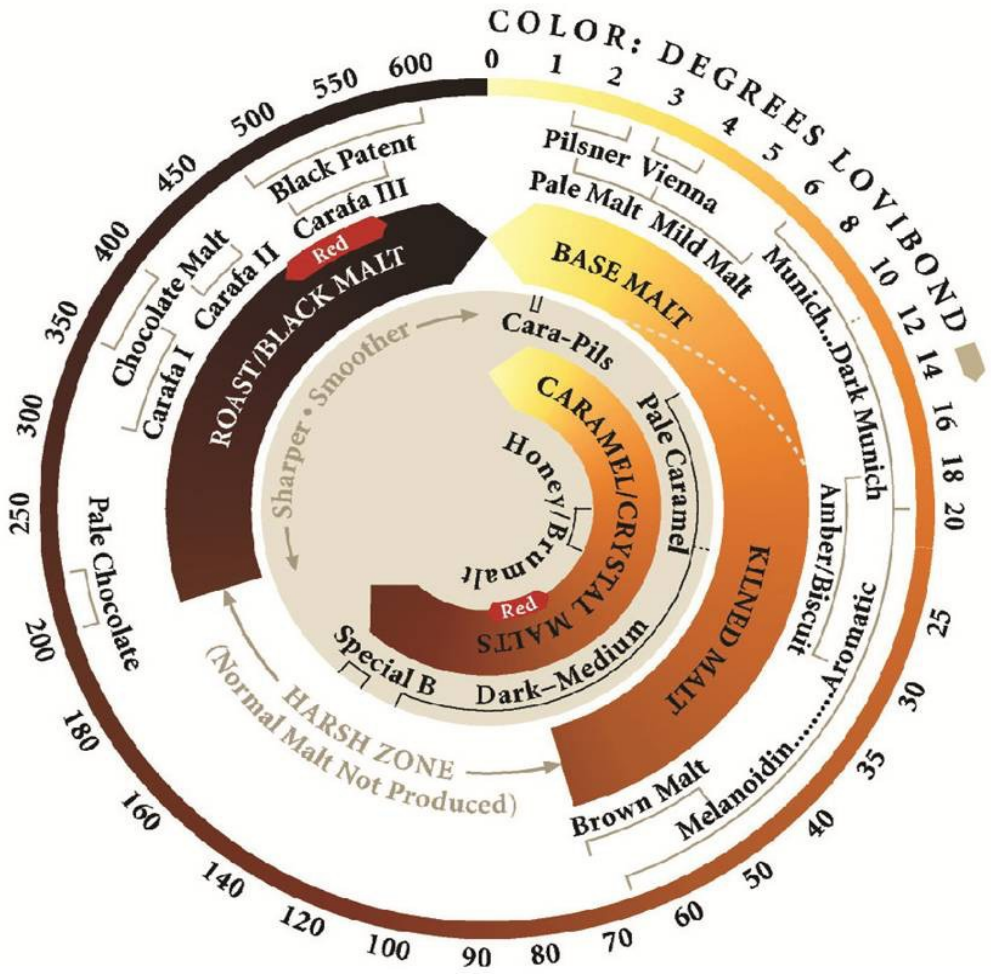
- The process of malting involves three main steps. The first is soaking the barley - also known as steeping - to awaken the dormant grain. Next, the grain is allowed to germinate and sprout. Finally, heating or kilning the barley produces its final color and flavor

Why malt the barley?

- Malting develops the enzymes needed to mash the barley and starts to break down the cell walls to aid in the mashing process.

The Malthouse

Lovibond – The Grain Color Scale



- Grains are heated during malting. This stops the germination and develops some sugars and the color of the grain.

Mashing

- Mashing is the process brewers use to convert starches into fermentable sugars.
- Enzymes within the grains, developed during malting, are activated at specific temperatures.
- These enzymes break long carbohydrate molecules into shorter sugar molecules. Holding (resting) the wet grains (mash) at temperature promotes this process.

Important Enzymes and their Activation Temperatures

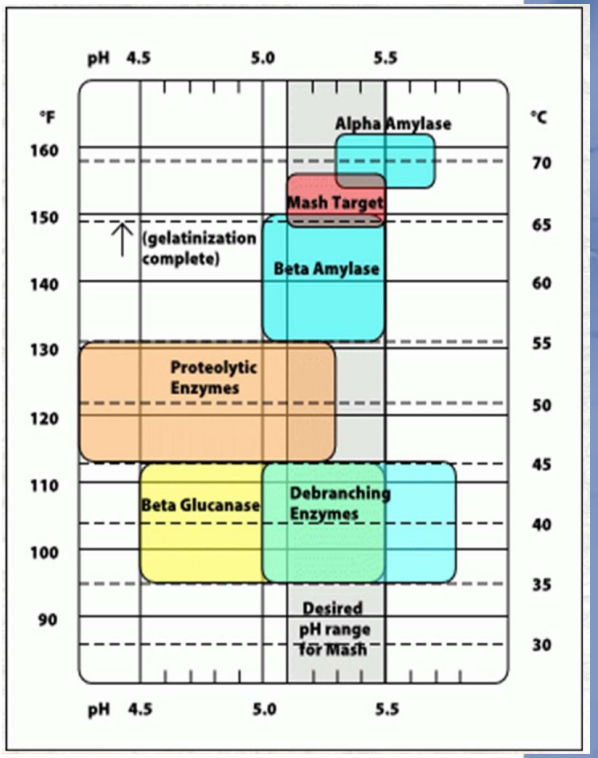
Enzyme	Temperature Range	Denatures	pH Range	Function
α-amylase	150-160 (66-71)	~170 (77)	5.3-5.7 (Ca2+ stabilized)	Cuts larger starches randomly
β-amylase	130-150 (54-66)	~160 (71)	5.0-5.5	Breaks down starch chains linearly into maltose
Proteases (peptidase)	122-138 (50-59) 113-128 (45-53)	~155 (68) ~145 (63)	4.6-5.3	Break down proteins (increase FAN)
β-glucanase et. al.	95-131 (35-55)	~140 (60)	4.5-5.5	Breaks down cell-wall materials
Limit-dextrinase	95-140 (35-60)	~150 (65)	5.0-5.8	Breaks down sugars left behind by amylases and can be inhibited

As we see, different enzymes are activated at different temperatures.

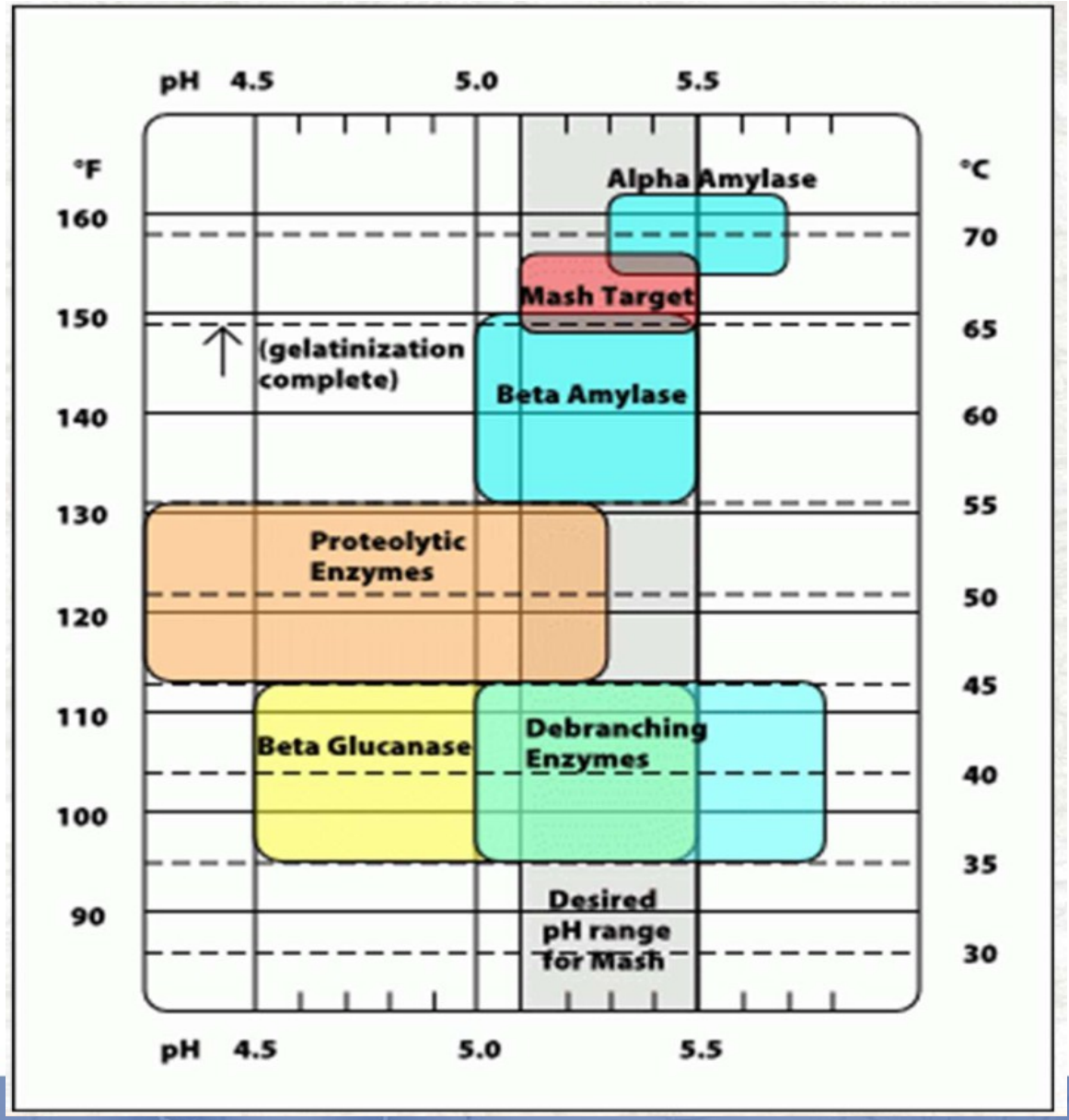
Single Infusion vs Step Mashing

Stepping and resting through the different ranges will enhance your brew considerably more than resting at a middle ground.

- A single infusion mash brings the grist (ground grains) to a temperature ~155/68, where alpha amylase and beta amylase enzymes both can work on the carbohydrate molecules.
- Single Infusion denatures other enzymes, so their benefits are lost.
- By stepping the grist temperature through low to high ranges, specific enzymes are activated.



Helles Mash Schedule



Specific Gravity

- The Specific gravity of a liquid is measured using a hydrometer. Denser liquids cause the hydrometer to float higher.
- Sugars extracted from the mashing process make the water denser.
- The alcohol content(abv%) can be calculated from the original(OG) and final(FG) gravities of a wort

$$ABV = (OG - FG) * 131.25$$

So an original gravity of 1.07 and an final gravity of 1.01 will yield an abv 7.87%

Specific Gravity

- Why bother?
  - SG will tell you how well your mash went.
    - The higher the SG the better the starch conversion.
  - SG can tell you approximately when your brew is done (true for ales, wine, meads, etc.)
    - DON'T GO BY BUBBLES!

Glossary of Terms

- Adjunct – unmalted grains used in brewing
- Barley – the key grain used in brewing
- Grist – the ground grains to be mashed
- Infusion – adding hot water to the grist
- Lovibond – grain color scale
- Malting – preparing the grains for mashing
- Mash – the act of steeping the grist to acquire wort
- Sparge – rinsing the grains with hot water
- Wort – extracted liquid from the mashing process

Bibliography

- DESALLE, R., TATTERSALL, I., & Wynne, P. J. (2019). A Natural History of Beer. Yale University Press.
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Cheers!

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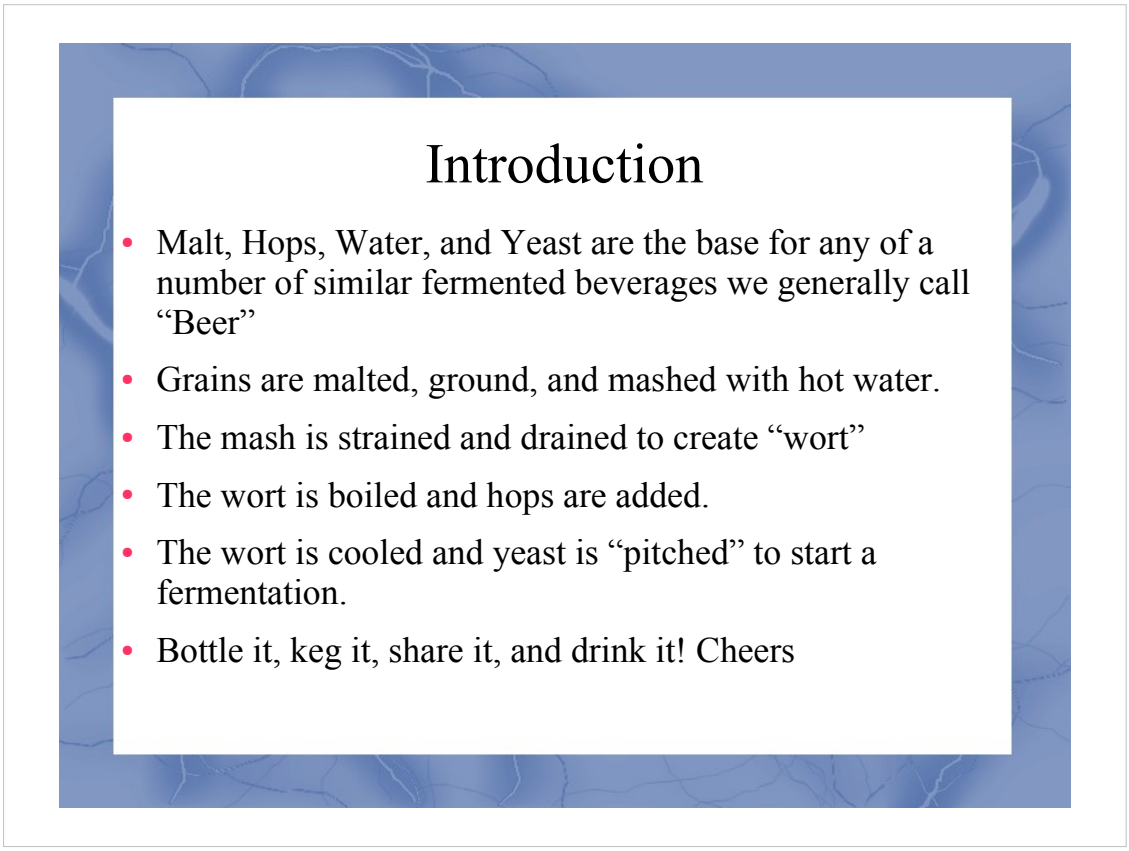
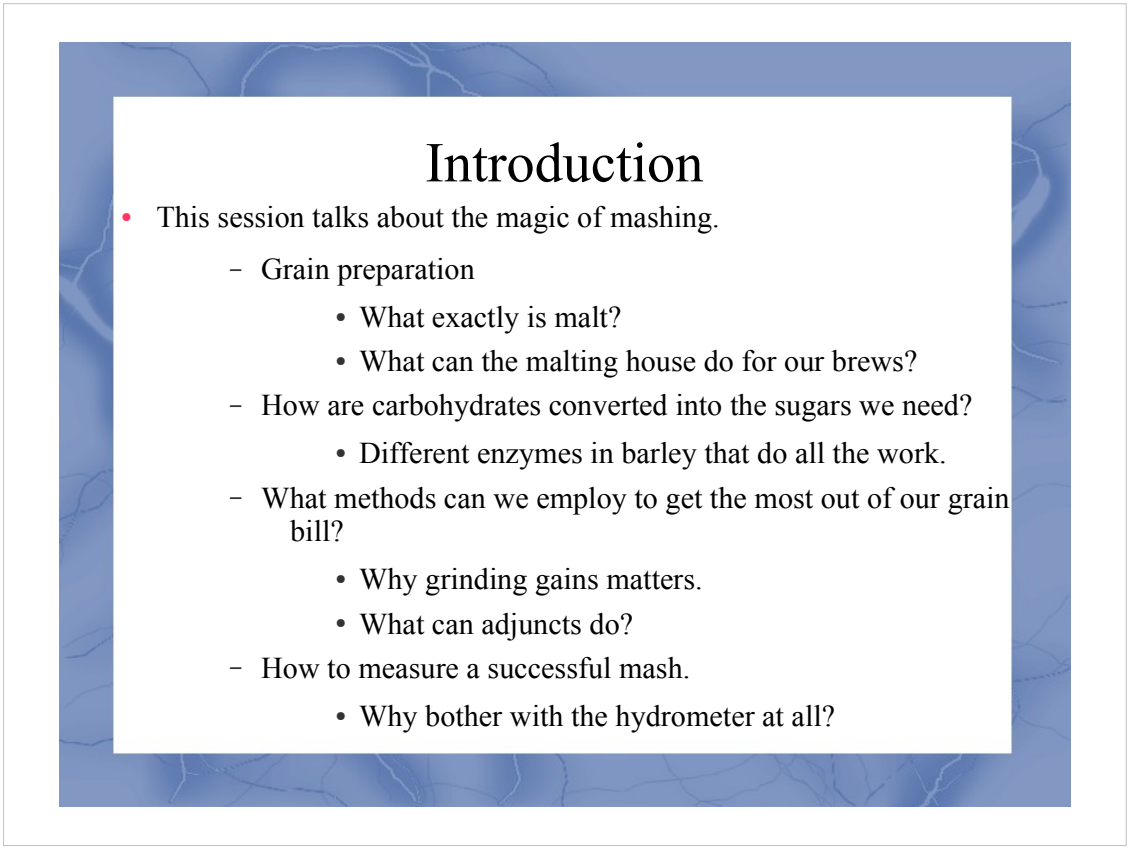


It's assume that the reader understand the basic processes and procedures of doing an all grain brew.here we simply review the major steps from raw grain harvest to thirst quenching goodness.



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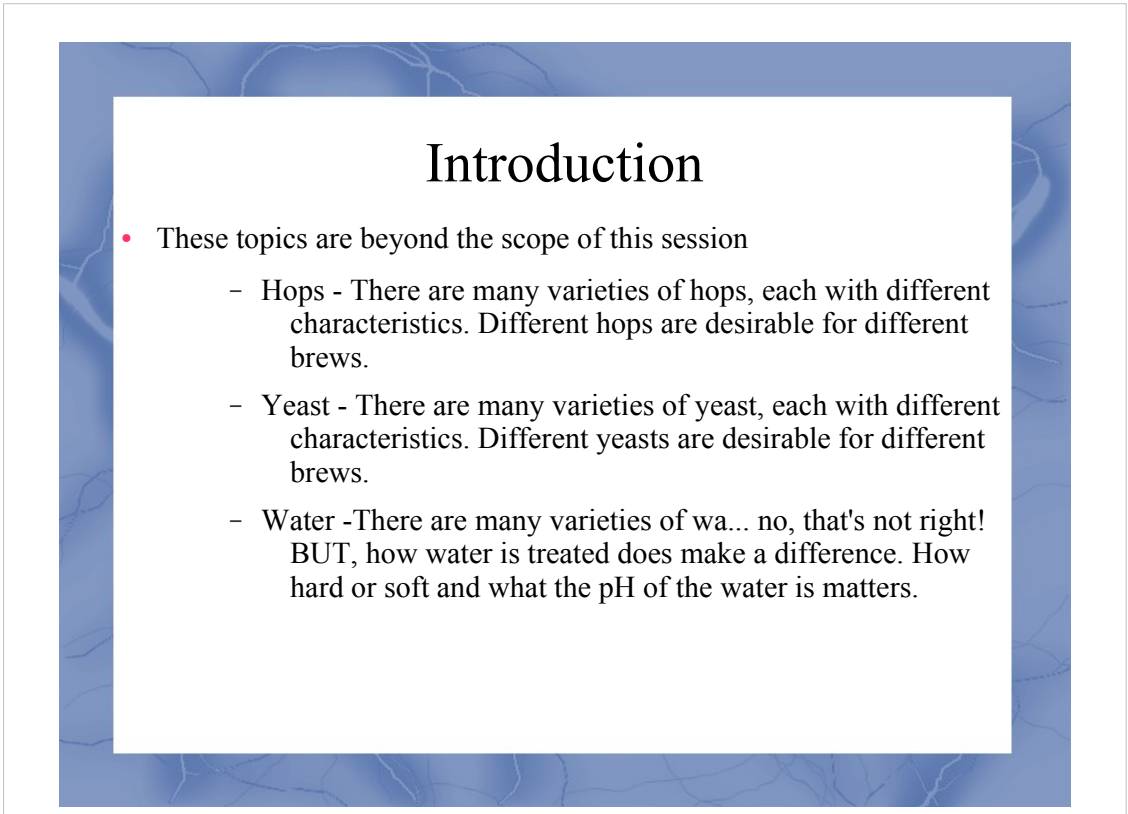
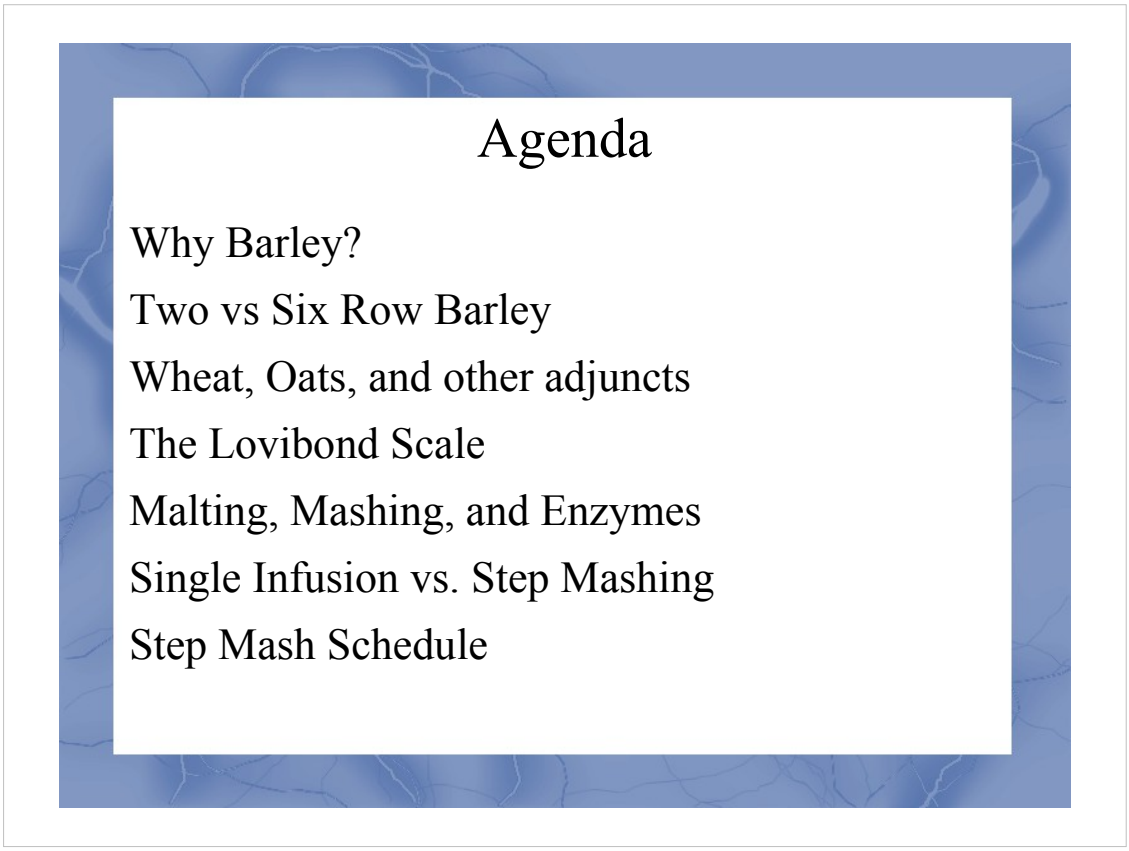


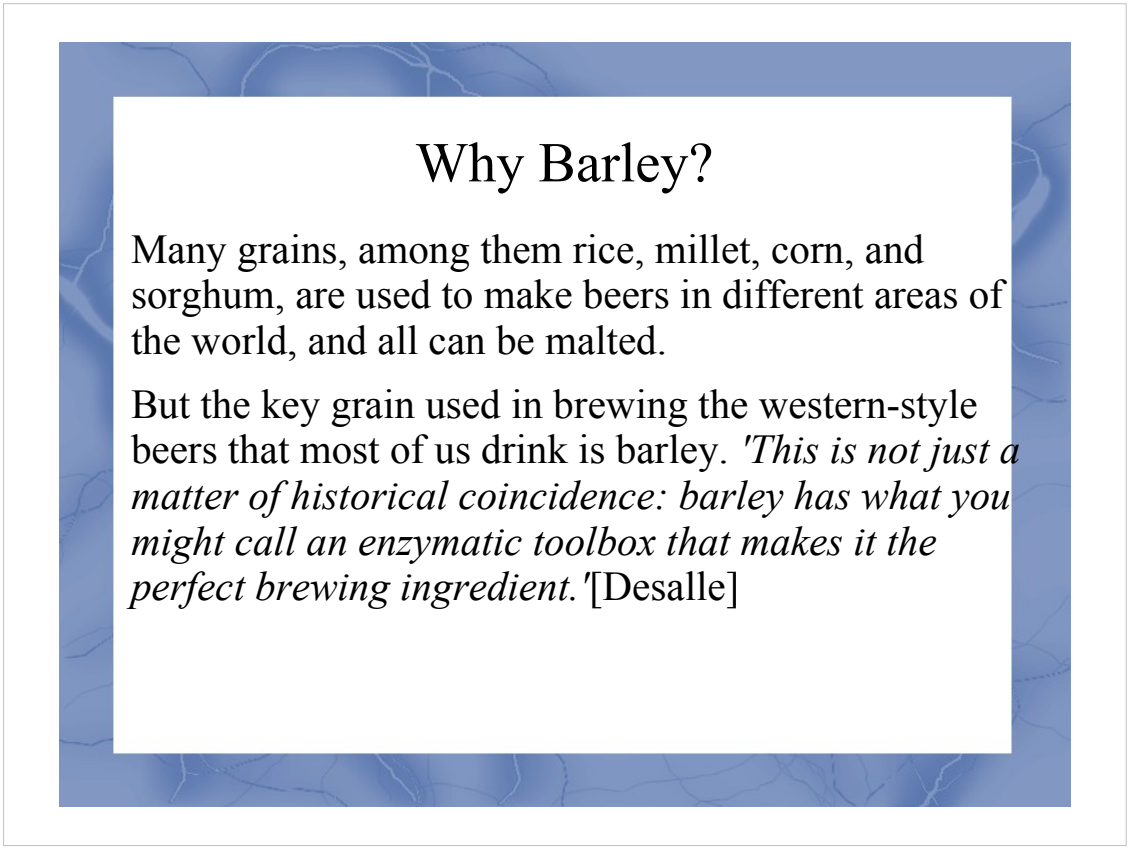
Aside from the mashing process, the rest of the brewday s not covered in this presentation.

There are four ingredients outlined in the Reinheitsgebot. Each may have a seemingly infinite set of variations.Combining these variations allows us tto create any brew we want. Adding adjunct grains and different botanicals increases the solution sett even further.

This session only discusses the mashing of grains.



- **Grains**
  - Two vs Six Row Barley
    - Give the history of barley is a few sentences.
    - What's the difference and why choose one over the other?
  - Wheat, Oats, and other adjuncts
    - What's an adjunct?
    - Why use grains other than barley?
  - What grains are appropriate for the target beverage?
    - What do these adjuncts bring to the beverage?
      - Corn – mouthfeel
      - Wheat – head
      - Oats - texture
      - Rice – lightness
      - Rye - flavor



Malting, as we will see, is the partial germination and then heating of a grain to develop sugars and enzymes needed for the brewing process.

Some grains can be malted, but the best for brewing is barley. This is because of the amount and types of enzymes present in the malt.

Two vs Six Row Barley

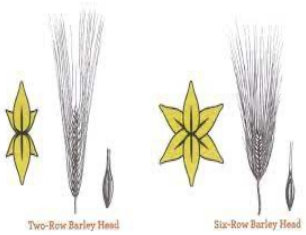
There are two main types of barley: two row and six row.

Two-row barley kernels tend to be symmetrical; they're also easier to grind in two-roller mills.

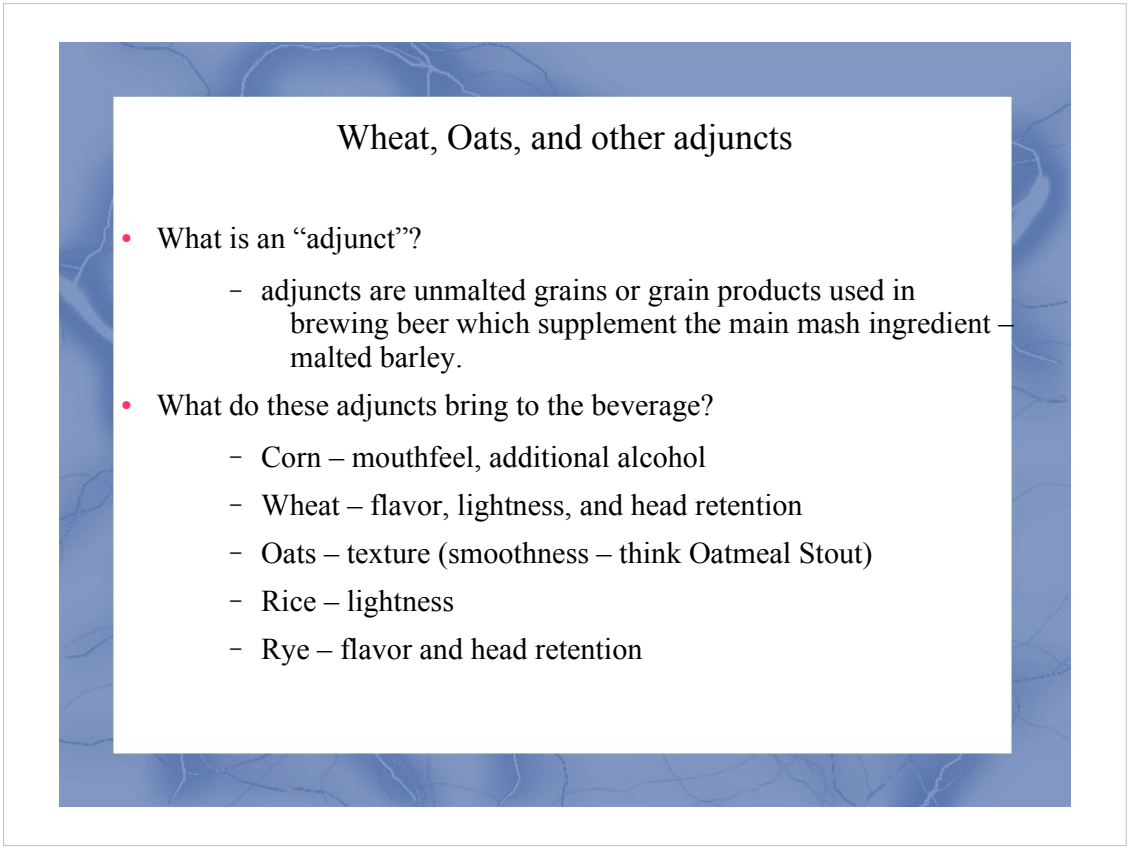
Six-row barley has a symmetrical center, but the two lateral rows of kernels are a little shorter, thinner, and twisted slightly.

Two row barley has lower enzyme content, lower protein, greater starch content, and thinner husk make it better suited to higher extract. There are enough enzymes to convert the starches to sugar, and the lower protein content helps reduce hazing.

More six row barley should be used in recipes with a larger amount of adjunct grains. This will provide more enzymes to work on the carbohydrates from grains that lack them.



The ease of milling and the higher enzyme content would make that six row is preferable to two row in brewing. Two row barley produces a less hazy brew, makes it far more desirable, considering it has enough enzymes for conversion.



Add more sugars and get more alcohol, right?

Not necessarily. Adjuncts like rice will contribute more sugars to the wort without much additional color or flavor, but it will result in a thinner and lighter brew (see: Budweiser). Oats, corn, wheat, and rye also contribute their own qualities to the brew. Using adjuncts may require the higher enzymatic power of six row barley.

Be careful when mashing adjuncts, they get sticky!

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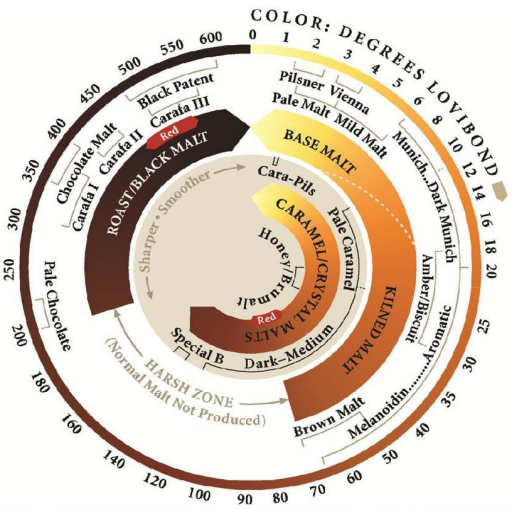

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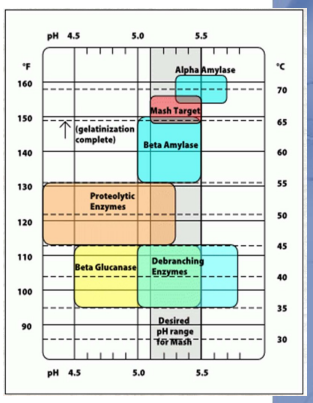
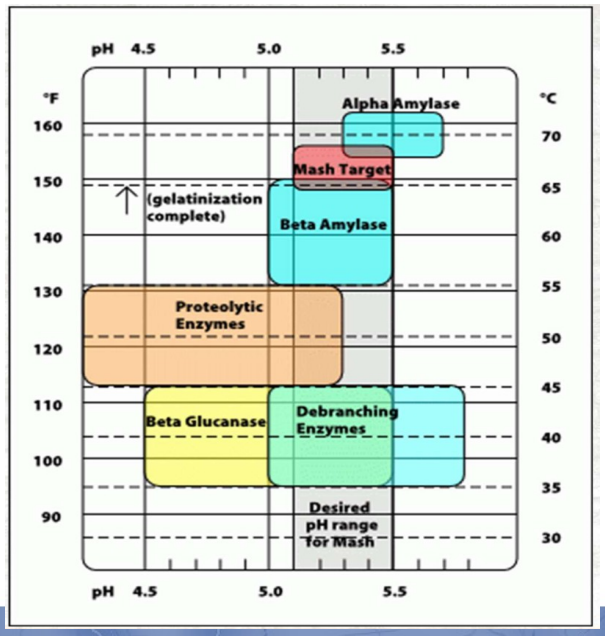


Single infusion mash – one addition of water to the grist then rest at a target mash temperature

Step infusion mash – multiple additions of water to “step” the grist through different temperature ranges in order to take advantage of all the enzymes available.

Helles Mash Schedule



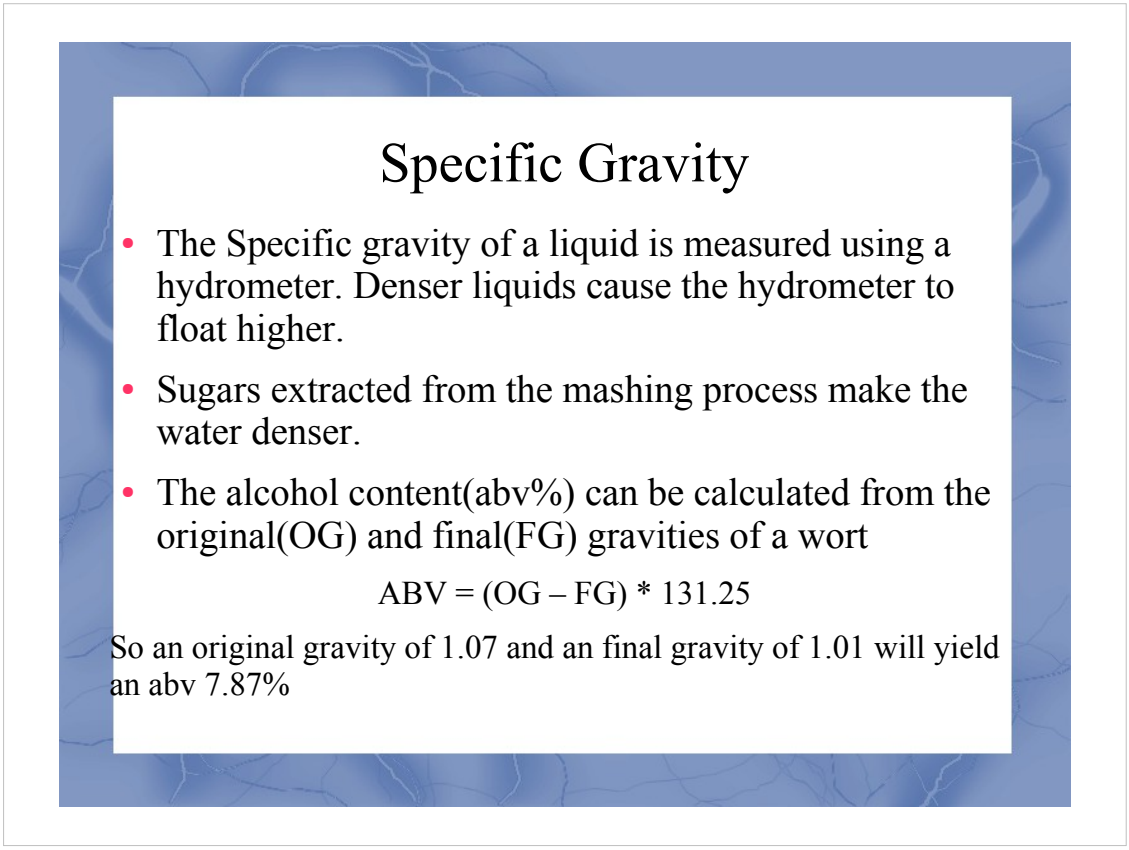
Optional Acid Rest - Dough in a thick mix of grain at 100 ‡ 5 °F (38 ‡ 2 °C) for an optional acid rest of 15 to 30 minutes.

Protein Rest - If you start with an acid rest, raise the mash temperature to about 122 °F (50 °C) for a protein rest of about 30 minutes, using a small quantity of hot water and external heat. If you skip the optional acid rest, dough in directly at the protein rest temperature.

Beta Saccharification Rest - Increase the mash temperature, using a combination of hot-water infusion and direct heat, to 146 ‡ 2 °F (63 ‡ 1 °C) for a beta saccharification rest of about 15 minutes. Again, you can accomplish this temperature increase by decocting one-third of the main mash.

Alpha Saccharification Rest - Next raise the temperature in the same manner to 156 ‡ 2 °F (69 ‡ 1 °C) for an alpha saccharification rest of about 15 minutes.

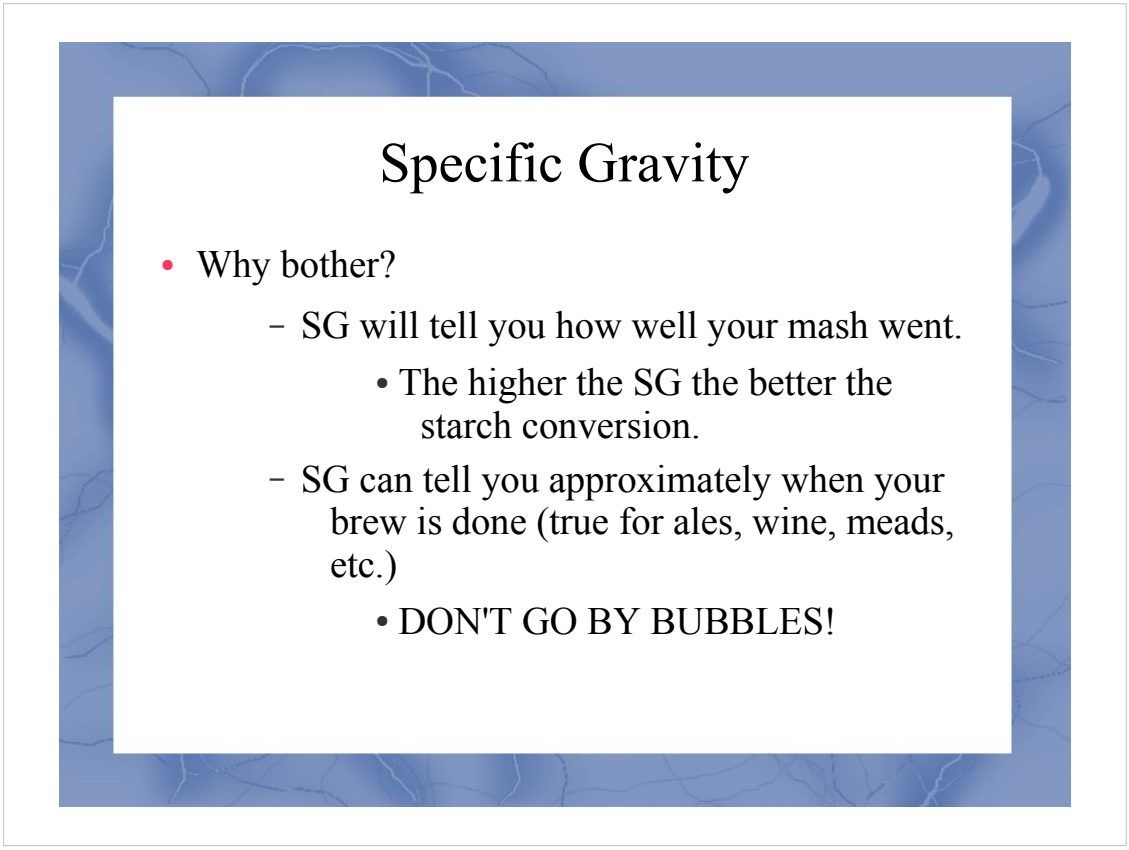
Mash Out - Finally raise the temperature to 170 °F (77 °C) for the mash out and start sparging.



Here is a specific gravity reading being taken in period from The Closet of Sir Kenelm Digby Knight Opened

STRONG MEAD

Take one Measure of honey, and dissolve it in four of water, beating it long up and down with clean Woodden ladels. The next day boil it gently, scumming it all the while till no more scum riseth; and if you will clarifie the Liquor with a few beaten whites of Eggs, it will be the clearer. The rule of it's being boiled enough is, when it yieldeth no more scum, **and beareth an Egge, so that the breadth of a groat is out of the water.** Then pour it out of the Kettle into woodden vessels, and let it remain there till it be almost cold. Then Tun it into a vessel, where Sack hath been.



non-Bubbling airlocks may fool you into thinking the fermentation is complete. It may just be stuck. There may be unfermented sugars in the must that can ferment later in the bottle. This is what causes “bottle bombs”

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