# Attenuation Factors

Presented by Mick Spencer

# *Malt Wort Carbohydrates*

| | |
|---|---|
| Glucose | Completely fermentable by Ale and Lager Strains |
| Fructose | |
| Sucrose | |
| Maltose | |
| Maltotriose | Partially fermentable by most Ale and Lager Strains (% depends on strain) |
| Higher Dextrins | Not fermentable by most Ale and Lager Strains |

- The basic fermentability of a wort depends on the proportions of the carbohydrates.
  - Less Maltotriose and/or less Higher Dextins means a more fermentable wort.

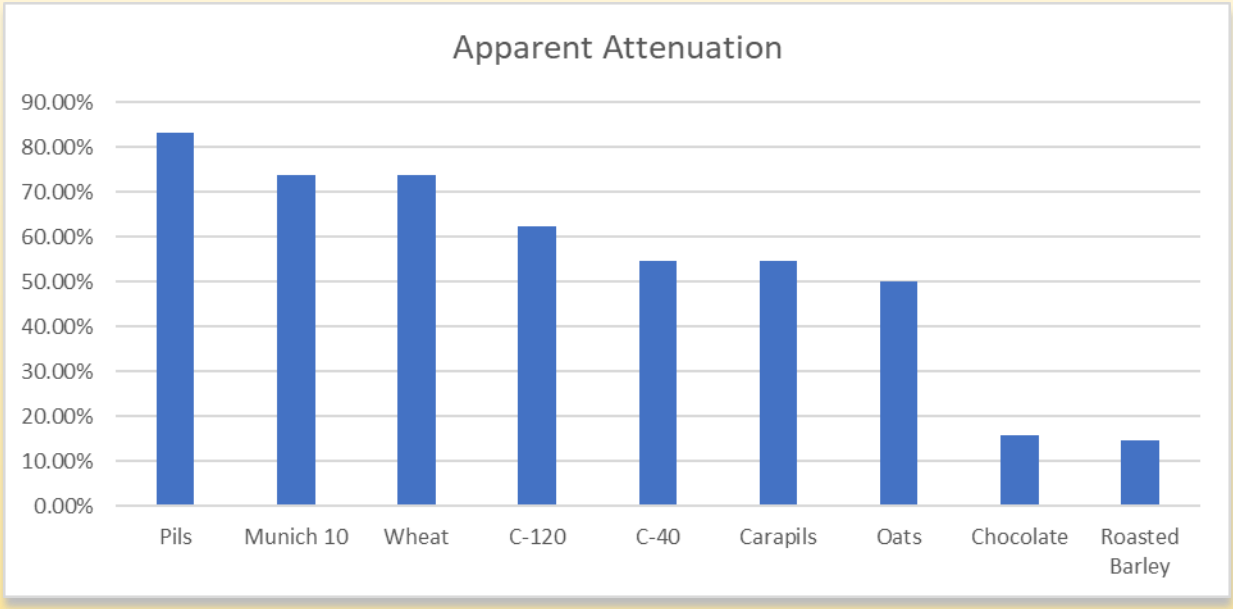
# *Basic Attenuation Factors*

- Wort Fermentability (carbohydrate proportions), driven by…
  - Grain Bill and Other Fermentables
  - Mash Temperature
  - Mash Length
- Yeast Strain

# *Grain Bill and Other Fermentables*

- Various malts and grains will, all else being equal, yield worts with different fermentabilities.
  - Example: Pilsner is more fermentable than Crystal Malts
- Simple Sugars are completely fermentable
- Lactose and Maltodextrin are essentially unfermentable

# *Grain Data*




Lightly kilned malts tend to be more fermentable than highly kilned/roasted malts

151F, 60 Minute Mashes, derived from Greg Doss' data

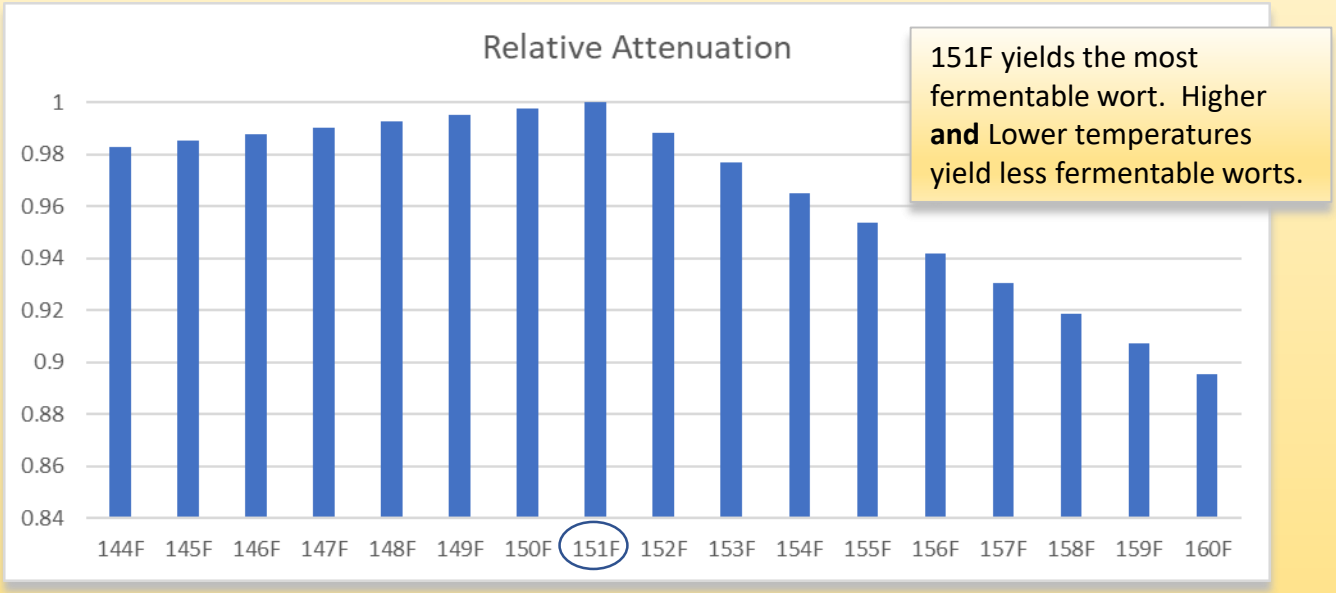
# *Mash Temperature*

Q: TRUE or FALSE?

“Higher mash temperatures make a less fermentable wort than lower mash temperatures.”

# *Mash Temperature (cont.)*

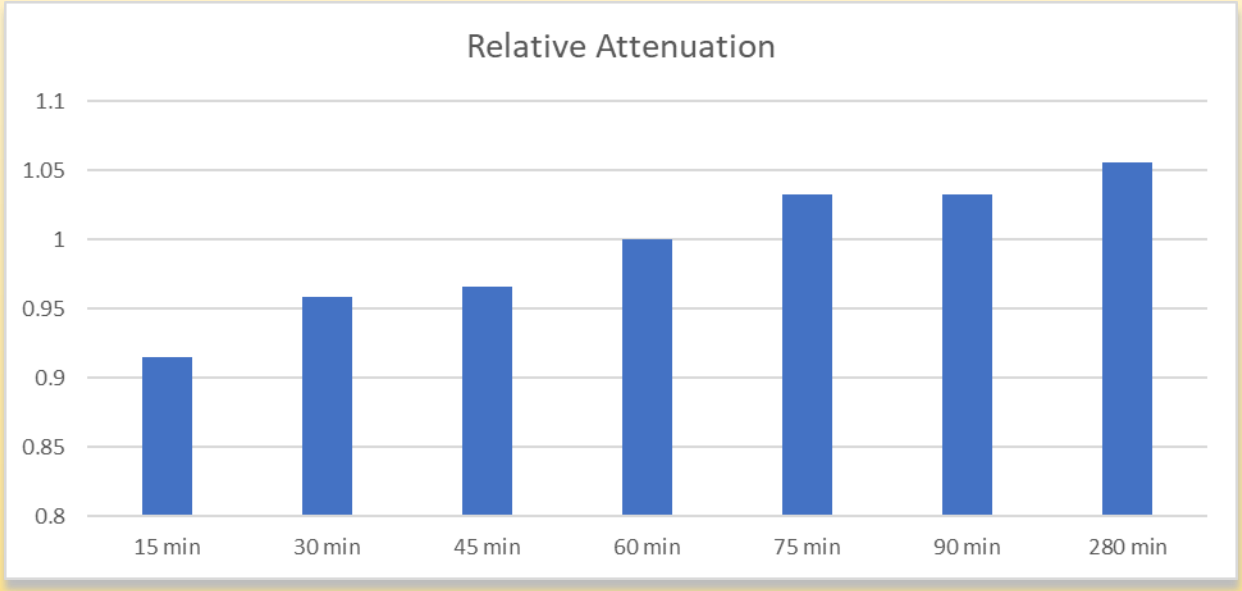
A: It depends on what you mean by higher and lower.




Single Infusion 60 Minute Mashes, all Pilsner grist. Derived from Kai Troester's data, with slopes fitted by Matt Kahn. Normalized to 1 max.

# *Mash Length*

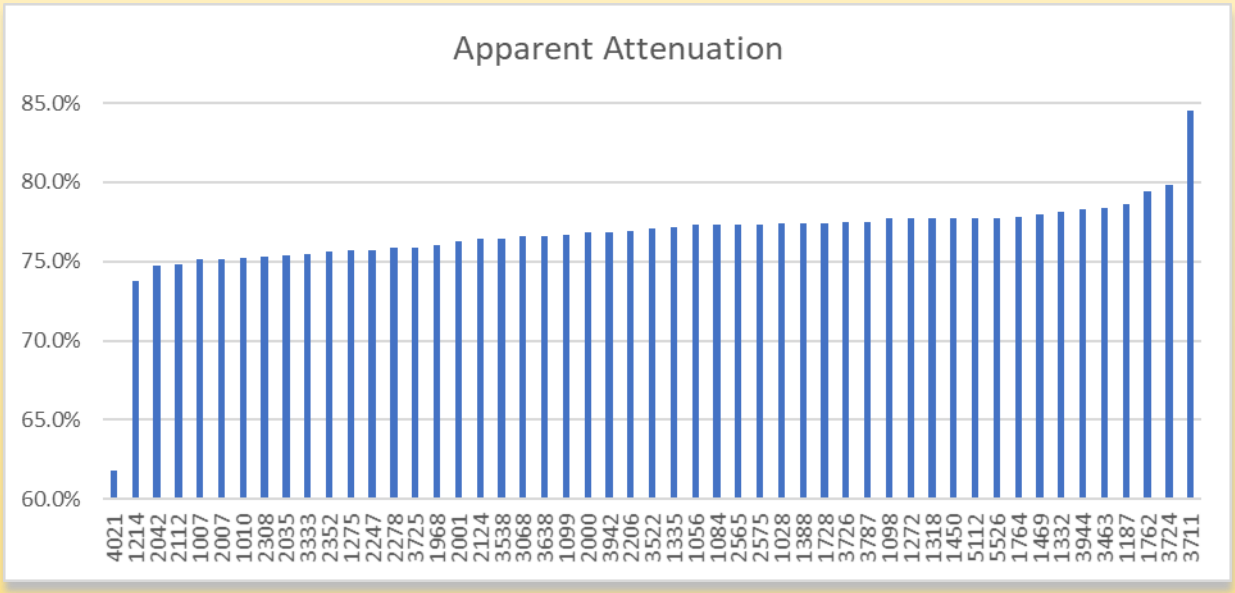
Longer Mash Times yield more fermentable worts.




Various mash temps. Pilsner grist. Derived from Kai Troester's data and Greg Doss' data, normalized to 1 at 60 minutes.

# *Yeast Strain*

*Relative* ability to ferment Maltotriose is *strain dependent*, accounting for most differences in overall attenuation.




Light DME fermentation. Values interpreted from Greg Doss' pictorial graph.

# *Summary*

- Basic Wort fermentability is determined by the mix of carbohydrates. The mix is driven by…
  - Grain Bill and Other Fermentables
    - *Lightly kilned malts -> more fermentable*
  - Mash Temperature
    - *151F yields the most fermentable worts*
  - Mash Length
    - *Longer Mash -> more fermentable*
- Ale/Lager yeasts ferment all simple sugars and some variable amount of Maltotriose, depending on strain. *The amount of Maltotriose fermented accounts for most differences in attenuation by strain.*

"More Fermentable" … less Maltotriose and/or less Higher Dextrins.

# *Attenuation Prediction in Brewing Software*

| | Factors Considered in Predicting Attenuation | | | |
|---|---|---|---|---|
| Software | Yeast Strain | Grain Bill | Mash Temp | Mash Length |
| BeerSmith | ☑ | ☐ | ☑ | ☑ |
| BrewCipher | ☑ | ☑ | ☑ | ☑ |
| BrewTarget | ☑ | ☐ | ☐ | ☐ |
| QBrew | ☐ | ☐ | ☐ | ☐ |

# *Further Reading*

"Exploring Attenuation" by Greg Doss, 2012

http://www.homebrewersassociation.org/attachments/presentations/pdf/2012/1616-04%20Attenuation%20-%20Gregg%20Doss.pdf

"Evaluation of the Effect of mash parameters on the limit of attenuation and conversion efficiency in single infusion mashing" by Kai Troester, 2008

http://braukaiser.com/documents/Effects_of_mash_parameters_on_attenuation_and_efficiency.pdf