The Influence of the Mash on Sour Beer Production

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Overview

- Carbohydrates
- Mash pH
- Esters
- Phenols
- Body & Mouthfeel

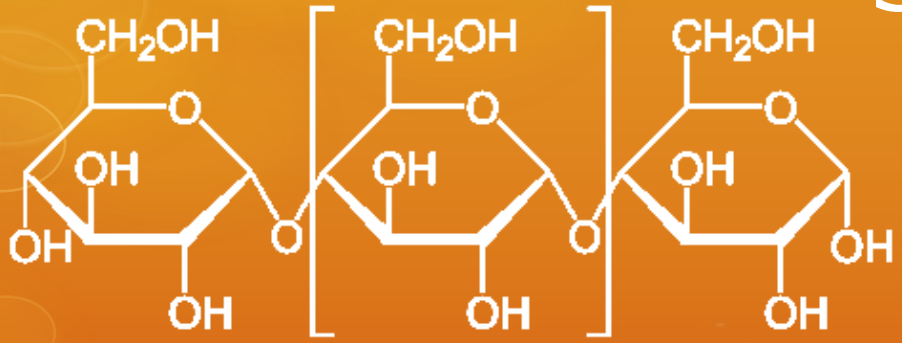
Your First Sour Beer

- Parameters:
  - OG = 1.040-1.060
  - IBUs < 20
  - SRM < 25
- Brew your favorite qualifying clean beer recipe
  - English brown, Kölsch, American wheat, Scottish 60/- etc.
- Pitch into primary:
  - Standard brewer’s yeast
  - Commercial souring blend (e.g., WY3763, WLP655)
  - Bottle dregs from two unpasteurized sour beers

Standard vs. Purpose-Brewed Wort

- Standard wort
  - Easy!
  - Split batches
- Purpose-brewed
  - Additional influence over:
    - Acidity
    - Fruitiness
    - “Funkiness”
    - Body

Starch Conversion



- Carbohydrates
  - Starches
  - Dextrins
  - Sugars

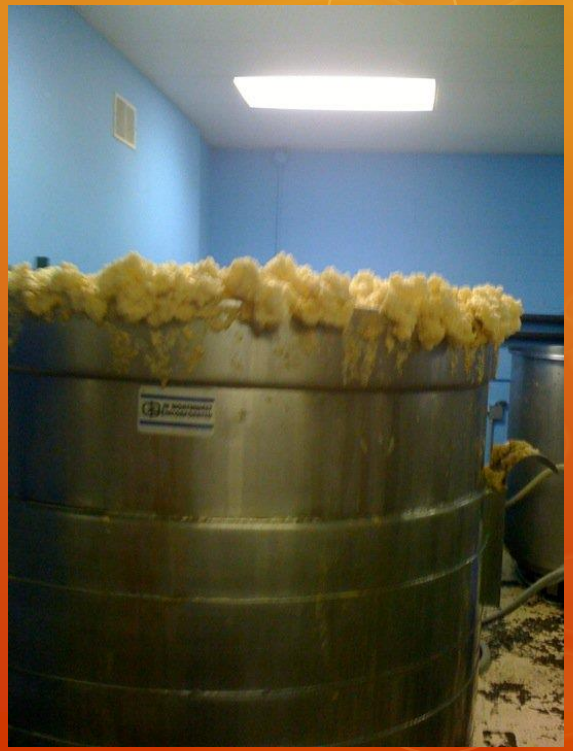
- Unfermentatable by what?
  - Above three glucose chains (maltotriose) for brewer's yeast, also lactose and other with beta-bonds (e.g., glycosides)
  - Above nine glucose chains for many *Lactobacillus*, and *Brettanomyces* strains (limit of alpha-glucosidase)
  - Some *Pediococcus* species are capable of fermenting starch!

Effect of Additional Dextrins

- Lactic acid bacteria
  - More carbohydrates = more potential acidity
  - Heterofermentative vs. homofermentative strains
  - Some commercial *Lactobacillus* strains are lacking…
- *Brettanomyces*
  - More carbohydrates = more CO_2 and ethanol
  - More esters anecdotally
  - No additional "funkiness"
    - 100% *Brett* fermented beers

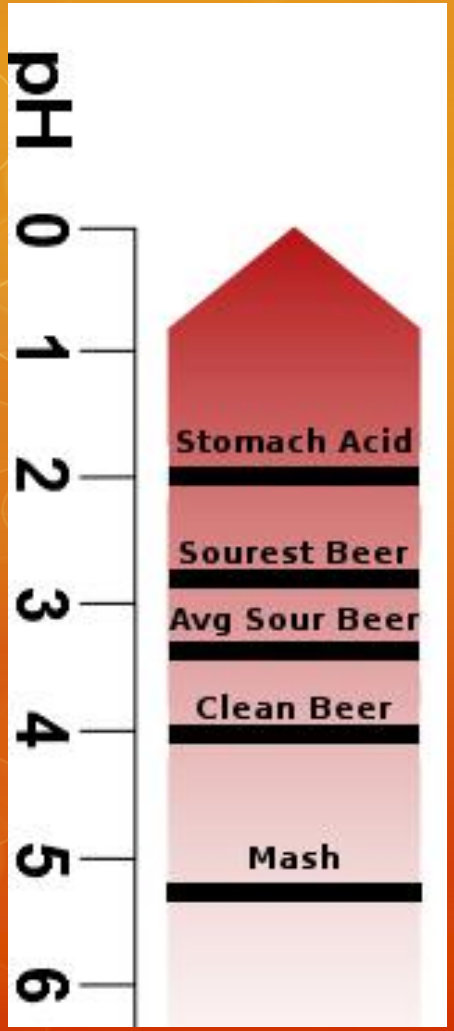
Reducing Initial Attenuation

- Mash hotter
- Pitch a less attenuative brewer's yeast
- Crystal/caramel malts in mash
  - Nilo Bortolotti's experiment: 50% crystal malt reduced attenuation by 3% with C10, 11% with C40, and 13% with C120
- Lower water-to-grain ratio
  - Kai Troester's experiment: no change between thick (1.21 qt/lb) and thin (2.37 qt/lb) mashes
- Long boil
  - Ankita Mishra's experiment: extending a boil from 30 min to 120 increased FG by .001



Unmalted Grains

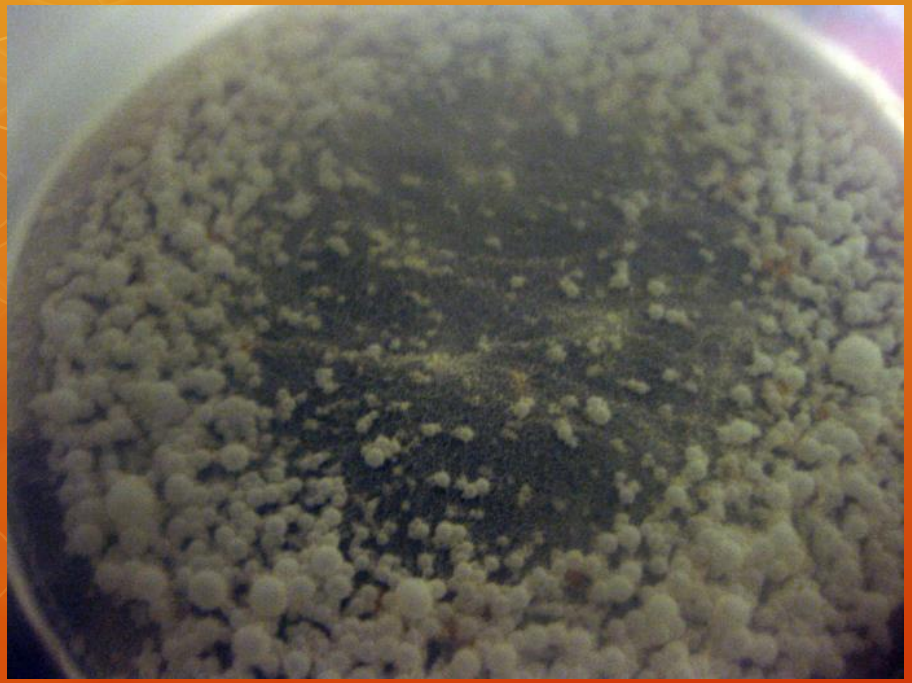
- Gelatinization/Gelation
  - Not gelatin!
- Raw grains
  - Cereal mash
  - Turbid mash
- Pre-gelatinized
  - Flaked
  - Torrefied
  - “Instant”
  - Minimal impact on fermentability



Influence of Mash/Wort pH

- Logarithmic scale
  - 3.0 100X more acid than 5.0
- Low pH can disrupt starch conversion
  - Cheater's turbid mash?
- Inhibit *Enteric* bacteria (spontaneous)
  - pH < 4.5
- Prevent protein breakdown by *Lactobacillus*
  - pH < 4.5–4.8
- Alters ester production by *Brettanomyces*

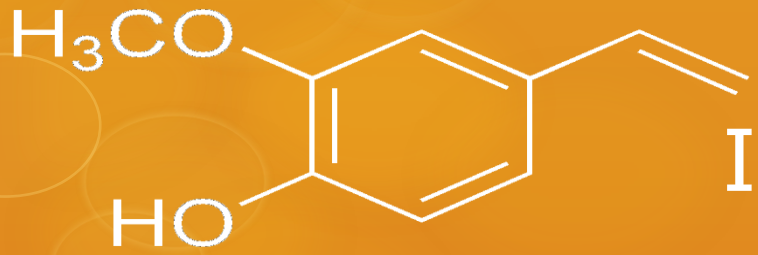
Lowering pH Pre-Fermentation



- Acid malt
  - Up to 20%
- Refined lactic acid
- Sour mashing
  - Highly variable
  - Not advised
- Sour the wort instead!

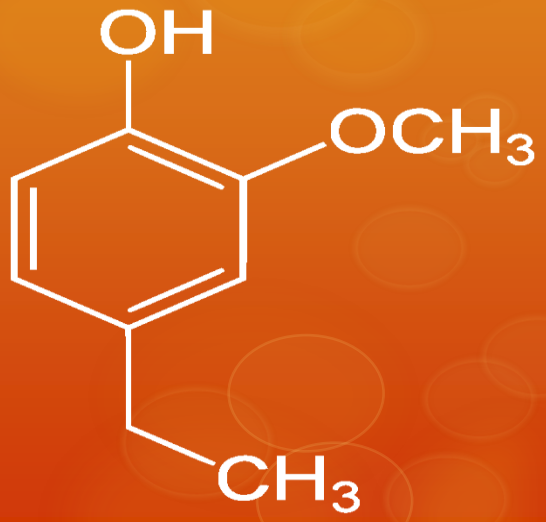
Acids to Esters

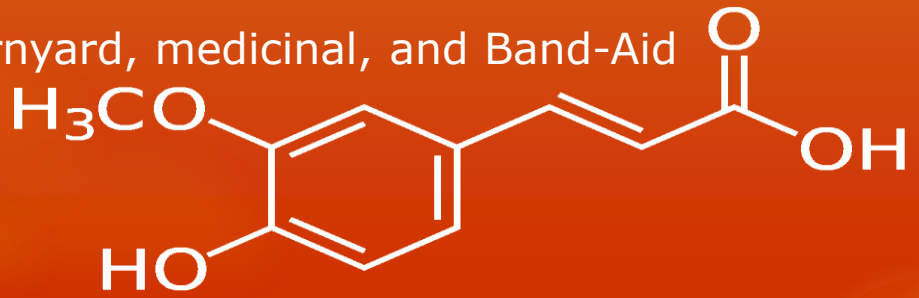
- Lactic acid – many sources
  - Ethyl lactate – fruity
- Acetic acid – *Acetobacter/Brett*
  - Ethyl acetate – fruity to solvent
- Caprylic – buckwheat/autolysis
  - Ethyl caprylate – pineapple
- Butyric – kombucha/parsnips
  - Ethyl butyrate – tropical
- Be careful, acid to ester conversion isn’t always complete!



Influence of Phenols

- 4 vinylguaiacol (4VG)
  - Classic clove "spiciness" of hefeweizen and Belgians
- 4 ethylguaiacol (4EG)
  - Smoky-barnyard flavors of *Brettanomyces*
  - Converted from 4VG
- 4 vinylphenol (4VP) and 4 ethylphenol (4EP)
  - Barnyard, medicinal, and Band-Aid





Controlling Phenols

- Wheat malt increases ferulic in wort
  - Despite containing less than barley
- Ferulic acid rest
  - ~113°F (45°C) for 10-15 minutes
  - Converted to 4VG by POF+ brewer's yeast
- Limit polyphenol extraction
  - Crush
  - Sparge (watch temperature and pH)
  - Use 2-row base malt

Body and Mouthfeel

- Why are wild beers so thin?
  - Lack of residual dextrins
  - Less glycerin (100% *Brett* especially)
- Remedies?
  - Additional protein
    - High-protein adjuncts
      - Rye, oats, spelt, and quinoa
  - Higher chloride water (100-150 PPM)
  - Beta-glucan, soluble fiber (maybe…?)
  - Be mindful of carbonation

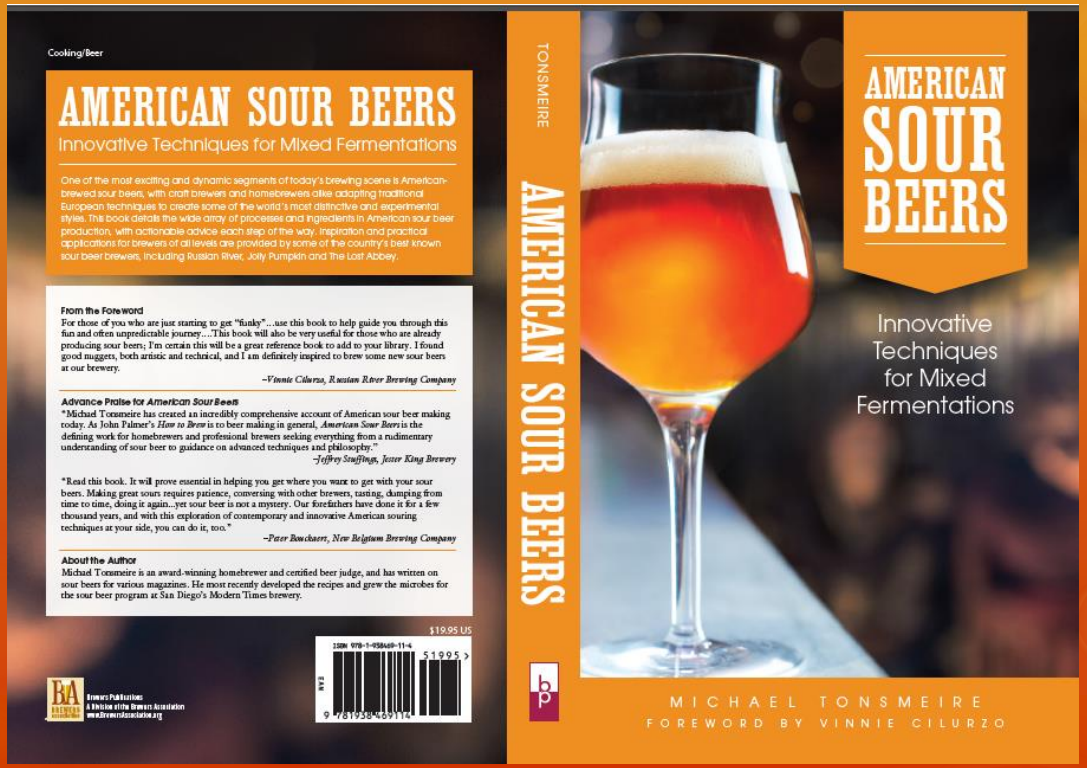
Minimize Funk and Acidity

- Minimize funk
  - No wheat malt
  - Straight to saccharification rest
  - Use a non-phenolic brewer's yeast (e.g., English, American, lager)
  - *Brettanomyces anomalus* (AKA *B. claussenii*) – or no *Brett*!
  - Rack to secondary after fermentation
    - Optional: cold crash, fine, or filter
  - Force carbonate
- Minimize acidity
  - Saccharification rest at 146-148°F (63-64°C)
  - Pitch highly attenuative brewer's yeast
  - *Lactobacillus delbrueckii, L. buchneri*

Maximize Funk and Acidity

- Maximize funk
  - Add wheat malt
  - Start with ferulic acid rest
  - Pitch a phenolic brewer's yeast strain (e.g., Trappist, hefeweizen, saison)
  - *Brettanomyces bruxellensis* (AKA *B. lambicus*)
  - Sour in primary fermentor
  - Bottle condition
- Maximize acidity
  - Saccharification rest at 158-160°F (70-71°C)
  - Pitch less attenuative brewer's yeast
  - *Pediococcus, Lactobacillus brevis*

Questions


Cooking/Beer
AMERICAN SOUR BEERS
Innovative Techniques for Mixed Fermentations
One of the most exciting and dynamic segments of today's brewing scene is American-brewed sour beers, with craft brewers and homebrewers alike adapting traditional European techniques to create some of the world's most distinctive and experimental styles. This book details the wide array of processes and ingredients in American sour beer production, with actionable advice each step of the way. Inspiration and practical applications for brewers of all levels are provided by some of the country's best known sour beer brewers, including Russian River, Jolly Pumpkin and The Lost Abbey.
From the Foreword
For those of you who are just starting to get "funky"...use this book to help guide you through this fun and often unpredictable journey...This book will also be very useful for those who are already producing sour beers; I'm certain this will be a great reference book to add to your library. I found good nuggets, both artistic and technical, and I am definitely inspired to brew some new sour beers at our brewery.
–Vinnie Cilurzo, Russian River Brewing Company
Advance Praise for American Sour Beers
"Michael Tonsmeire has created an incredibly comprehensive account of American sour beer making today. As John Palmer's How to Brew is to beer making in general, American Sour Beers is the defining work for homebrewers and profesional brewers seeking everything from a rudimentary understanding of sour beer to guidance on advanced techniques and philosophy."
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"Read this book. It will prove essential in helping you get where you want to get with your sour beers. Making great sours requires patience, conversing with other brewers, tasting, dumping from time to time, doing it again...yet sour beer is not a mystery. Our forefathers have done it for a few thousand years, and with this exploration of contemporary and innovative American souring techniques at your side, you can do it, too."
–Peter Bouckaert, New Belgium Brewing Company
About the Author
Michael Tonsmeire is an award-winning homebrewer and certified beer judge, and has written on sour beers for various magazines. He most recently developed the recipes and grew the microbes for the sour beer program at San Diego's Modern Times brewery.
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