Brettanomyces:

Flavors and performance of single and multiple strain fermentations with respect to time.

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“Brett” Descriptors

- Horse Blanket
- Barnyard
- Pie Cherry
- Sweetarts/ Smarties Candy
- Smokey
- Band-aids
- Bacon
- Spice
- Cloves
- Cheesy
- Rancid
- Mousy/ Mouse Urine
- Bready
- Dirty Socks

- Clean????

Outline of Talk

- General Brettanomyces Information
- Wyeast Experiment
- Tasting/ Discussion

General

- Isolated by Claussen 1904 as cause of 2^{o} fermentation of English Stock Beer
- Brettano-myces = British Brewing-Fungus
- Dekkera
  - Interchangeable name for Brettanomyces
  - Sporagenous form or sexual anamorph
  - Spore form is rare in nature <1.0%

General

- Major spoilage organism in wine.
  - Responsible for $ millions annual losses in the wine industry.
  - Most research performed on Brettanomyces in wine.
- Very little research in beer.
- Common character of Lambics and Orval
- Homebrewers Gaining Popularity
  - (Burgundian Babble Belt, Mad Fermentationist, etc.)
- US Commercial Brewers
  - Russian River, Pizza Port, Jolly Pumpkin, The Shed etc.

General

Brettanomyces/ Dekkera Species Taxonomy

- B. bruxellensis
  - B. lambicus, B. intermedius
- B. anomala
- B. custersianus
- B. naardenesis
- B. nanus

Each specie very diverse with many strains

General

- Slow growing
  - Grow to large populations from very few cells
- Fastidious
- Very adaptable
- Resilient to harsh conditions
  - Low pH
  - High alcohol
  - Low nutrient
- Resistant to Cycloheximide

Morphology

- Variable Morphologies
  - “Boat” shaped (Ogival)
  - Spherical
  - Elongated (Pseudohyphae)

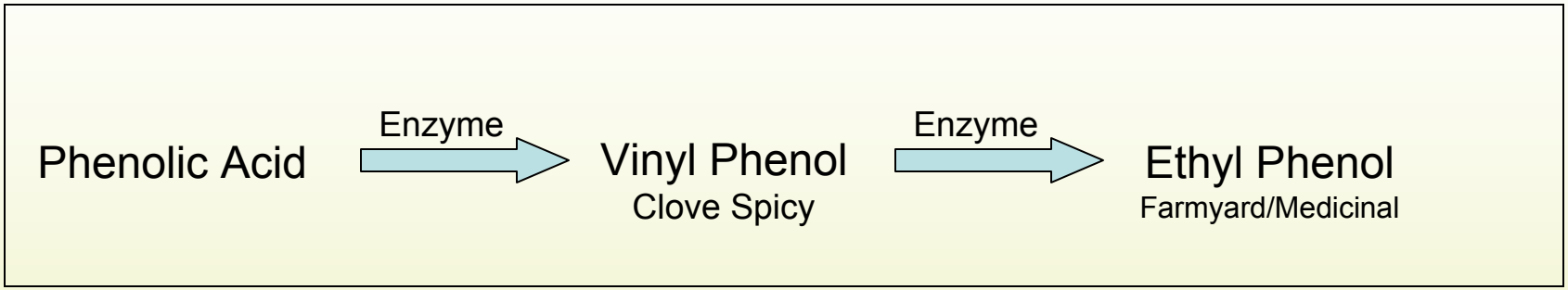
Metabolism

- Can use a large number of substrates for carbon source
  - Simple Sugars
    - Glucose, Fructose, Sucrose, Trehelose, Maltose, Maltotriose
  - Dextrins
    - Maltotetrose completely
    - Maltopentose & Larger dextrins partially
  - Alcohol
    - Ethanol, glycerol
  - Cellibiose (Wood)
    - Most of the problems in wine industry

“Brett” Flavor Contribution

- Volatile Phenols
  - Medicinal (Band-Aid, plastic)
  - Farmyard (Horse blanket, Wet animal, Wet leather)
  - Spicy Clove
- Acetic Acid (Vinegar)
  - O_2 required
  - More found in barrel/ carboy aging
  - Less if added at bottling
- Isovaleric Acid (Rancid, Cheesy)
  - Leucine conversion
- Tetrahydropyridines (Mouse urine [High] , Bready [Low])
  - Ethanol + Lysine (O_2)
- Ethyl Lactate
  - Fruit, Coconut

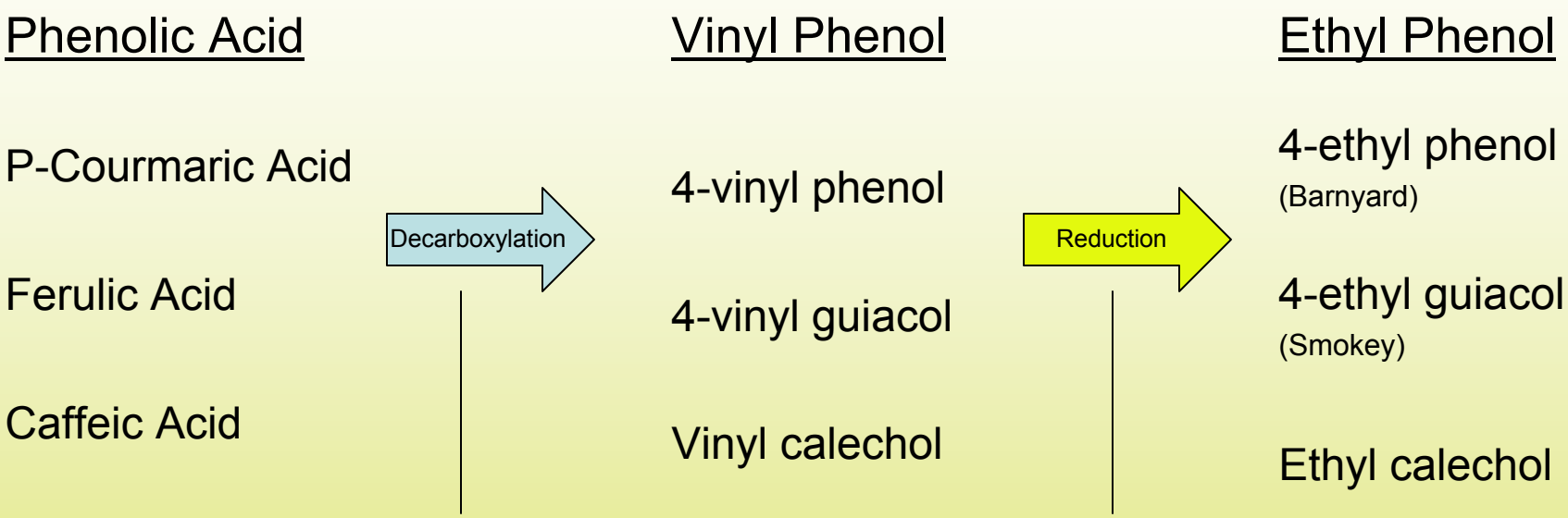
Volatile Phenols



- Why do they do that? .
  - Survival mechanism.
  - Way for cell to replenish coenzyme NADH pool

- Reaction is dependant on enzyme activity and substrate levels
  - Not necessarily dependant on growth
    - Population
  - Enzyme activity is dependant on fermentation conditions.
    - ☆ Manipulated by O_2, pH, Density, Temperature
  - Level of substrates - Hydrocinnamic Acids (Penolic Acids)
    - Abundant in plants including cereal grains.
    - Anti-oxidants
    - Natural antimicrobials
    - ☆ Manipulated by Grist/ Mash profile

Volatile Phenols



Common

Saccharomyces

Most Wild yeast

Lactic Acid Bacteria

Unique

Brettanomyces

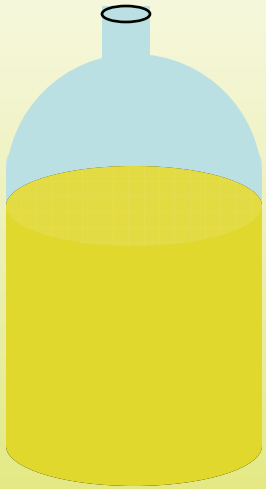
Pichia spp.

Candida spp.

Few Lactic Acid Bacteria

Sanitation

- Why are we scared?
  - Don't know a lot about it.
  - Will survive in low pH, high alcohol, low nutrient environments.
  - Very recognizable flavor profile.
  - Bio-film



- Don't be scared!
  - Brettanomyces dies like everything else.
    - Use good sanitation techniques – no problems
    - Susceptible to heat and chemicals.
      - 155F
    - Avoid plastic fermenters
    - No cracks in gaskets
    - Take all parts of corni apart
    - Chemicals
      - Cleaner
        - » Caustic
        - » Glo-san/ PBW
        - » Can add chlorine if concerned with biofilm.
      - Sanitizer
        - » Iodophor
        - » Acid Sanitizer
        - » Peracetic acid

How do we use Brett in the Brewhouse?

- CommercialExamples
  - Orval @ Bottling 5000 cells/ ml.
    - No priming sugar added
    - Flavor production around 3 months.
  - Lambic Breweries
    - Natural inoculation
    - Flavor production 6 months
  - Russian River
    - Number of different beers.
      - Most 2º Brett in barrel
      - Sanctification all Brett
    - Bottles at 1.010, Ends up at 1.004
  - Jolly Pumpkin
    - 1º stainless, 2º Natural Brett in barrel
    - Not a lot of density drop from Brett
- Homebrew
  - Bergundian Babble Belt Brett Exchange
  - http://madfermentationist.blogspot.com/
- Not a lot of difference between US Comercial and Homebrewers
  - Pioneers. A lot to experiment with.

How do we use Brett in the Brewhouse?

- Problems
  - Not a lot of research on beer.
  - Very complex flavor production.
  - Lengthy fermentations/conditioning
  - Many variables involved.
  - Profile changes with CO_2

Brewing Variables

Brettanomyces Strain
Saccharomyces Strain
Timing of Incoculation
Pitch Rate
Temperature
Grist
Mash
Density
pH
O_2

Wyeast Experiment

- Goal
  - Determine the affect the timing of inoculation.
  - Determine the affect of other yeast strains on Brettanomyces flavor production
- Protocol
  - Brew standard/simple wort every month for 3 months
  - Inoculate 4.5 gal. fermentations
  - Test pH, density, and sensory each week

Recipe

General

Vol.	44 gal
IBU	10

Malt

25#	Briess Pilsen DME	(63%)
10#	Briess Wheat DME	(25%)
5#	Maltose	(12%)

Boil

30 min	8oz.	Williamette (5.5%AA)
12 min	7 g.	Tan B
10 min	20 g.	Whirlflock
5 min	20 g.	Wyeast Nutrient

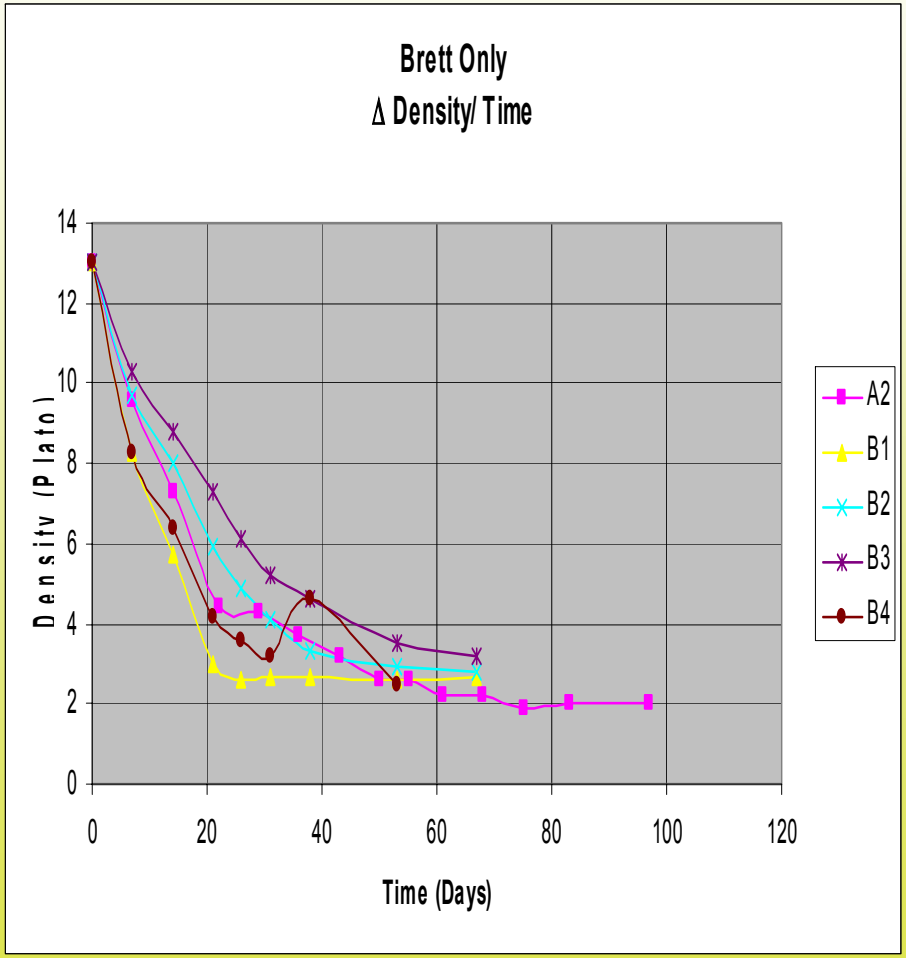
Fermentation

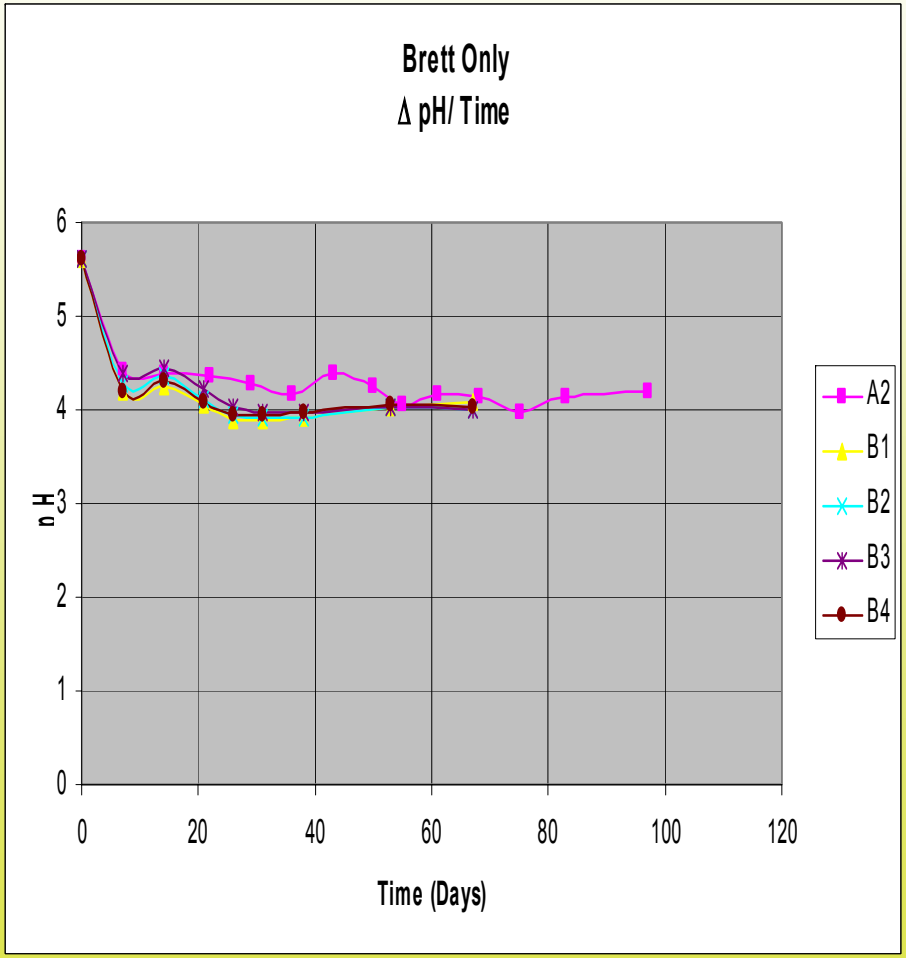
OG	13.0^{o}P
O_2	13 ppm.
Fermentation Temperature	70F
Saccaromyces Pitch Rate	6 million cells/ ml.
Brettanomyces Pitch Rate	3 million cells/ ml.

Inoculations

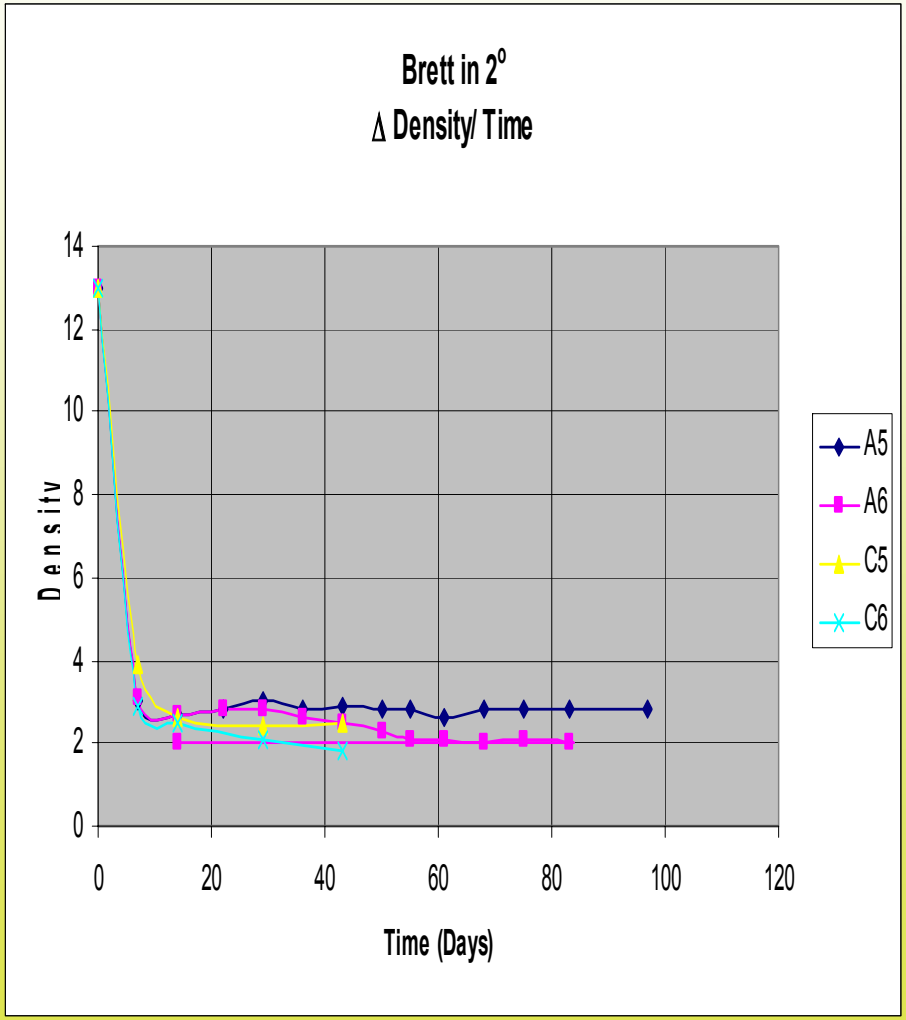
- #1
  - 1º Brettanomyces (5526)
- #2
  - 1º Saccharomyces (1007, 1056, 3787)
  - 2º Brettanomyces (5526)
- #3
  - Co-inoculation Saccharomyces-Brettanomyces
  - (1007-5526, 1056-5526, 3787-5526)

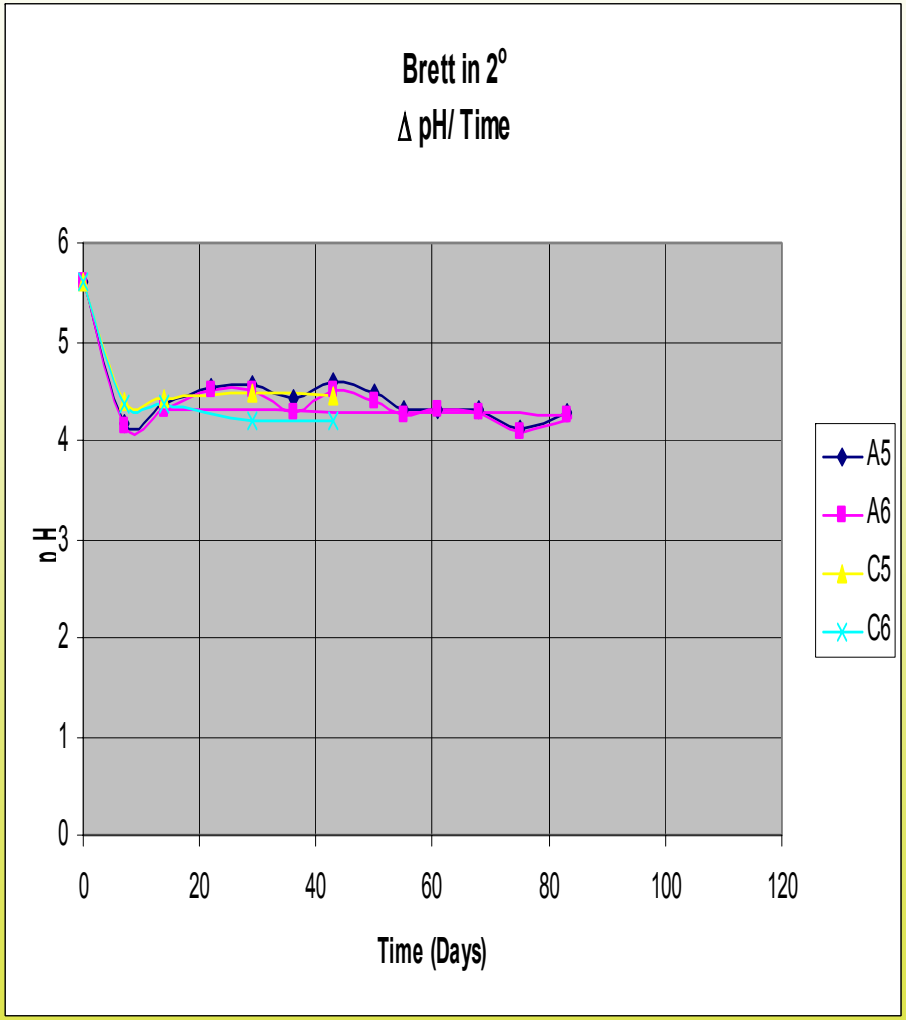
Fermentation Data
Brett Only



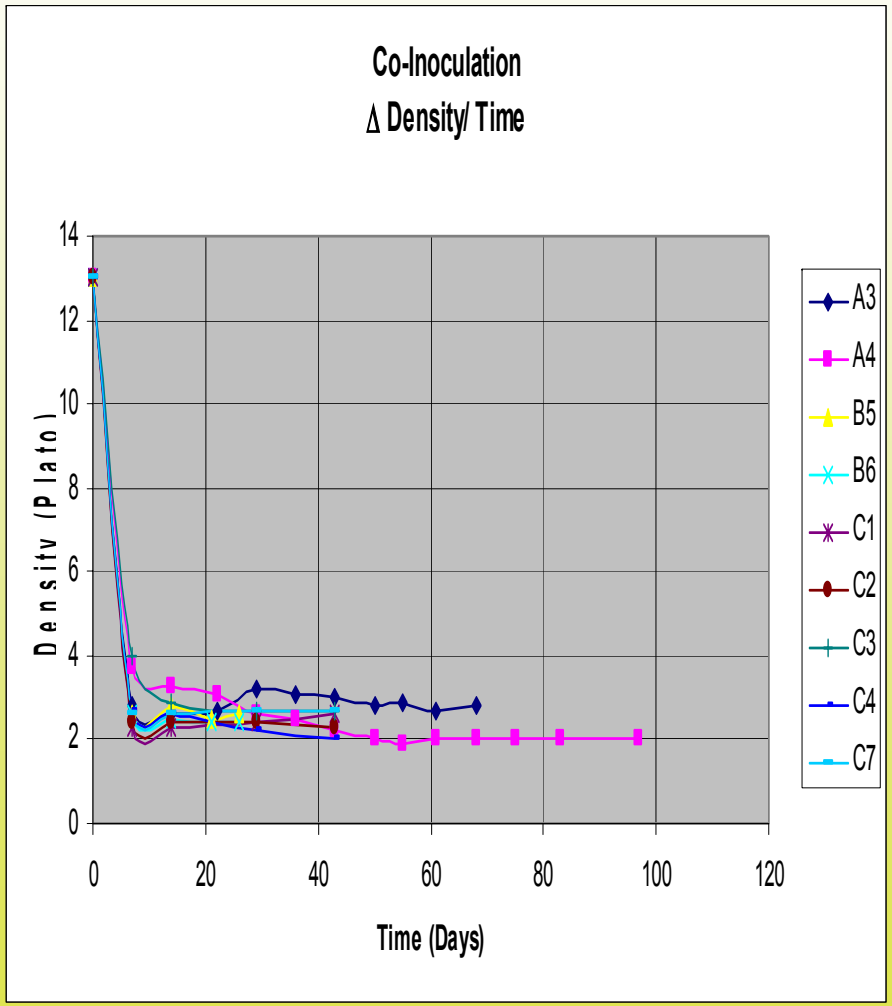


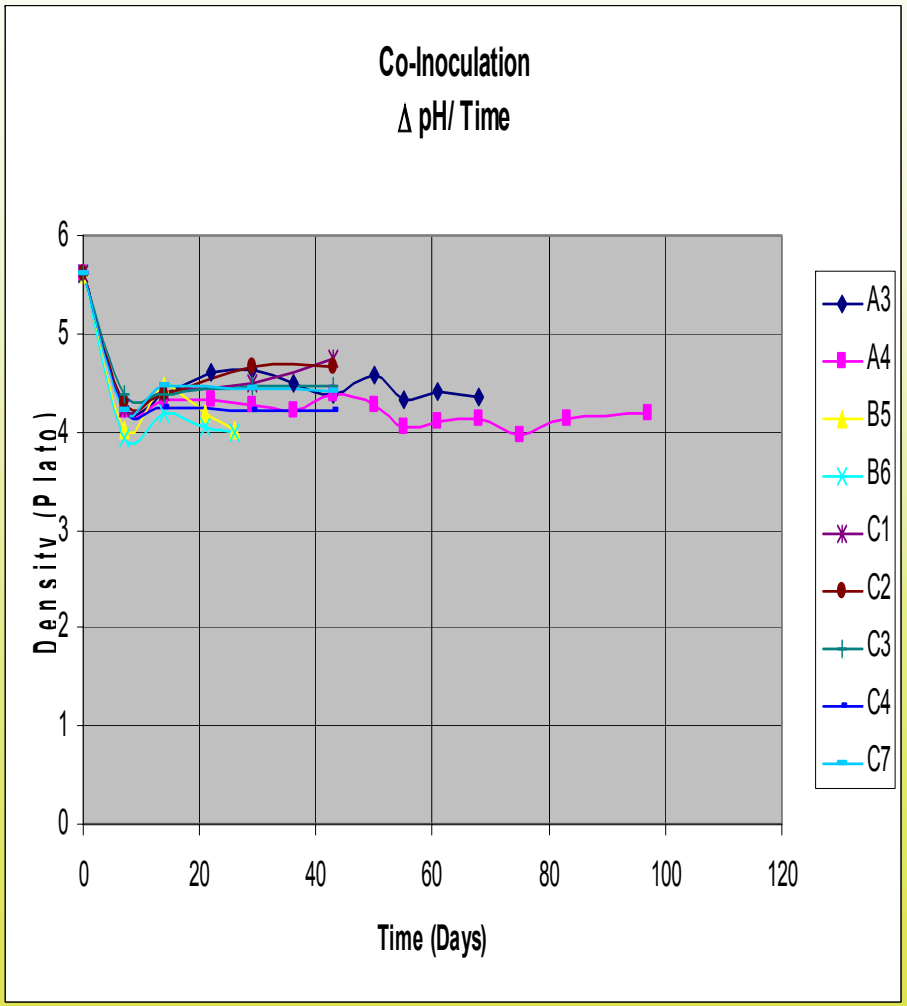
Fermentation Data
Brett in 2°





Fermentation Data
Co-Inoculation





Conclusions

- 2^{o} inoculation preferred beer
  - Possible CO_2 inhibition with Co-inoculation
- Saccharomyces strain does make a difference.
  - Competition for metabolites
  - Production of Ethyl phenol pre-cursers
- Can produce nice Brett beer relatively quick.
  - Onset of Brett character in 3-5 weeks.
- TG stabilized as Brett flavors continued
  - TG 1.004-1.008
  - All Brett 60-80 days
  - Co-inoc & 2^{o} inoc 30-50 days
  - May be different with different strain, grist, mash, OG.
- This is only one trial of 1 experiment!!
- Don’t be afraid to try this at home.

Tasting

- 6 samples
- Beware of “Palate Fatigue”
- Go back frequently to “Control”
- Samples changed with every tasting.

Tasting #1

- Control (A7) Saccharomyces Only
  - 1007 German Alt
  - 14 weeks
  - TG 2.8^{o}P
  - pH 4.54
- Nose
  - Slight fruit, red apple, pear
- Flavor
  - Fairly neutral
  - Slight fruit
  - Slight yeast
  - Malty finish

Tasting #2

- Co-inoculation (C2)
  - 1056-5526
  - 6 weeks
  - TG 2.3
  - pH 4.67
- Nose
  - Slight Sweetart/Smarties
  - Med Smoke
  - Slight Band-aid
  - Med-High Horsey
  - Med Burnt Rubber
- Flavor
  - Med Smoke
  - Med Band-aid
  - Med Horsey
  - Slight Acetic
  - Full on palate
  - Bready
- Overall
  - Not preferred

Tasting #3

- Co-inoculation (C4)
  - 3787-5526
  - 6 weeks
  - TG 2.0
  - pH 4.21
- Nose
  - Med Acetic
  - Med Fruit - Juicy Fruit
  - Mild Horsy
  - Slight Burnt Rubber
- Flavor
  - Med Acetic
  - Med Horsy
  - Slighty Asrtingent
- Overall
  - OK

Tasting #4

- Brett in 2^{o} (C6)
  - 3787 1^{o}, 5526 2^{o}
  - 6 weeks
  - TG 1.8
  - pH 4.19
- Nose
  - Med Acetic
  - Med Horsy
- Flavor
  - Med Acetic
  - Med Horsy
  - Nice “Lambic” Character
  - Med Clove
- Overall
  - Preferred

Tasting #5

- Brett only (A2)
  - 5526 1°
  - 14 weeks
  - TG 2.0
  - pH 4.20
- Nose
  - Mild Acetic
  - Mild Horsey
  - Mild Fruit - Juicy Fruit
  - Mild Stone fruit
  - Dirty Socks
- Flavor
  - Mild Acetic
  - Mild Horsey
  - Mild Fruit - Juicy Fruit
  - Mild Stone fruit
  - Dirty Socks
- Overall
  - A lot cleaner than expected

Tasting #6

- Co-inoculation (A4)
  - 1007-5526
  - 14 weeks
  - TG 2.0
  - pH 4.18
- Nose
  - Slight Acetic
  - Mild Fruit - Pear
  - Mild Bubblegum
- Flavor
  - Slight Acetic
  - Mild Fruit - Pear
  - Mild Bubblegum
- Overall
  - A lot cleaner than expected

Thanks

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- Michael Tonsmiere – Mad Fermentationist
- David Osborne - Wesmar Chemicals
- Ron Jefferies – Jolly Pumpkin

Questions?

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