Sour Beer

November 14, 2013

Steve Smith
Science Guy & Head of Sales

GigaYeast, Inc.
Professional Grade Liquid Yeast For Brewers

Welcome to Sour Beer!

- The Original Beer Style!
- Now intentionally acidic, tart, sour taste
  - Lactic acid, acetic acid
- Typically low hops, dry, malty taste
- Takes awhile (6-36 months) to produce
- Very unpredictable to brew
- Any style of beer may be soured (in theory)
- Most common sour styles:
  - Lambics
  - Gueuzes
  - Flanders red & brown ales
  - Berliner Weisse
- Category #17 of the BJCP Style Guidelines

GigaYeast, Inc.
Professional Grade Liquid Yeast For Brewers

Introducing The Organisms

- Bacteria: prokaryotes
  - Lactobacillus sp.
  - Pediococcus sp.
  - Acetobacter sp.
- Fungus: eukaryotes
  - Brettanomyces sp.
  - Saccharomyces cerevisiae
  - Saccharomyces pastorianus
  - Saccharomyces uvarium

GigaYeast, Inc.
Professional Grade Liquid Yeast For Brewers

Several Strains Make Sours

- Saccharomyces cerevisiae: typical ale yeast
- Saccharomyces pastorianus: typical lager yeast
- Brettanomyces sp.: typical souring yeast
- Lactobacillus sp.: typical souring bacteria
- Peciococcus sp.: souring bacteria
- Acetobacter sp.: souring bacteria

Each Strain is Responsible

- Lactic acid
  - Lactobacillus and Pediococcus
- Acetic acid
  - Brettanomyces and Acetobacter
- Many phenolics and esters not produced by Saccharomyces or Brettanomyces

BEER CONTAMINATION!!

- Contaminating organisms = souring organisms
  - Wild yeast
  - Brettanomyces (fungus)
  - Lactobacillus
  - Pediococcus
  - Acetobacter
- Brewed in non-sterile environment
  - Open to the air
  - Fruit often added

"Normal" Contamination

- Sauerkraut
- Pickles
- Kimchi
- Sake
- Sausage
- Yogurt
- Blue cheese
- Soy Sauce
- Kefir
- Chocolate
- Sourdough
- Other Cheeses
- Vinegar
- Wine
- Butter
- Aged meats
- Olives
- Sour cream
- Acidophilus milk
- Etc…

Traditional Sour Styles

- Young Lambic: Available only in Belgium
- Aged Lambic: Uncarbonated
- Fruit Lambics: Oude Krieks and more
- Gueuze: Carbonation from blending
- Flanders Red: Modern sour
- Oude Bruin/Flanders Brown: medium bodied, reddish-brown
- German lactics: Berliner Weisse & Gose wheat beers

Different Approaches Produce Different Effects

- Sour flavors and attenuation help brewers choose the strains for their intended beer

GigaYeast, Inc.
Professional Grade Liquid Yeast For Brewers

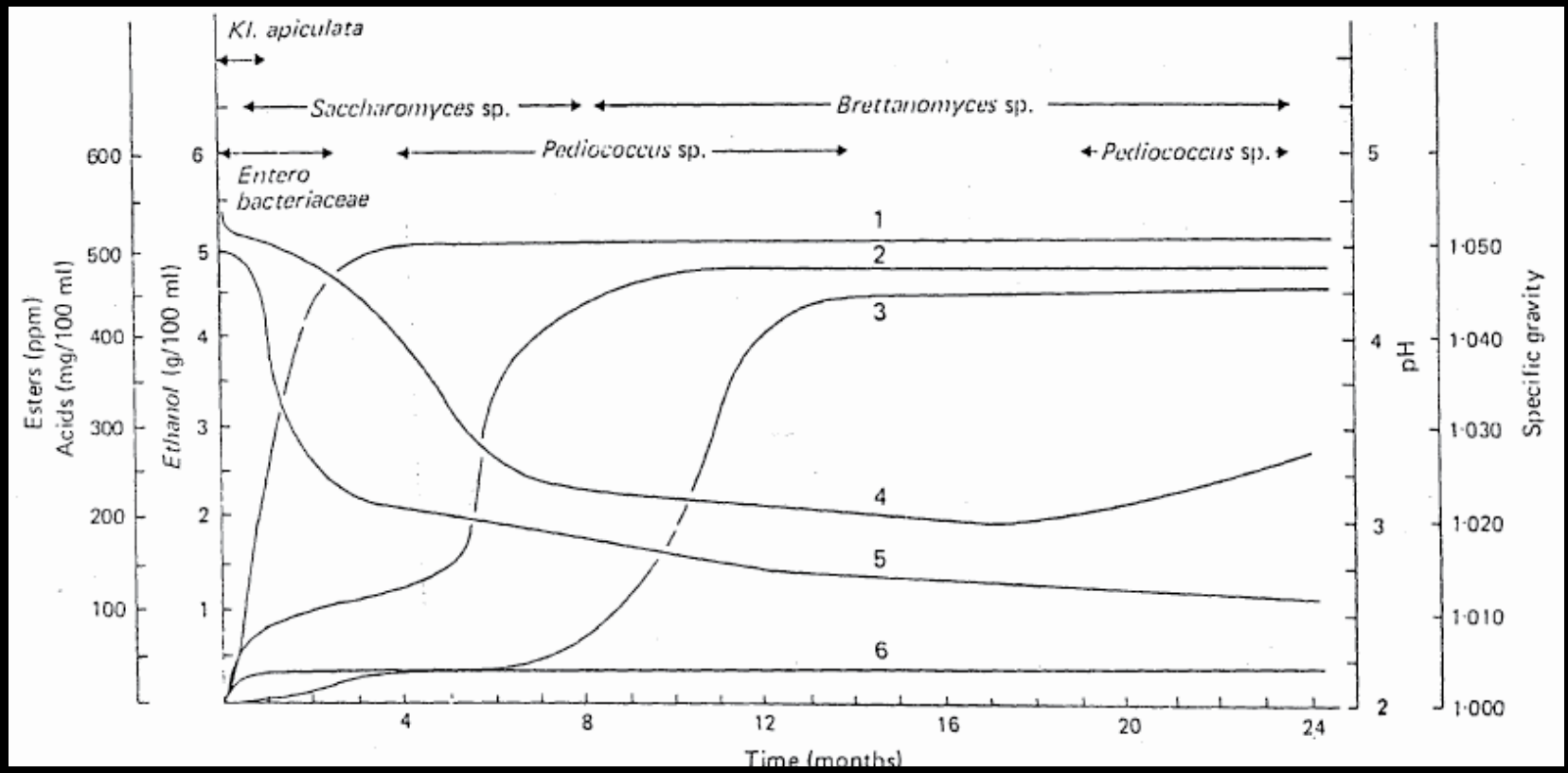
Fermentation Methods For Brewing A Sour

- Different fermentation methods have different results
  - Primary fermentation with Sac and aged with sour organisms
  - Primary with both Saccharomyces + sour organisms
  - Sour the grains/mash/wort before Saccharomyces ferments
  - Primary fermentation with sour organism and no Sac
- Each method has specific effects
- We characterize sour flavors and attenuation in our organisms to help brewers choose the right strains

Not Every Batch Is Perfect

- Wrong (bad) bacteria = Bad Beer

Fermentation Changes



Evolution of some important parameters of spontaneous lambic fermentation: 1 = ethanol; 2 = lactic acid; 3 = ethyl lactate; 4 = pH; 5 = real extract; 6 = acetic acid. Note sequence of microorganisms involved (from Van Oevelen et al. 1977. J. Inst. Brew. 83:356-60)

GigaYeast, Inc.
Professional Grade Liquid Yeast For Brewers

A Beer Must Be Sick To Be Strong

Jean Van Roy, Cantillon brewer

- Belgian brewers call their beer "sick" when slime forms
- English brewers call beer "ropey"
- Pediococcus & Lactobacillus produce slime in fermenting wort
- Slime disappears in 3-4 months, and can happen twice!
  - Slime = exopolysaccharides forming pellicle
- Belgians brew Lambics in winter then barrel age for two summers
- Slime produces greater acidity and richer mouthfeel. It's harmless, and much desired
- Sick beer only looks gross. (Unless it's sick in the bottle!)

Sours Are Easy To Brew

- Easy method (Steve Piatz) for (pseudo) Lambic wort:
- Brew 5 gallons using dry extract
- OG 1.056; FG <1.016; IBU ??; SRM 3; ABV <5.2%
  - FG will drop further after 3+ months
- 3.0 lbs (1.4 kg) light Dried Malt Extract
- 3.0 lbs (1.4 kg) wheat DME
- 0.25 lbs (0.11 kg) malto-dextrin*
- 3.5 oz (85 g) aged or oven-dried low-alpha hops
- Boil 90 to 120 minutes with hops
- Add yeast and bugs and Ferment!!

* Compensates for mash temp and lack of unmalted wheat starches in Lambics. Consider whole wheat pasta for easily gelatinized starches

Piatz pLambic Fermentation

- Mimic the Lambic sequence of dominant organisms:
  - Use your kitchen as coolship room: 48 hours in your kitchen with the lid ajar *
  - Pitch any clean ale yeast, add airlock
  - After 2 weeks add a blend of Lacto, Pedio, Brett, and/or Lambic bottle dregs

  *Some brewers add cultures in sequence, but is difficult!
- Or you can add yeast and bugs together or separately

GigaYeast, Inc.
Professional Grade Liquid Yeast For Brewers

Brewing Fruit Lambics

- Choose fruit after fermentation
  - If mild: use tangy fruit like apricots
  - If using cherries: use sour, tart or pie varieties
  - Fresh, dried, flash-frozen fruit better than bottled juice
  - Ripe fruit is best
  - Smell and taste are important
  - Use one pound per gallon is good starting point
- Crush the fruit
- Freeze briefly to avoid Brett contamination
- Transfer the pLambic onto fruit for 3 months usually works
  - May need few more months

Sours Are Usually Aged

- Patience is the most important ingredient. Leave Lambics alone for 3 months and taste only periodically
- You are not the master of this brew
- "You need passion, the best ingredients, and time." Jean Van Roy
- "The beer must die first. Then it's reborn" Lauren Salazar
- "If you are just starting out making funky beers, making a beer that is palatable will be considered a success" Vinnie Cilurzo
- i.e. The Beer is Ready When It's Ready

Aging Sours Can Be Tricky

- Don't age fruit beers: you'll lose the fruit character
- Acetic beers are difficult to age:

"Brett can metabolize acetic acid and ethyl alcohol to ethyl acetate. In low levels, ethyl acetate is a lightly fruity ester. At higher levels ethyl acetate has solvent/nail polish solvent aroma. Young beers may have good acetic acid levels, but when aged has potent off flavors." - Chad Yakobson Crooked Stave

Sours Are Often Blended

"A blender must envision what the end beer will taste like after blending and after it is carbonated" Vinnie Cilurzo.

- Blend with an acidic beer to increase the acidity
- Blend with a "mellow" dry, finished beer to decrease acidity
- Can blend with water
- Belgian blenders use more / less bitter, younger / older beers

Brett Can Do It All

- By increasing oxygen:
  - Increases cell counts
  - Decreases overall character of the Brettanomyces
  - Makes "clean" Brett
- Primary will have a longer lag phase
  - 24+ hours to begin vigorous fermentation
  - 1.060 to 1.020 in 10 days
  - 1.020 to 1.010 in ~8 weeks
- Lower cell counts increase the "funkiness" of beer
- Beware bottle bombs!

Cleaning and Sanitation

- Ferment in a metal (or glass) keg that can be boiled
  - Replace washers and other rubber parts
- Sanitizers will kill Brett on non-porous surfaces like glass
- Plastic is considered uncleanable (too porous)
- Have two of everything that is not glass or steel
  - Plastic bottling equipment parts (for bottling)

Carbonation

- Typically low dissolved CO_2 present
  - Aged Lambic or Flanders Red beer has nearly no dissolved CO_2
- Brett alone may take months to carbonate
- Adding acid-tolerant dry red wine yeast and priming solution works well
- Bottle priming may results in a pellicle from O_2
- Belgian Gueuzes are carbonated by blending young and old Lambics
- Fruit juice can be an excellent priming solution
  - Add sugars to the juice to meet the gravity needed

Sour Brewing Resources

- "Wild Brews" by Jeff Sparrow
- http://www.slideshare.net/bschmaltz/r-rsour-beerpresentation
- http://embracethefunk.com
- http://www.themadfermentationist.com
- http://www.brettanomycesproject.com/dissertation
- http://liddil.com/beer/lambic/lamfaq.html
- http://www.babblebelt.com/
- http://www.youtube.com/watch?v=HxZ1KlmuEtM

Acknowledgements

- Jim Withee (GigaYeast: Founder, CEO, Chief Scientist, Head Janitor)
- Loran Gibbs (GigaYeast: Head of Production)
- Gail Ann Williams (www.BeerByBART.com; Celebrator Beer News)

GigaYeast, Inc.
Professional Grade Liquid Yeast For Brewers

Brettanomyces

- Originally isolated from British stock ale at Carlsberg in 1904
- Many species and strains of Brettanomyces
  - B. bruxellensis
  - B. claussenii
  - B. anomalous
- Strain-dependent flavor characteristics:
  - Tropical fruit, Citrus, Leathery, Apple, Stone Fruit Horse blanket, goaty, mousy, wet dog, sweaty, poopy, etc.
  - May transform compounds into more attractive nose and taste
  - See Chad Yakobson's thesis at the Brettanomyces Project
- Brett metabolism slow at 3.4 pH (sour!)
- Brett make a pellicle - a thick white biofilm covering the fermenting beer
  - May combine with yeast
  - Guards against oxidation and other contamination
- Brett is a super attenuator!
  - Can ferment dextrin and starches, and sugars from a toasted oak barrel
  - Can reduce gravity near 1.00
  - Can metabolize alcohol like Acetobacter if oxygen present

Lactobacillus

- Metabolism of L. delbrueckii
  - Prefers reduced oxygen levels
  - Best in warm (90-100°F) conditions
  - Produces lactic acid and CO_2
  - Make gentler sourness than Pediococcus
  - Inhibited by <3.8pH and >10IBU
  - In yogurt, cheeses, and sourdough breads
- In Beer
  - Essential in Flanders beers, Berliner weisse, Gose many American sours
  - Lambics get little acidity from Lactobacillus; may help drop pH and influence Brett

Pediococcus

- Metabolism
  - Ferments sugar into lactic acid
  - Makes significant diacetyl and a significant pellicle
  - Does not produce carbon dioxide
  - Grows slowly and is inhibited by oxygen
- In Beer:
  - Makes "sick" and "ropey" textures
  - Adds the lactic acid intensity to Lambics and other sour beers
  - Produces muddy, almost peanut butter notes
  - Brett cleans up nose and taste from Pedio
- To Culture:
  - Grows well in an apple or tomato juice starters without oxygen

Acetobacter

- Metabolism
  - Uses oxygen and ethanol to make acetic acid
  - Will chew up all the alcohol!!
  - Fruit flies (vinegar flies) can carry acetobacter
  - Dry airlocks admit fruit flies and oxygen
  - Can blend in vinegar if none produced in beer
- In Beer:
  - Typically in Flanders Red beers: acetic essence
  - Classic examples are blended to stabilize and stop vinegar production
  - Adds balsamic quality