Sour brewing

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If there's one trend in craft beer that has fought hardest to beat out the hoppy-hoppier-hoppiest IPA arms race, it's the boom in popularity of sour beers. Small production, time-intensive sour brews offer an intriguing history (and hype-inducing rarity), but it's their unique flavor that seems to turn most drinkers into dedicated sour beer fans. The tart, puckering taste is often met with a shocked, love-it-or-hate-it type of reaction, and those with the former can't seem to get enough of the stuff. The secret ingredients that set these beers apart from the rest of the brews on the shelf are actually living creatures: **yeast and bacteria**. Sour beers are typically made with a cocktail of little fermenting organisms, each one leaving a unique and identifiable fingerprint on your beer. Aside from Saccharomyces cerevisiae, the most common yeast used for brewing ales, sour beer brewers will often employ the wild yeast Brettanomyces, as well as bacteria such as Lactobacillus, Pediococcus, and Acetobacter.

Brettanomyces

Known for inspiring such tasting notes as "barnyard," and "horse blanket," Brettanomyces is a funky beast that tends to freak people out a little bit. Its impact on beer varies dramatically based on fermentation temperature, the other fermentation organisms present in the beer, and at what point it's added, but Brett (as it is commonly known), is most easily identifiable by that barnyard funk associated with 4-ethyl phenol, a flavor compound it produces. Brett is also known for tearing through sugars that normal yeast cannot, leaving beers very, very dry. Producing very little acid, Brett is usually not responsible for creating sourness in beers; instead, you're looking for horsey, earthy funk.

Seek out Orval, which is bottled with a dose of Brett, for a good example of what the yeast can do—there's a funky dryness on the finish that is a great expression of the yeast. Anchorage Brewing Company also makes great beers that employ Brett to develop flavors, and Denver's Crooked Stave has a line of 100% Brettanomyces-fermented beers called Wild Wild Brett. Check 'em out!

Lactobacillus and Pediococcus

Lactobacillus and its cousin Pediococcus are bacteria that produce lactic acid, which provides the tartness you can find in yogurt, buttermilk, and in almost all sour beers. While Lactobacillus tends to gently produce lactic acid, Pedio tends to take a more aggressive approach, quickly generating tons of lactic acid. Unfortunately, Pediococcus also produces a significant amount of the undesirable buttery flavor compound known as diacetyl and can leave beer with a snot-like consistency. (Ew.) So Pediococcus is rarely used without Brettanomyces by its side, since Brett "cleans up" after Pedio and yields a more palatable final product.

If chugging buttermilk doesn't sound like a very enjoyable way of tasting the lactic acid calling card of Lactobacillus and Pediococcus, seek out the sour beers of Portland, Oregon's Cascade Brewing. Their tart beers are soured with just Lactobacillus, which leaves them with a uniquely full mouth feel and clean lactic sourness. Pediococcus is

present in traditional Lambics and many of the beers attempting to emulate that style (like the sours of Santa Rosa's Russian River Brewing)—look for an intense lactic acidity paired with a funky, dry Brett character.

Acetobacter

Inappropriate in most sour beer styles, Acetobacter produces acetic acid. This stuff eats the ethanol in beer and turns it, essentially, into vinegar. That sounds pretty terrible until you try it. For a pretty intense taste of acetic acid, take a swig off that bottle of distilled white vin you've got in your pantry—then go down to the beer store and grab a Duchesse du Bourgogne. This beer has an obvious vinegar-like acetic acid twang to it, and you'll never forget the taste and the benefits it can provide to beer.

All Together Now

Interested in seeing what these bugs can do together? Grab a traditional Belgian Lambic—these beers typically contain all of the above organisms except Acetobacter, and the best ones showcase the deep complexity made possible by these yeast and bacteria.

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Outline

- Methods for souring beers
  - In the mash
    - By holding the mash at an elevated temp overnight it will sour
  - Spontaneous ferment
    - Belgian breweries use cool ships (shallow open fermenters)
  - Classic primary wild yeast secondary
    - Ferment beer normally then inoculate with a wild strain
  - Brettanomyces primary
    - Begin fermentation with a wild strain
- Finding Wild yeast strains
- Home brewing Sour beers
- Resources

Sour mash steps

There are many ways to lower the pH of a mash. The most straightforward solution is to add lactic acid, calcium sulfate (gypsum) or calcium chloride. Sour mashing is another method which involves keeping your mash at an elevated temperature for an extended length of time.

Making a sour mash is simple. You'll need to start two to four days before brewing day. A small sour mash should be between 5 to 20 percent the size of the main mash. (For example, if your recipe calls for 10 pounds of grain, you should make your sour mash with 0.5–2.0 pounds of malt.) For a sour beer, your sour mash should be at least 20 percent the size of the main mash or larger.

Step One: Mashing

Crush the pale malt and mash it in the normal fashion. A single infusion mash held at 150–158°F for one hour will suffice. More elaborate mash regimes are not necessary. The mash will produce sugars for the bacteria to ferment.

Step Two: Inoculating

Cool the mash to about 122°F and add a handful of crushed (unmashed) or acidulated malt. This malt will contain any naturally occurring Lactobacillus delbruckii that is on malt. The "cold" malt should also drop the temperature to 120°F.

Step Three: Incubating

Keep the mash in a sealed container and hold it between 95 and 120°F for two to four days. The mash temperature will drop over time, so you will likely need to boost the temperature once a day.

To boost the temperature of your sour mash, boil some water for 15 minutes to de-aerate it. Stir this water into the sour mash until the temperature is about 120°F. When stirring, try not introducing any air into the mash. Seal the container again as quickly as possible. (You may lose some liquid from overflow when adding water. This is fine.) Don't peek at the mash other than when you are boosting the temperature. Each time you open the lid, oxygen gets in.

Step Four: Monitoring

The mash should smell sour, but clean. L. delbruckii does not produce any smelly by-products. You should never use a sour mash that smells off in any way.

If you do notice rancid smells, diacetyl smells or growth on the surface of the sour mash, skim it and heat to 140°F. Cool the sour mash back down to 120° F and re-inoculate with a handful of crushed malt. If the smell persists, discard the sour mash. Even if the sour mash does not smell, it is a good idea to skim the top layer, which often contains any aerobic contaminants present, before using it.

Step Five: On Brewing Day

Stir the sour mash into the main mash. The pH of the sour mash should be around 4. Add half of the sour mash, and then check pH. Keep adding until pH is 5.2. (Follow pH meter instructions with care. You might have to cool down the mash to get specific readings).[1]

[1] From BYO Magazine Sept 2000

Spontaneous fermentation

Wild Yeast occurs naturally all around us it survives on most all living things including plants and fruits and vegetables. The thin white coating you see on fruit is wild yeast. Before yeast was isolated as required component for brewing all beer was fermented by naturally occurring yeast. Some Belgian style sour beers are inoculated solely by wild yeast.

Simple method steps to propagate and inoculate a beer using Wild Yeast

First make a small amount of wort approximately 1.035 OG.
Put into a container or (several containers) that is covered with fine mesh to keep bugs out. Set outside in proximity to vegetation, for 9-36 hours while the temperature is favorable 50-75°F degrees. Transfer the wort(s) into an airlock container and step the size up progressively to a patchable volume. Taste the fermented beer to determine the viability of the collected product.

Use this wild yeast as primary fermentation yeast or add at the end to a beer that has been fermented traditionally with Sachromyescies.

A more scientific method would involve adding Flaked Agar to the wort and divide into petri dishes to collect your samples then separate out the viable colonies (the milky looking ones). Gradually step up these samples with a series of starters.
A u-tube link can be found here Part_1 and Part_2
Additionally review Chad Yakobson's Thesis of Brettanomyces for culturing tips.

Where the Wild Things Are

Lactobacillus, Pediococcus and Brettanomyces AKA the bugs

The following is a list of the cultures involved in Sour beer fermentations and the sequence of activity:

- Enteric bacteria (3 to 7 days)
- Kloeckera apiculata (3 to 7 days)
- Saccharomyces species (2 weeks)
- Lactic acid bacteria (3 to 4 months)
- Brettanomyces yeast (8 months)
- Oxidative yeasts (8 months)

Each one of these groups of organisms adds some character to the finished beer; however three groups in particular do the lion's share of the fermentation and contribute the bulk of the flavor characteristics. Typically, it is impractical to try and manage all of these cultures. The enteric bacteria and the Kloeckera apiculata are not readily available and contribute the least amount of character to the final beer. The Oxidative yeasts are also not readily available and also contribute very little to the final profile of the beer. That leaves the Saccharomyces yeast, the lactic acid bacteria, and the Brettanomyces yeast.[2]

Saccharomyces cerevisiae, Saccharomyces carlsbergensis and Saccharomyces pastorianus are the strains of yeast that are typically used for traditional brewing.

Lactic Acid Bacteria

- Pediococcus (Sauerkraut)
- Lactobacillus (Yogurt)

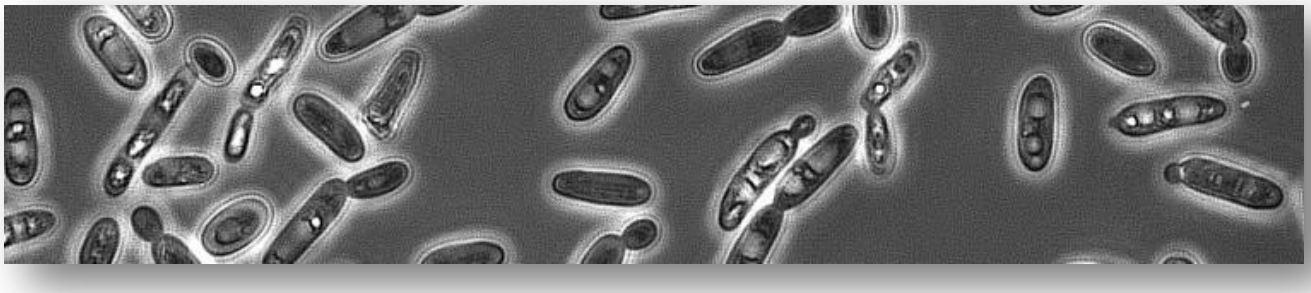
Brettanomyces This is a very versatile family of yeast that contrary to popular belief is not a strain of wild yeast it actually lives on the skin of grapes and other fruits. There are four known strains. They are often referred to be the first letter of the strain.

- Lambicus (Brett L) one of the two most widely used strains,
- Bruxellensis (Brett B) one of the two most widely used strains,
- Claussenii (Brett C)
- Anomalus (Brett A)

[2] From Wyeast website http://www.wyeastlab.com/com-lambic-brewing.cfm

Acedobacter This is another form of bacteria readily floating around in the atmosphere found on skins of fruit and the nectar of flowers it is often present during the fermentation of sugar to Ethanol (alcohol).of less than 18% abv. This is how vinegar is made; it is generally undesirable in your beer Acedobacter is a gram negative, aerobic bacteria that requires oxygen to grow. Presence of fruit flies generally indicates there is Acedobacter being produced.

Home Brewing With Wild Yeast



Where to get your Wild strain of Yeast

- Wyeast Labs
  - 5112 Brettanomyces bruxellensis
  - 5335™ - Lactobacillus
  - 5526 - Brettanomyces lambicus™
  - 5733 - Pediococcus™
  - 3278 - Belgian Lambic Blend™
  - 3763 Roeselare Blend
- White Labs
  - WLP630 Berliner Weisse Blend
  - WLP644 Brettanomyces bruxellensis Trois
  - WLP645 Brettanomyces claussenii
  - WLP650 Brettanomyces bruxellensis
  - WLP653 Brettanomyces lambicus
  - WLP655 Belgian Sour Mix 1
  - WLP665 Flemish Ale Blend
  - WLP670 American Farmhouse Blend
  - WLP675 Malolactic Cultures
  - WLP677 Lactobacillus Bacteria
- Collect Dregs from bottle conditioned Sour Ales
  - Jolly Pumpkin beers

Planning the brew day

Yeast starter or not

- Differing opinions on value of yeast starter for your bugs

Decide on your plan for Fermentation

- Start fermentation with a Saccharomyces species
- Alternately make a 100% Brett beer
- Add a cocktail of yeast strains (Wyeast 3278, WLP 655)

Equipment

- Have dedicated equipment for everything that touches beer after inoculation to avoid cross contamination of non-sour beer

Grain selection

- Flavor contributions of grains
    - Base grains usually 2 row or Pilsner
    - Roast/black grains will be enhanced due to high attenuation
    - Caramel grains will contribute fruit flavors
    - Acidulated grains will acidify your mash or fermentation (sour)
- Grains that contribute body
    - Oats, Rye, Spelt and un-malted grains
    - Un-fermentable Dextrin's
    - Lambic style have large amounts of un-malted wheat
- Water chemistry will affect beer
    - Calcium Chloride will make the beer appear softer maltier
    - Calcium Carbonate will make the beer appear drier and sharper

Mash temperatures

- Will affect finished beer
- Belgian beer is known for multi-step mashes
- Lower mash will lessen the effects of the Brett and lacto
- Will make for a crisper and cleaner beer though Ferment plays a role too
    - Can be counteracted by adding bugs sooner in the ferment
- Higher mash results in complex sugars that the Brett and lacto will consume.
- Un-malted grains require a cereal mash (boil un-malted grains with 10% malted barley for 15 minutes than added to main mash, establish additional rests such as acid at 95f and protein at 121°F before raising to a saccharification rest at 147-158°F. These are traditionally infusion mashes. And accounts for longer wort boils to concentrate wort.

Mash pH

- Mash should be in the range of 4.7-6.2 however the lower end of this range is preferred for sour beers as bugs will perform better at lower pH

The boil

- Lambics especially are known for long boils sometimes 3-6 hours

Hops and IBU's

- IBU's are generally kept low as the alpha acids will inhibit Brett and Lacto
- You do still want the cohumulone component of the hops
    - This can be accomplished by using aged hops
- Add hops late in the boil to reduce transfer of Alpha Acids
- If you wish hop flavors add as a dry hop after Brett is done (6 months)

Fermentation

- Probably the most critical element of the process is the ferment
- I recommend consistent low temps 57-64°F to prevent fusel alcohols
- Oxygen in the wort; infuse oxygen prior to first yeast pitch only.
- Primary lasts about 1-2 weeks
- Many options for yeast
    - Begin traditional Saccharomyces then add bugs at 70% attenuation
        - Theories are split on starters for inoculation (I make starters)
    - Begin with Brett from the start (recommend making a starter here)
        - Results clean dry slightly tart but not sour finished beer
    - Begin with a cocktail blend (monitoring temp is extra important here)
        - These are often the easiest way to go
- Secondary fermentation
    - Rack beer to new vessel
    - No open fermenters (in secondary)
    - Still use an air lock
    - Glass is preferred over plastic
    - Minimize airspace after initial Kraeusen falls "top up"
    - A Pellicle will often form as a barrier against oxygen don't pierce it
    - Draw samples below the Pellicle or better yet resist temptation
    - Once the pellicle falls transfer the beer
    - Try to keep acetic acid at bay (Acedobacter)

Fermentation Schedule

- Traditional start 1-2 weeks primary till 70% attenuated then I crash cool rack into Co2 purged secondary bring back to 62ºf pitch bugs. Ferment 1-2 months. Crash Cool rack, then age

Fermentation vessels

- Glass carboy 5.3 gallon size 17 O2 Liters per year
- Plastic bucket 5.3 gallon size 220 O2 Liters per year
- Wood barrels 10.6 gallon size 23 O2 Liters per year
- Stainless Unknown
- **Below are commercial size wood vessels (for comparison)**
- Rodenbach Wooden Tun (Large) 5,280 .53 O2 Liters per year
- Rodenbach Wooden Tun (small) 3,168 .86 O2 Liters per year
- Wine barrel 79.2 8.5 O2 Liters per year

Stages of fermentation

- Primary 1-2 weeks
- Secondary 1-4 Months
- Tertiary (aging) 6 months to several years

Aging

- Age cold if possible
- Avoid oxygen Each Racking of your beer introduces oxygen Take precautions
- Keep vessels topped up to avoid oxidation.
- Can age for long periods of time and flavor will evolve

Additions

- Fruit
  - Best added after fermentation is complete (6 months to a year)
  - Blanch fruit with skins then slice up add to a clean fermenter and rack the wort on top (best to use a Co2 purged fermenter)
  - Dried and canned fruit is an option too
- Oak cubes, chips and staves
  - Good alternative to using oak barrels
  - Great way to store and transfer your wild strains
- Dry hops
  - Best way to introduce hop flavor and aroma into wild beer
  - Again dry hop after fermentation is complete (6 months to a year)

Finishing bottling

- Use thick walled glass bottles
- Don't bottle until your FG is in single digits (Brett beers generally finish at 1.005)
- Brett and Lacto inoculated beers produce half the Co2 as Saccharomyces beers
- It a good idea to introduce fresh actively fermenting yeast at bottling
- Champagne bottles, caged and corked are a good option
- My procedure for bottling Sour beer
  - Wait until FG is below 1.010 and remained stable for 4 weeks
  - Rack into Co2 purged clean cornie keg
  - Mix in an actively fermenting yeast starter (Straight or blended).
  - Add priming sugar or unfermented wort assume 1 volume of Co2 in suspension of your wort and use a carbonation calculator to determine the optimum amount of priming sugar.
  - Stir well
  - Dispensed into clean bottles under Co2 pressure of 5 PSI using a length of hose estended from tap faucet to reach the bottom of the bottle.
  - Fill and cap

Aging cellaring

- Beer definitely changes as it is aging
- Age in a cool or refrigerated dark place

Drinking

- Always chill before opening
- Be prepared for an occasional gusher
- Savior the drink don't pass judgment on your first sample
- Let warm and see how the flavors evolve
- Take note about what you do and do not like

Learning and experimenting

- I would like to start a group of sour beer fans as part of KLOB
- Contact me at funk.works@yahoo.com if you want to be added to a mailing list

Resources

Whose, who in the world of sour brewing;

You will be well served to read any articles and interviews with these people.

Chad Yakobson of Crooked Stave brewery Ft Collins CO; wrote a master theses an propagating Brett in the lab;
http://www.brettanomycesproject.com/
Another site version of the above information http://brettanomyces.wordpress.com/

Vinnie Cilurzo of Russian River Brewing Co
http://morebeer.com/content/RussianRiver
http://www.slideshare.net/bschmaltz/r-rsour-beerpresentation

Jeffrey Stuffings and Ron Extract of Jester Kings Brewing Austin TX

Tomme Arthur of Lost Abbey Brewing

Art Larrance and Ron Gansberg of Cascade Brewing Portland OR

Ron Jeffries of Jolly Pumpkin Dexter MI

Other Sour beer sites and blogs

http://embracethefunk.com/about/

Michael Tonsmeire AKA The Mad Fermentist A great Blog that contains tons of info
http://www.themadfermentationist.com/2009/11/brewing-sour-beer-at-home.html

Lambic brewing

This is the most comprehensive description for Lambic brewing I know of;
http://www.brewery.org/brewery/library/LmbicJL0696.html
Article on Lambic Brewing
http://morebeer.com/articles/Brewing_Lambic_at_Home
BYO article on Lambic Brewing
http://www.byo.com/stories/item/975-lambic-brewing
Wyeast article on brewing Lambics;
http://www.wyeastlab.com/com-lambic-brewing.cfm

Storing aging

Solera Ale Zymurgy article about aging beer in casks

Sour beers

http://www.craftbeer.com/craft-beer-muses/immaculate-fermentation-science-not-sorcery

Home brew talk Forum; Sour ale section Great place to ask questions
http://www.homebrewtalk.com/f72/
Presentation by SNOBS homebrew club

Brett Articles

Sui Generis Scientist Home brewer blog

Print

Wild Brews; Jeff Sparrows
Zymurgy Magazine Vol 35 May/June 2012 Brett Beer

Podcasts

The Brewing Network and Jamil Show
Interview with Jester King
Interview with Crooked Stave
Interview with Trinity Brewing
Interview with Cantillon
Brewing with Brett
Interview with Ithaca Beer Co
Interview with Russian River Brewing
Interview with Allagash Brewery
Interview with The Bruery
Interview with Ommegang
Interview with BYO Mag about Sour Beers
Sour beer/Lambic brewing
Sour beer brewing with Vinnie Cilurzo
Interview with White Labs
Interview with Belgian beers with Vinnie Cilurzo
Brewing Jolly Pumpkin Dark Dawn
Brewing Jolly Pumpkin Bam Bier
Brewing Classic Styles Flanders Brown/Oud Bruin
Brewing Classic Styles Lambic, Gueuze
Brewing Classic Styles Berliner Wiesse
Brewing Classic Styles Flanders Red
Brew Strong Wood Aging

Beersmith
Interview with Mike Mraz
Sour beer in Home brewing