The Power of Sour

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Sour Beers

- A beer style characterized by an intentionally acidic, tart, sour taste.
- Category 17 of the Beer Judge Certification Program Style Guidelines.
- In theory, any style of beer may be soured
- In practice, the most common styles that are soured are Belgian lambics, gueuzes, Berliner Weisse, Flanders red ale, and most recently, the American Wild Ale.
- Today’s discussions will focus on lambics.

Lambic

- Senne River Valley of Belgium near Brussels
  - Small hills with cherry trees
  - Small farms growing hops, grains
  - Mild climate
- Open fermentation tanks (coolships) and open-air breweries
- These wild-fermented wheat beers are among the world's rarest
- Brewed for over 500 years

Coolship at Cantillon

Lambic (2)

- Unlike traditional brewing, wild yeasts and bacteria are embraced
- Traditionally through infected barrels
- Most common souring agents - Lactobacillus, Brettanomyces, Pediococcus
- Also add tartness with fruit
  - Cherries (Kriek) or Raspberries (Framboise)
- Unpredictable brewing process
- Can take years

Lambic (3)

- Senne Valley is a very special area about 15 x 75 miles, with a very unique mix of microflora
- Most other areas would have less desirable results
- Alaska experiment
- Most brewers must use commercial bacteria and yeast or blends
- Some breweries trying spontaneous fermentation - Allagash, Russian River

Cross-Contamination Concerns

- Many are concerned with cross-contamination
- WIld yeast/bacteria are just as susceptible to acid sanitizers
  - Normal cleaning / sanitation should be fine
- Plastic / Porous equipment should be kept separate
  - Easily scratched, which can harbor bacteria

Anachronisms of Traditional Lambic

- By definition: spontaneously fermented ales made up of a grist of at least 30% unmalted wheat
- Incompletely converted mash
- Oxidized Hops
- Intentionally Infected
- No Stainless Steel
- Generously Aged
- Blended to Taste

Gueuze Simplified

- The base lambic is blended to make a distinct, wine-like drink
- Blend of 1/3 young and 2/3 old lambic
- Traditionally served with the meal
- Known to mature beautifully, and stories abound of discovering age-old gueuze lambics that had matured to perfection
- I recently had 1952 and 1985 Gueuzes at the Woodshop event and both were absolutely stellar.

Fruit Lambics Simplified

- Nowadays fruit lambic beers are extremely popular.
- First fruit beers were made with sour cherries growing in villages around Brussels. The most famous in Schaarbeek, which gave its name to the best variety.
- 1930s: different farm breweries started brewing kriek by adding crushed cherries to young lambic in the casks
- Artisanal lambic breweries, such as Cantillion, make their fruit beers by blending the lambic and fresh fruit before bottling producing Kriek (cherry), Framboise (raspberry), Cassis (black currant), Blueberry (Blabaer), and Muscat (grape).

Cantillon Rose de Gambrinus

Other Types

- Mars - A Sour ale made from the final runnings resulting in a low gravity table sour.
- Faro - A sweet, light table beer made by sweetening blended lambic and Mars with dark candy sugar and caramel.

Wort Preparation

- Grist: usually composed of pale barley malt with 30–40% raw wheat
- Most traditional method of working with the grain is turbid mashing
- Time-consuming and labor-intensive
- Effectively break down the proteins in ungelatinized raw wheat
- Leaves a good supply of starches and free amino nitrogen for the yeast and bacteria to feed on during the long fermentation.
- Homebrewers have various forms of wheat available, which can simplify the procedure.

Types of Wheat Available

- Raw
  - Traditional, but complex mashing
  - Must be gelatinized
  - Milling concerns
- Rolled or Flaked Wheat
  - Pregelatinized
- Malted
  - Simplifies Mashing

A Scaled Down Mash Schedule from Cantillon Brewery

Jean van Roy Sampling Chris' Lambic

Cantillon Mash - Step 1

In kettle #1, combine water (about 2.4 quarts) at 144 °F (62 °C) and the crushed grain to achieve a temperature of 113 °F (45 °C). Mix the grain and water thoroughly and allow it to rest at 113 °F for 10 minutes. This amount of water is just enough to wet all of the grain and flour. The mash needs to be stirred well to make sure that all the grain is wetted and that no clumps of flour are present. Total time for this step is about 20 minutes, including the temperature rest.

Cantillon Mash - Step 2

Next, add enough boiling water (212 °F [100 °C]) to the mash to bring the temperature to 136 °F (58 °C). Do this over the course of 5 minutes, mixing thoroughly. It will take about 3.5 quarts of boiling water to raise the mash temperature to 136 °F, very soupy mash with plenty of excess liquid. Allow mash to rest for 5 minutes at this temperature. Remove about 1 quart of liquid from the mash, add it to kettle #2, and heat to 176 °F (80 °C). The liquid taken off should have the appearance of milk. Once heated it will clear up and large particles of hot break will form.

Cantillon Mash - Step 3

Add more boiling water to the mash over the course of 10 minutes to bring the temperature to 150 °F (65 °C), again with constant mixing. It will take about 5 quarts to achieve this temperature. Allow the mash to rest for 30 minutes at 150 °F (65 °C). At this point, the mash will be very soupy and the liquid much less milky in appearance.

Cantillon Mash - Step 4

Remove 4 quarts of liquid from kettle #1 and add it to kettle #2, which will put it up to 5 quarts. Continue to heat kettle #2 to maintain a temperature of 176 °F (80 °C). The liquid removed from kettle #1 will be very cloudy, but not quite as milky as the liquid previously removed in step 2.

Cantillon Mash - Step 5

Add more boiling water to kettle #1 to bring the temperature to 162 °F (72 °C) and allow it to remain at that temperature for 20 minutes. Again, it will take about 5 quarts of water to reach the rest temperature. The mash should be very thin and soupy with a great deal of small particulate matter in the liquid portion.

Cantillon Mash - Step 6

After the 20-minute rest, run off the liquid from kettle #1 and bring to a boil in a third kettle. Add enough of the liquid from kettle #2, at 176 °F (80 °C), back into the mash in kettle #1 to bring the mash to a temperature of about 167 °F (75 °C). Allow the mash to rest at that temperature for 20 minutes. If any liquid is left in kettle #2, it can be added to the previously collected runoff in kettle #3

Cantillon Mash - Step 7

After 20 minutes, recirculate the wort in kettle #1 to clarify it, and begin sparging with 185 °F (85 °C) water. Sparge until the gravity of the runoff has dropped to less than 1.008 (2.06 °P). Boil the wort, now in kettle #3, until the volume is reduced to about 5 gallons.

Cantillon Mash - Step 8

As the wort begins to boil, hop with about 4 oz of aged hops. The combined water additions and sparging should add up to about 9 gallons of wort. Total boiling time to reduce this volume to 5 gallons will depend on your equipment and methods. At the beginning of the boil, the wort will be cloudy and full of large flocculent break material. As the boil proceeds, the wort should clarify as the proteins continue to coagulate and the starch dissolves. Cool wort using your method of choice. This method of mashing does not yield the large amount of break that a typical all-malt infusion mash would yield.

Results

- A test batch using this method yielded a wort with an original gravity of 1.040 (9.97 °P).
- At about 25 points/lb/gal, the mash efficiency was not as high as that obtained at Cantillon,
- Yield could probably be improved by extending the times for the various rest steps
- May be a good idea to heat the liquid withdrawn from kettle #1 each time at a very slow rate.
- May want to start out with a larger grain bill based on conservative yield of 25 pts/lb
- Your own results will vary with your methods, percentage of efficiency and equipment.

Sparging

- Hotter than usual sparge temperatures, close to 190°F
- Extracts dextrins and unconverted starches from mash
- Extracts tannins, but these are precipitated out or broken down over the long fermentation cycle
- Particularly important if you follow a true turbid mash–type schedule because of poor conversion.
- In lambic brewing, starches and tannins are needed to support the long fermentation process and will ultimately be used by the yeast and bacteria
- Without these usually undesirable products, the lambic organisms may not thrive, and the finished beer may not have the right flavor characteristics.

Boiling

- The boil should be vigorous and last 1.5–2 hours or longer, depending on the initial volume of the wort.
- The boil serves a number of functions, including:
    - precipitation of excess proteins from wheat
    - reduction of the volume of liquid collected
- Makes Irish moss or other clarifying agents unnecessary; any excess proteins that may remain in solution will either be used or precipitated during fermentation process.

Hopping

- Hops in lambics should be aged 1-3 yrs
- No bittering to detract from the beer
- Contain tannins that give dry, astringent taste
- Antioxidants help control levels of undesirable Gram-positive bacteria
  - Bacillus, Sarcina, Streptococcus, and others.
- Varieties used are low to med AA range
  - Hallertauer, Tettnanger, or Brewers Gold.
  - Almost any variety will do, with the exception of high alpha-acid varieties such as Chinook
    - Tend to retain bittering power and flavor

The Hop Aging Process

- Age 1-2+ years unsealed at room temp
- Heat at low temps (<200F) for 4-5 hours
- Age in summer sun for 1-2 weeks
  - Warning: keep away from dogs
- Check homebrew shops, hop suppliers
  - Hopsdirect sells aged, debittered hops
- Natural food stores
- Whole or pellet are both ok, but pellets should be broken into powder

The Lengthy Fermentation Process

Fermentation Process

- Microbiology is what makes them so unique and complex
- Spontaneous or natural fermentation - fermented by the microbial flora found in the brewery and the atmosphere surrounding it
- Not so unique - many great wines are still made in this way today in such famous wine making regions as Burgundy and Bordeaux
- Resulting combination of microorganisms involved in the lambic fermentation is unique

Fermentation Process (2)

- Comprised of both yeast and bacteria
- A truly surprising fact for most brewers who recognize yeast, only saccharomyces cerevisiae, or saccharomyces carlsbergensis, as the only agents that may turn their wort into a quality beer
- Brewers rightfully fear bacteria as the agents of beer contamination or spoilage.

Fermentation Process (3)

- Lambic fermentation is often thought of as controlled spoilage
- As homebrewers we must control the fermentation process imitating the spontaneous fermentation process to achieve the greatest results
- Often,Lambic fermentations last 2+ years
- In all of the homebrewed examples you will try, the fermentation took 3 years.

Sequence of Species

- Enteric Bacteria (bacteria)
- Kloeckera apiculata (yeast)
- Saccaromyces (yeast)
- Pediococcus damnosus and lactobacillus (bacteria)
- Brettanomyces (yeast)
- Oxidative Yeasts (yeast)

Propagation of Yeast/Bacteria

- Always propagate to ensure high enough cell counts
- For Brett: use $CaCO_3$ to increase pH
- For Pedio and Lacto: apple juice medium

Kloeckera Bacteria

- Start with Ale yeast
- After 3-7 days of fermentation add Kloeckera Apiculata
- Ferments glucose, not maltose
- Gets taken over by ale yeast in a couple weeks
- Secretes enzymes that break down remaining proteins
- Minor flavor contribution - some fruity esters and floral notes
- pH drop from 5.1 to 4.6

Saccharomyces

- Prefer Wyeast 1338 European Ale yeast
- Any fairly neutral ale yeast will suffice
  - Chico / Cal Ale
- Added at starts
- Overtakes Kloeckera after about 2 weeks.
- Ferments glucose and maltose, main sugars in wort

Pediococcus and Lactobacillus

- After 3-4 months, main fermentation is complete
- Pediococcus Lambicus, Pediococcus Damnosus, and Lactobacillus are added
- Lactic acid producing bacteria
    - pH will drop from 4 to 3
    - Responsible for sour taste
- Ferment glucose into lactic acid without emitting carbon dioxide
- Slow fermentation
- May produce diacetyl, which will later fade

Pediococcus and Lactobacillus (2)

- Pellicle or cake will start to form
  - Important not to disturb
  - Prevents oxygen and acetobacter
- Spiders may make webs
  - Do not remove them
  - Catch flies
  - Traditional lambic breweries do not remove spiders or spiderwebs

Brettanomyces

- Added after about 8 months of fermentation
- Brettanomyces Bruxellensis and Brettanomyces Lambicus
- Remain for 16+ months
- Main contributor of funky aroma
- Slowly ferment remaining sugars
    - Ethyl Acetate, Ethyl Lactate
    - Sometimes produce acetic acid
    - Horsey / barnyard character

Oxidative Yeasts

- Also at 8 months
- Genera Pichia, Candida, Hansenula, and Cryptococcus
- Further form pellicle
- Contribute to ester profile
  - Fruity, cidery notes
- Found at surface because they require oxygen and chain together to float

Blending

- A good idea to reserve some for blending
- Straight, unblended lambic can be enjoyed as-is
- Fruits for fruit lambics
- Candi Sugar and Molasses - Faro
- Save to blend in future years for Gueuze

Extract Lambic Recipe

- 3 # Pale Malt Extract
- 2 # Wheat Malt Extract
- ½ # Corn Sugar
- ½ oz. of each Fuggles and Hallertaur hops (3 yr old)
- ¾ cup corn sugar for priming
- Saccharomyces, Kloeckera, Brettanomyces, Pediococcus, Lacto, Pichia, Candida, Hansenula and Cryptococcus propagated from isolated cultures or (from a bottle of Gueuze)

All-Grain Lambic Recipe

- 3 # Dingamans Pale Malt
- 2 # Wheat
- ½ # Crystal 40 Lovibond
- 1/3 oz. ea Fuggles and Hallertaur hops (3 yr)
- ¾ cup corn sugar for priming
- Saccharomyces, Kloeckera, Brettanomyces, Pediococcus, Lacto, Pichia, Candida, Hansenula and Cryptococcus propagated from isolated cultures or (from a bottle of Gueuze)
- OG- 1.053 or 13.2 Plato
- Terminal Gravity-1.013 or 3.2 Plato
- Boil 2 hours
- Ferment at 69 degrees

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