THE POWER OF SOUR

Sour beer is a beer style characterized by an intentionally acidic, tart, sour taste. It is Category 17 of the Beer Judge Certification Program Style Guidelines. In theory any style of beer may be soured, but 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 the latter.

There's magic in the air around the Senne River Valley region of Belgium near Brussels. Live, wild, natural, airborne yeast and bacteria suspends almost weightless – and a lucky few finally rest into open fermentation tanks known as coolships, in open air breweries, creating spontaneous and funky beer, called Lambic.

The romantic, mysterious, wild-fermented wheat beers of Belgium's Flanders are among the world's rarest beers. The unique combination of the Senne River valley; small hills with numerous cherry trees; small farms growing hops, barley and wheat; and a mild climate has given the region an air-disseminated micro flora that has seeded farm breweries for more than 500 years.

Unlike traditional beer-brewing, which is done in a sterile environment to guard against the intrusion of wild yeast, sour beers are made by allowing wild yeast strains and bacteria into the brew. Traditionally, Belgian brewers allowed wild yeast to enter the brew naturally through the barrels which were infected – an unpredictable process that many modern brewers avoid. The most common agents used are Lactobacillus, Brettanomyces, and Pediococcus. Another method for achieving a tart flavor is adding fruit – most commonly cherries (to produce kriek) or raspberries (to produce framboise) – during the aging process, to cause a secondary fermentation. Because of the uncertainty involved in using wild yeast, the sour beer brewing process is extremely unpredictable. The beer takes months to ferment and can take years to mature.

The scary part of making lambic is the potential for wild yeast cross contamination in your home brewery. Search on the internet, and you will find many warnings about making lambic with wild yeast and bacteria. True lambic brews are not made with a particular yeast rather they are spontaneously fermented with anaerobic wild yeast strains and bacteria. The wort is just exposed to the local critters and Mother Nature does the rest. If we attempted this outside of Belgium's Senne Valley, our results would likely be less than favorable. While working as a commercial brewer we tried this open spontaneous fermentation method in the Chugach National Forest outside of Anchorage, Alaska. The results were less than desirable although some people really loved the beer. The reason is the wild yeasts, microbial flora and bacteria local to parts of Belgium especially the Senne River Valley near Brussels - a region about 15 by 75 miles in size are used to make lambic and are isolated to the region of the entire world. The rest of the world must use a commercial lambic blend or isolated strains of wild yeasts at different intervals which is my method of choice. There are others trying this method of spontaneous fermentation (The Allagash coolship series for one) in the states but I wouldn't compare them to any of the beers of Brussels because the flora and thus the characteristics are so very different.

Coolship at Cantillon

The lambic blends available includes Brettanomyces, Saccharomyces, and the bacterial strains Lactobacillus and Pediococcus. There are other yeasts and bacteria, but science has determined that these are the critters that produce the flavor profile we want when producing lambic.

There are many myths surrounding these yeast and bacteria. Since they are “wild”, it is assumed they have supernatural powers above and beyond the normal beer yeast. Brewers worry the critters will lurk in every crevice of your home or brewery and infect every beer you ever make again and this is a legitimate concern. If you are brewing in porous wood barrels, uncovered fermenters, and/or you don’t clean or sanitize anything you may have something extra to worry about. Using proper sanitation and properly cleaning your equipment will protect you from these “wild” yeasts and any truly wild yeast living in your home brewery. When you are finished, clean all of your equipment as you normally would. If you feel extra worried, you can soak your equipment in star san a bit longer. These micro-organisms are just as

susceptible to the acid-based sanitizer as all other brewing critters. If I have any plastic equipment in contact with my Lambic it is then deemed lambic only and I would segregate it as I do using a fluorescent marking for the only reason that plastic scratches very easily and has the potential to harbor bugs that make it impossible to clean and sanitize effectively. In the many years of making sours, which is now over 15 years I have the luxury of having acquired enough various equipment so I never cross contaminate by using equipment that has come in contact with wild yeast when brewing anything non-sour. If you are unwilling to have brewing equipment devoted to lambic, sours and wilds, I would suggest not ever taking on the effort.

The mashing process is somewhat similar to other styles, but up to 30 percent unmalted wheat is added to the malted barley in the grist. Mashing is slow, involving liquid transfer, and is known as a "turbid mash." And whereas most brewers use the freshest hops during the boil, lambic brewers use 3 year old aged hops to contribute preservative properties without the bitterness of the herb (this protection is important to the final product, since it is such a long process from start to finish). Singularly, in the world of brewing, no yeast is added to this beer. After the boil, lambic wort is transferred into a coolship (a large, shallow vessel) that exposes the hot wort to the cool fresh air and wild yeast. Outside air - laden with floating wild yeast cells, in a natural balance - can enter the coolship rooms via louvers in the walls.

After fermentation, the beer is transferred into fermenting vessels for two summers of maturation. A second, slower fermentation takes place here, influenced by oak, either in an oak cask or in steel with oak chips added. After aging, the base lambic is treated in different ways to make different beers.

Without question, lambic is the world’s most unusual and many including me say it’s the best beer on the planet. Lambic is unique in that the brewing process often takes several years like in the case of the sample I have brought for you to taste. Lambics are a complex family of beers, which include dry aperitif beers, full-bodied dinner beers and fruity dessert beers.

The Anachronisms of Traditional Lambic

Lambic is defined by Belgian law and further protected by a European Union ordinance established in 1992 and by the European Beer Consumers Union. Belgian law defines lambic as spontaneously fermented ales made up of a grist of at least 30% unmalted wheat. Many additional idiosyncrasies combine to the make the style what it is.

Incompletely converted mash: Turbid mashing is the most traditional of lambic brewing techniques. It is similar to decoction, except that it involves removing and boiling liquid (rather than grain) portions of the mash. Unlike more mainstream mash methods, turbid mashing results in large amounts of unconverted starch in the finished wort.

Oxidized hops: Whereas most brewers want only the freshest of hops, lambic brewers rely instead on hops that have been stored in the open for 2–3 years until thoroughly oxidized and

leached of their bittering properties. Old hops retain properties that allow lambic brewers to tame some of the beer's "wildness" by controlling certain bacteria.

Intentionally "infected" lambic worts are not pitched with a pure strain of yeast, but are instead allowed to cool overnight in open cool-ships which are large, shallow basins that maximize surface area for heat transfer and exposure to the air. During the night the wort is inoculated with wild yeasts and bacteria that waft in through open windows. Lambic breweries typically only operate from about October to May due to lambic's dependence on naturally occurring microbes, which can get out of hand during the summer months, the summer months are typically maturation months.

No stainless steel: The inoculated wort is fermented not in stainless steel vessels, but in old oak casks. Some American home brewers intentionally infect their own casks to help authenticate their lambic-style ales.

Generously aged: Born on dating will never be an issue in lambic circles. Lambic production is slow; it involves a period of fermentation and aging as lengthy as that of wine (one of the reasons lambic is considered a footbridge between the worlds of wine and beer).

Blended to taste: Lambic brewers manage the ever-changing flavors of aging lambic by blending old and young batches.

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.

Gueuze. A sparkling, fruity beer made by blending young and old lambic and then filtering and bottle-conditioning the mixture to achieve a naturally carbonated effervescence similar to that of champagne.

Fruit lambic. Made by re-fermenting young lambic with whole fruit (cherries, strawberries, peaches, grapes, etc). The fruit/lambic blend is generally matured for several months and then bottle-conditioned with another addition of young lambic.

Gueuze Simplified

For gueuze, the base lambic is blended to make a distinct, wine-like drink that is traditionally served with the meal (a blend of 1/3 young lambic and 2/3 old lambic). Gueuze is known to mature beautifully, and stories abound of discovering age-old gueuze lambics that had matured to perfection, I recently had a 1952 and 1985 Geueze at the Woodshed event and both were absolutely stellar.

Fruit Lambics Simplified

Nowadays fruit lambic beers are extremely popular. The 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. In the 1930s different farm breweries restarted 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).

*Jean-Xavier Guinard's Lambic describes all aspects of lambic beer and brewing, including its history, its traditional production processes, and the breweries that still produce the style. It also goes into a fair amount of detail in outlining the microbiology of spontaneous fermentation and describes methods for making a pure-culture lambic-style ale at home. I have found the

information in the book to be accurate and concise, with the exception of a few minor details. Those of us who have pursued this type of brewing like I have, have found the book to be an invaluable resource and an excellent stepping stone. I highly recommend this book to anyone considering making pure-culture lambic-style beer.

Just keep in mind that there is no such thing as “instant” lambic-style ale. The microorganisms used to ferment lambic grow very slowly and are equally slow at producing the flavor profile that gives the style its true depth of character. You cannot buy a kit or follow some recipe in a homebrew shop catalog and end up with a well-balanced, complex product of true Belgian character. Your beer is not going to develop Brettanomyces character or the proper acidity in a few weeks. It will not become a mélange of flavor after two weeks in the bottle.

Most important, understand that success is to a large degree a matter of chance and that is possible that you may fail, even after investing a great deal of time and effort into your beer and after following all the procedures meticulously. You can use traditional mashing techniques, use all the right ingredients, and add all kinds of wild yeast and bacteria, ferment in a cask for years, and still end up with an utterly disappointing product.

There is little you can really do to change what ultimately happens in the fermentation vessel. Either the beer will develop the classic Brettanomyces, pellicle (film), ropy mouthfeel, and horsey character — or it will not. Your beer may end up so acidic you will want to use it for cleaning calcium deposits off of your brew kettle, or it may be so mild that it barely passes as infected beer. Even after bottling, lambic-style beers can undergo large changes in flavor.

These precautions should not be taken as discouragement from brewing this most challenging beer style. These are merely the facts of lambic life. Belgian brewers manage this level of variability and uncertainty by strict adherence to traditional methods and by what may seem like a bit of a cheat — blending. All lambics are variable, and the art of successful commercial lambic brewing is in blending various batches to create a balanced, complex, and pleasing flavor profile. Every one of the samples provided today commercial or not were blended.

With a bit of effort and patience, anyone can produce a reasonable lambic-style ale in the home setting.

Wort Preparation

The grist: A lambic grist is usually composed of pale barley malt highly enzymatic mixed with 30–40% raw wheat. The most traditional method of working with the grain in lambic brewing is called turbid mashing. Turbid mashing is a time-consuming and labor-intensive process that was devised to effectively break down the proteins in ungelatinized raw wheat while leaving a good supply of starches and free amino nitrogen for the yeast and bacteria to feed on during the long fermentation. Home brewers, however, have various forms of wheat available to them, many of which can simplify the procedure greatly.

Types of Wheat Available to Home Brewers

Lambic-style recipes call for wheat as 30–40% of the grist. Traditional lambic brewers used raw wheat, which requires a complex mashing method to break down its proteins while leaving a good supply of starches and free amino nitrogen for the yeast and bacteria to feed on during the long fermentation.

Wheat is available to home brewers in various forms, including whole wheat berries (hard red or soft white varieties), flaked or rolled wheat, and malted wheat. The form you choose will likely be based on the equipment you have and how traditional you want to be in your recipe formulation.

Raw Wheat

Like any adjunct, wheat must be precooked somehow before mashing to gelatinize, or disperse its tough starches so that the enzymes can work on them. Turbid mashing is one means of accomplishing this goal. You could, of course, pregelatinize your own raw wheat by precooking it.

Crushing raw wheat: If you work with raw wheat, you will have to deal with crushing it. Raw wheat is not friable because it has not yet been malted or kilned; it therefore has a tendency to squish rather than crush, making it difficult to mill, especially with a roller mill. Running the wheat through a roller mill several times will help reduce it to fairly small particles. However, I have found that my mill attachment to my Kitchen Aid works perfectly. This is one instance in which a Corona-type mill (designed for grinding rather than crushing) may have an advantage over any of the various roller-type mills available. Because wheat has no husk, grinding it into a fine powder is not a problem. I have also used unmalted buckwheat and Emmer wheat to produce lambic.

Wheat flour: A few individuals have replaced the wheat fraction of the grist with whole wheat flour without encountering any problems with stuck mashes or slow runoffs. Of course this will depend on your mashing and lautering setup and your level of experience. If you feel adventurous, give it a try but you should know how to reverse or correct a stuck mash before attempting this just in case.

Rolled, Flaked, or Malted Wheat

I suggest flaked or rolled wheat or malted wheat as alternatives to raw wheat. Wheat flakes and rolled wheat are pregelatinized, which makes for a less time-consuming mashing procedure. These forms of wheat can be found at most homebrew supply stores and often at natural food stores, along with raw wheat of either the hard or soft varieties. Malted wheat also simplifies the mashing step and is usually readily available through most homebrew stores.

The mash: Whatever you choose for the grist, the goal is to produce a wort that is high in amino acids and dextrins and light in color. You can achieve this composition in a few different ways, from simple extract brewing to the complex traditional turbid mash method. Whether or not a turbid mash is required to achieve optimal flavor is a matter of debate, and not all lambic brewers use this method. However, two of the most traditional breweries, Boon and Cantillon, do and I have always used this mashing method as well.

The extract option. Tradition is nice, but you can make lambic-style beers even if you are not an all-grain brewer. The simplest approach to making lambic-style ale is to use dry or liquid malt extract. Since you need extra amino acids and dextrins in the wort to support the long fermentation, you may consider using an extract meant for making wheat beer. These are typically made from 60–70% malted wheat and are readily available. I have had good results using Weyerman's wheat and pilsner liquid malt extracts.

If you use extracts, get the freshest, lightest extract possible and boil for a full hour to maximize the extraction of the hop antiseptic compounds and to precipitate the excess proteins in the extract. The main problems with extracts as a whole are that they generally produce beers darker than equivalent all-grain beers, and the extracts themselves may be somewhat nutrient deficient.

The all-grain option. If you are an all-grain brewer, you can use malted, flaked, or raw wheat in your mash and choose from a variety of mash routines. Probably the simplest grist comprises 30–40% malted wheat — which is easier to mill than raw wheat — with the remainder being two-row pale malt.

The grain can then be mashed using a single-step infusion in the 150–155 °F (65–68 °C) range to produce a reasonably dextrinous wort that is also very light in color. If you use this method I recommend using some Carapils or dextrin malt. Or you could modify the mash schedule by using a step mash or decoction mash. This technique helps break down the excess wheat proteins and provides the extra amino acids needed by the various yeast and bacteria. One problem, though, with such an intensive mash schedule is that it can lead to too much breakdown of the dextrins in the grist and thus too little carryover into the wort.

If you choose to use raw wheat, you have several options that traditional brewers didn't have. Using pregelatinized flakes, or pregelatinizing the wheat yourself before the mash, can allow you to stick to simpler mashing techniques.

The traditional turbid mash. The goal of the turbid mashing procedure is to break down the larger proteins of the raw wheat and malt into free amino acids and to produce a wort high in

dextrins and starches. The process of turbid mashing is somewhat like inverse decoction mashing; it involves removing the liquid portion of the mash, boiling it, and then reintroducing it to the whole mash (in decoction, the grain is included in the removed portion). This process of removing, boiling, and returning is repeated a number of times until the mash reaches saccharification temperature. After a two-hour saccharification rest, the wort is run off and the grains sparged with near-boiling water. The whole process is followed by a 2 hour boil that reduces the large volume of liquid, precipitates the excess proteins, and bursts any suspended starch granules.

A Scaled-Down Mash Schedule from Cantillon Brewery

Jean Van Roy turbid mashing

Jean Van Roy pouring a taste of my Lambic

The following is a homebrew-scale version of the Cantillon Brewery's (Brussels, Belgium) turbid mash schedule. The Cantillon Brewery gets about 33–34 points/lb/gallon. The Cantillon grist is composed of 34% raw wheat and 66% malted barley. The recipe is scaled down here to yield 5 gallons of wort with an original gravity of 1.048 (11.86 °P), or 5 x 48 = 240 points. If we assume we will get 30 points/lb/gallon, then 240 ÷ 30 = 8 lb of grain. The barley malt fraction is 66% of 8 lb, or 5.3 lb of malt, leaving the remaining fraction of raw wheat at 2.7 lb.

The Cantillon schedule calls for mashing 1,300 kg of grain into 850 L of water (2,860 lb grain into 900 quarts water), or 3.2 lb grain/qt water, or 0.3 qt water/lb grain. Our 8 lb of grain therefore requires 8 x 0.3 quarts, or 2.4 quarts of water.

Procedure

In all of the following steps, the temperature and water additions were taken directly from the Cantillon schedule as published and scaled accordingly.

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.

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, making sure to mix thoroughly. It will take about 3.5 quarts of boiling water to raise the mash temperature to 136 °F, and you will end

up with a very soupy mash with plenty of excess liquid. Allow the 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.

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.

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.

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.

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.

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.

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 solubilizes. After boiling, the wort can be cooled using your method of choice. This method of mashing does not seem to 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, but the yield could probably be improved by extending the times for the various rest steps. It may also be a good idea to heat the liquid withdrawn from kettle #1 each time at a very slow rate. To play it safe, you may want to start out with a larger grain bill based on the more conservative yield of

25 points/lb of grain. Clearly, your own results will vary with your methods, percentage of efficiency and equipment.

Sparging

The sparging of a lambic mash is typically carried out with water that is hotter than customary sparge temperatures, usually close to 190 °F (88 °C). This temperature helps to extract dextrins and unconverted starches from the mash. The process extracts tannins from the malt as well, but these are precipitated out or broken down over the long fermentation cycle and do not contribute any significant astringency to the finished beer.

The use of hotter-than-normal sparge water is particularly important if you follow a true turbid mash–type schedule because of its poor conversion. Bear in mind that in conventional beer production, you do not want starches and tannins extracted into the wort, but in lambic brewing they 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 the precipitation of excess proteins from the wheat and the reduction of the volume of liquid collected. The long boil in lambic brewing makes Irish moss or other clarifying agents unnecessary; any excess proteins that may remain in solution will either be used or precipitated during the lengthy fermentation process.

Hopping

The hops used in lambic production should be aged for one to three years, to the point at which they have lost all of their bittering power and so do not detract from the acidic, pungent character of the beer. Aged hops also contain tannins that give lambic its dry, astringent taste, and antioxidants from hop resins allow the lambic a longer shelf life and help control levels of undesirable Gram-positive bacteria such as Bacillus, Sarcina, Streptococcus, and others.

The varieties typically used are of the low to medium alpha-acid range, such as Hallertauer, Tettnanger, or Brewers Gold. Almost any hop variety will do, though, with the exception of high alpha-acid varieties such as Chinook, which tend to retain bittering power and intense flavor even after long aging.

The Hop aging process

Home brewers have a couple of options for achieving the effect of aged hops. Once again, you'll have to reverse everything you've learned about hops and the importance of keeping them fresh.

One strategy is to buy fresh hops and leave them out at room temperature for a year or two, this is what I do but I realize this requires planning and is not convenient for the beginning lambic-style ale brewer. You or a friend may have some old hops that you just could not part with but that have never been used, and if these are old enough they may serve the purpose. Newer hops can be heated at low temperatures in the oven (<200 °F [<93 °C]) on a cookie sheet for 4–5 hours. The idea is to heat the hops until all of their aroma has been driven off. Be aware that the smell may not be one that others find pleasant, like ones wife.

As hops age they take on a very pale green to yellow color and lose all aroma; the lupulin in whole hops turns from yellow to orange-brown. They also go through a stage of smelling rancid and cheesy. This smell is unpleasant, so it is best to leave them in a well-ventilated area like the garage or storage shed.

I have found that leaving hops outside in the California summer sun for a week or two seems to do a very good job of aging them watch this if you have dogs even old cheesy hops are lethal to dogs. And if you have a total aversion to "ruining" perfectly good hops you may be able to purchase end-of-the-year hops at a reduced price from your local homebrew shop or from one of the many homebrew mail order supply companies. Alternatively, the herb departments of many natural food stores stock hops that are usually well-aged and devoid of aroma with well-oxidized lupulin glands.

Whether you choose to use whole or pellet hops does not seem to matter as long as the hops are well-aged. Both forms can be used alone and together, depending on what's on hand. Powderizing the pellets will help to enhance the oxidation process. You may want to put the hops into a container with a fine mesh cover of some sort and shake the container every once in a while to enhance oxidation.

The Lengthy Fermentation Process Begins

Oak Casks fermenting out

The selection of hops is the last stage of the lambic brewing process over which you have a reasonable degree of control. Once your lambic-style beer begins the fermentation process, you have no option but to dig in and let the microorganisms do their work.

We will now enter the world of lambic fermentation, starting with a map of the microbiological terrain of the lambic fermentation process.

The microbiology of Lambic beers is what makes them so unique and complex. Lambic beers undergo a spontaneous or natural fermentation, that is, they are fermented by the microbial flora found in the brewery and the atmosphere surrounding it. This practice itself is not so unique and many great wines are still made in this way today in such famous wine making regions as Burgundy and Bordeaux. It is the resulting combination of microorganisms involved in the lambic fermentation that is unique. It is 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, and rightfully fear bacteria as the agents of beer contamination or spoilage.

Lambic fermentation is often thought of as controlled spoilage, in the case of lambic and other sour ales this is of great significance. As homebrewers we must control the fermentation process imitating the spontaneous fermentation process to achieve the greatest results. Often Lambic fermentations last two years, in all of the homebrewed examples you will try the fermentation took three years.

There is a specific sequence of the main microbial species involved in the lambic fermentation which follows the below order:

- Enteric Bacteria (bacteria)
- Kloeckera apiculata (yeast)
- Saccaromyces (yeast)
- Pedicococcus damnosus (bacteria), and
- Brettanomyces (yeast)

My preference is to inoculate along these time lines following the sequence mentioned previously. Pure cultures are available from all of the major yeast manufacturers. There are blended lambic cultures but I can't stress enough that this will not achieve the same results as pitching individually at different time intervals. I add the mildest toasted Chestnut, French, or Hungarian (stay away from American unless it is neutral) cubes or chips after primary these will allow for lots of nooks and crannies for the bugs to thrive in, or if one was inclined to this entire process could be done in the cask.

I always propagate, this increases the cell counts and I have a high level of activity prior to pitching. For Brett strains I use some CaCO3 in conjunction with boiled DME, the calcium carbonate buffers the acidity, for Pedio and Lacto strains I use an apple juice medium for growing these two. You can always harvest from a previous fermentation but this process proves to remedy the starting point issue assuming one has never made lambic before. As far as a saccharomyces yeast strain I use Wyeast 1338 European Ale yeast but any fairly neutral ale yeast will suffice like Wyeast Chico Ale 1056 or White Labs Cali Ale.

After 3-7 days of fermentation on the ale yeast strain I add the Kloeckera Apiculata, it ferments glucose and not maltose thus causing it to get taken over by the ale yeast in a couple weeks. The Kloeckera secretes enzymes that further break down proteins not precipitated in the boil. The flavor contribution is minor some fruity esters, with floral characteristics that are stripped of during the main fermentation. During this period the PH will decrease from 5.1 to 4.6.

As mentioned after about two weeks, K. Apiculata is over grown by the saccharomyces. These strains perform the main alcoholic fermentation and are responsible for most of the attenuation of the wort. They are very capable of fermenting glucose, maltose, and in some cases maltotriose the main sugars in wort.

After 3-4 months, the main fermentation is now complete. The yeast population decreases and the bacterial population increases with the addition of Pediococcus Lambicus, Pediococcus Damnosus, and Lactobacillus. As lactic bacteria, Pediococcus Lambicus, Pediococcus Damnosus, and Lactobacillus ferment glucose into lactic acid without emitting carbon dioxide. Large increases of lactic acid concentration is observed after a few months and the PH will drop further from 4 to 3. This process of bacterial growth is rather slow and never reaches a very high density in the lambic wort because of their complex nutritional requirements. Lactic acid is responsible for the sour taste in lambic beers. At this time diacetyl concentrations may heighten resulting in a buttery taste and or aroma these levels will later drop to roughly ¼ the concentration level.

At this point a pellicle or cake will have started to form, it is so very important that this not be broken or disturbed. This is a protective membrane of sorts eliminating lambic wort from being exposed to oxygen, acetic bacteria need oxygen without it they cannot thrive. I often find many

spiders making their cob webs around my vessels at this time as well, again, do not disturb them they are welcomed and will eliminate unwanted acetic acid harboring insects like fruit flies. In Belgian Lambic breweries it is sacrilege to kill a single spider they are as much part of the cellaring room as the oak cask.

After about 8 months of fermentation, the yeast population increases yet again, this time with the addition of strains belonging to the species Brettanomyces Bruxellensis, and Brettanomyces Lambicus. These strains remain in the lambic wort for the next 16 months and are the main contributors to the aroma of lambic beers. Their growth coincides with a further slow decrease in residual extract. These yeasts account for a small fraction of the total fermented sugars, they comprise many different kinds of compounds, each in a fairly low concentration, but many with even lower detectable thresholds. The main among these compounds is esters ethyl acetate and ethyl lactate. Some acetic acid is sometimes produced by Brettanomyces yeasts at this stage of fermentation as well as the notorious horsey character which can be strong or weak. What causes this character is not yet fully understood. A elevated presence of Ethanol and the amino acid lysine in the growth medium are thought be the determiners for a more a more pronounced Horsey character. Since wort contains both, the conditions are set for the horsey flavor to be produced when Brettanomyces is the predominant species in the lambic wort. The contribution of Brettanomyces which is significant is very slow, just as was the case with the Pedio species for the same reason.

Lastly, at 8 months oxidative yeasts of the genera Pichia, Candida, Hansenula, and Cryptococcus are added to further the formation of the film on the surface known as pellicle. They do also contribute to the existing ester profile, and other volatiles attributed to producing the fruity and cidery notes characteristic of lambic beers. These yeasts are found at the surface because they are oxidative and chain together thus giving them the ability to float.

So, we have turbid mashed, and now fermented our precious nectar for two years, and we are now ready to bottle or keg. I prefer to always reserve a portion for blending. I feel it is always a wise choice with a two year time investment. At this point we have straight lambic or unblended lambic which can be enjoyed as is. If one were so inclined there is an array of various fruits that can be added to the elixir to create Fruit Lambic; such as, raspberries, grapes, peaches, apples, currants, cherries, which are all traditional choices. You could take a portion out back sweeten it with candi sugar and molasses to make Faro a blend of Mars beer and lambic usually a 50/50 blend. Of course there is an opportunity to use the reserved portion in later years to make the coveted Gueuze the Champagne of Brussels. When brewing you can take the last runnings to ferment using the same processes and make a lighter lower gravity Mars beer too. One thing I have found is I can never brew enough of this wonderful beer. I have progressed to 110 gallon batches at a time from 5 gallon batches because it is so time consuming. I would strongly encourage folks to pick up some old barrels from a San Diego brewery and fill it up in two years or three years you will be glad you upped the batch size if your beer turns out as favorably as mine have.

Here is a basic 5 gallon recipe both extract and all-grain to play with, if any questions should arise feel free to contact me directly;

Extract Version
-Lambic-
3 # Pale Malt Extract
2 # Wheat Malt Extract
½ # Corn Sugar
½ oz. of each Fuggles and Hallertaur hops (3 year 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 Version
-Lambic-
3 # Dingamans Pale Malt
2 # Wheat
½ # Crystal 40 Lovibond
1/3 oz. of each Fuggles and Hallertaur hops (3 year 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)
OG- 1.053 or 13.2 Plato
Terminal Gravity-1.013 or 3.2 Plato
Boil- 2 hours
Ferment at-69 degrees

Even the trash in Belgium is better!

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Chad Yakobson, Crooked Stave Artisan Beer Project, Brettanomyces Dissertation

Cheers,

Thanks for allowing me to speak to you all about brewing lambic. Don’t forget to share some of your efforts with me. This style which was almost lost is now seeing resurgence thanks to craft beer lovers like us. Support the craft beer movement and keep these truly unique, unusual, complex and fascinating styles alive for generations to follow.


CANTILLON