NATIVE FERMENTATION

Native, wild, spontaneous, feral fermentation; all are terms that refer to allowing the wild yeast species contained within and adhering to the skin of apples to ferment. Fermentation will be initiated by apiculate yeasts already present in the flesh of the apples. Apiculate yeast has a relatively low alcohol tolerance and as their population peaks, wild saccharomyces yeast replaces it until it has either exhausted all available sugar or it runs out of nutrients (nitrogen). Here are some simple steps to achieve a successful native fermentation.

Preparing to Ferment

The first step is to know your must. Measure the pH, SG, total acid, and run a pectin test. If necessary, add malic acid to bring your pH down to approximately 3.5 and the total acidity in the range of 4-6 g/l. This level gives the must some protection against spoilage organisms and is about the range you will want in your finished cider though don't expect the initial values to necessarily remain constant. If the must has a starting gravity less than 1.040 consider adding sufficient fructose to get to at least 1.045 which will result in an alcohol concentration to protect the finished cider as well. Run a pectin test by mixing 10 ml of must with 1 ml of isopropyl alcohol in a test tube or small graduated cylinder. Shake vigorously for a minute or two and set it aside for an hour. If a white translucent flocculate forms, it is pectin coming out of solution. If you have a tenth of a ml at the bottom of your test tube after a couple of hours, you should add pectinase to the must. As all enzymes, the activity of pectinase is temperature dependent so keep the must at 60˚ or more for 12 hrs. Do not add sulfite before letting the pectinase do its job.

Whether you start with fruit or must, your starting material has a robust microbiome. You need to thin the herd and the most effective way to do that is with SO_2. If you put in too much, you will either kill the native yeast species or stunt it so that your must is vulnerable to infection by spoilage organisms. A rule of thumb for a wild ferment is to add 25 ppm SO_2 to the must as soon as possible. Even though you are allowing the native yeast to do the fermentation, the same strict sanitation measures you would use for a cultured yeast fermentation are essential.

At this point, you can either allow the fermentation to get under way or try to separate as much fine pulp from the must as possible. To ferment a nitrogen deprived must, the first step is to refrigerate the must for 1-2 days then decant the clear must from as much of the settled pulp as possible.

Fermentation

A long cool fermentation will allow the yeast to grow without stress and thus produce little sulfur. A starting temperature of around 60˚ should be reduced to as low as 40-45˚ if possible after fermentation is well underway. If your ferment does not start within two to five days, use

a sanitized paint stirring bit in an electric drill to agitate it and put it in a warmer place until fermentation is clearly underway. Wild yeast usually does not have as strong a log phase as commercial yeast but it is clearly recognizable.

Unlike commercial cultured yeast, wild yeast does not require the addition of nitrogen. Fermenting with nitrogen limited to the natural content of the must will limit the speed and final gravity of the ferment. Apiculate yeast benefits from vitamins (see yeast info on last pages) though I have never used them.

If you have already clarified your must by cooling and separating the clear juice, you are already on your way to a nitrogen deprived fermentation. Further nitrogen reduction can be achieved by racking after the first 20 point drop (approximate end of log phase) and every subsequent 10 point drop.

The goal is to slowly ferment and stick the ferment at around 1.010.

The graph below shows the fermentation history of must from the 2017 WORTS cider buy at Cider Hill Farm. Note the length of the four phases of fermentation (lag, log, deceleration, stationary). The upper curve is SG vs time and the lower curve is the speed of fermentation (FSU vs time). The initial conditions were:

pH= 3.4

Total $Acid_{(malic)}$= 4.0 g/l

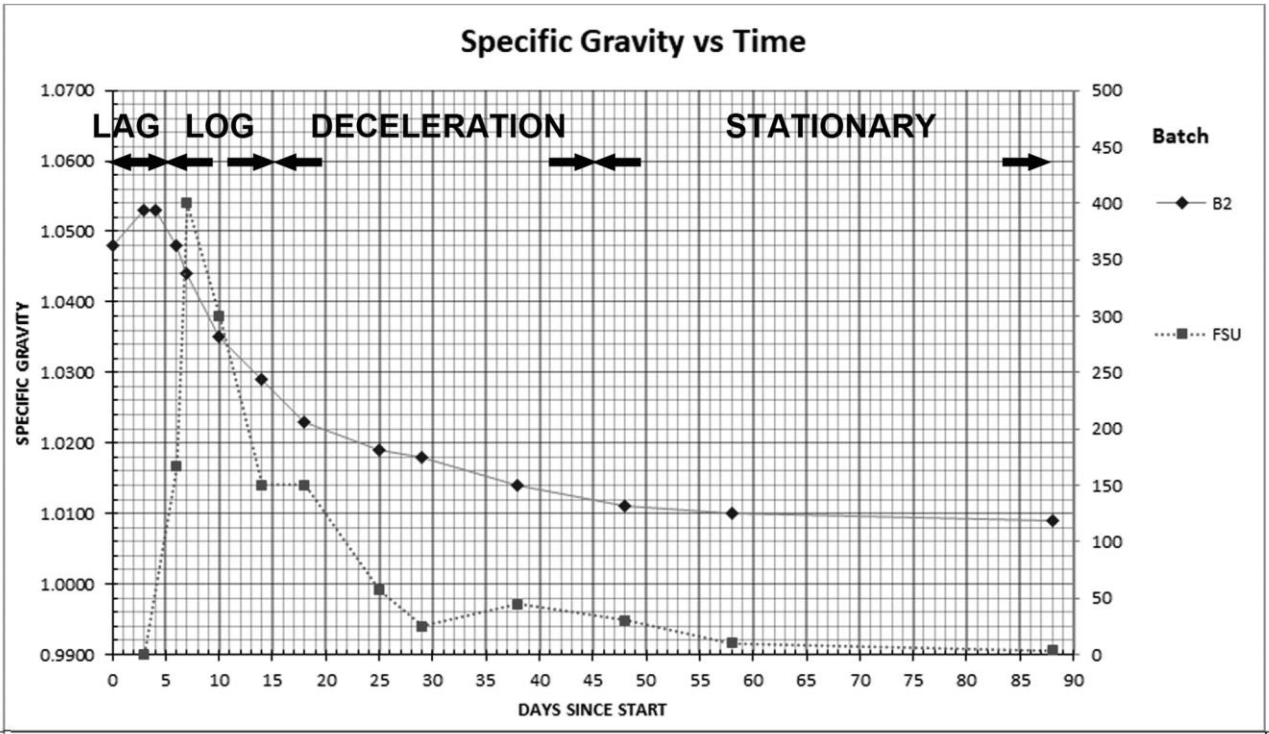
SG=1.048

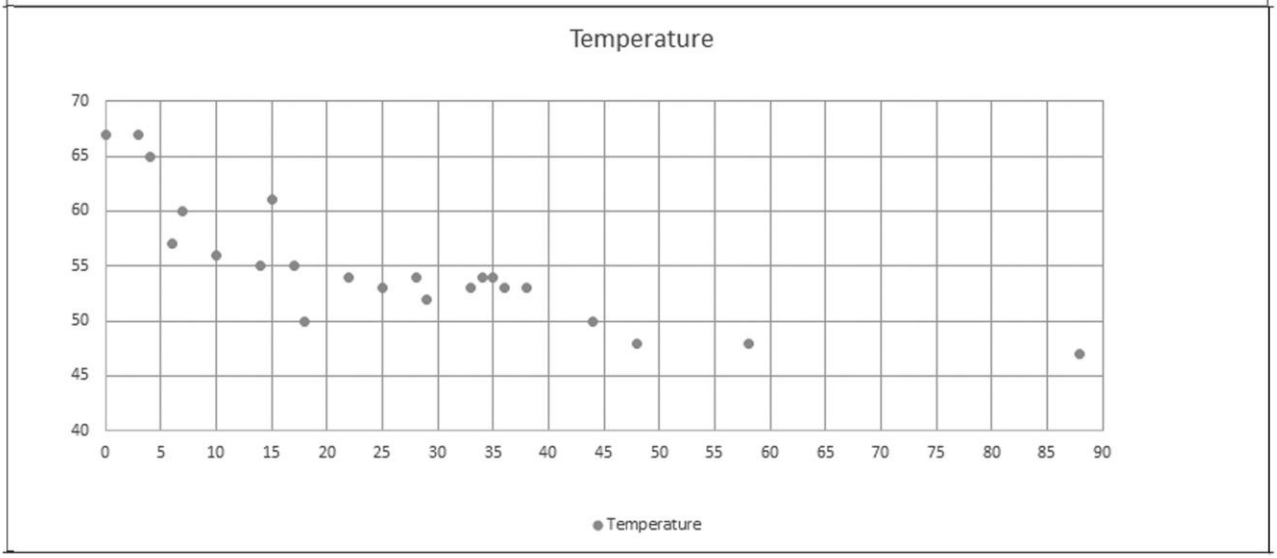
Before fermentation, I added 20 ml of stock sulfite solution and 550 g of fructose. There was vigorous airlock activity on day five. The first rack was at SG 1.035, the second at 1.029, and the last rack at 1.011. Lag phase lasted around five days, log phase was over by day 15 and it entered stationary phase by day 45. Two bottles were filled on day 88 where I noted there was a faint sulfur smell that dissipated rapidly, a total acid of 3.7 g/l and a pH of 3.5. It continued to slowly ferment in the bottle until today, 332 days since fermentation began.

Cheers

Tom Bell

September 12, 2018


Specific Gravity vs Time
LAG
LOG
DECELERATION
STATIONARY
SPECIFIC GRAVITY
DAYS SINCE START
Batch
B2
FSU


Temperature
Temperature

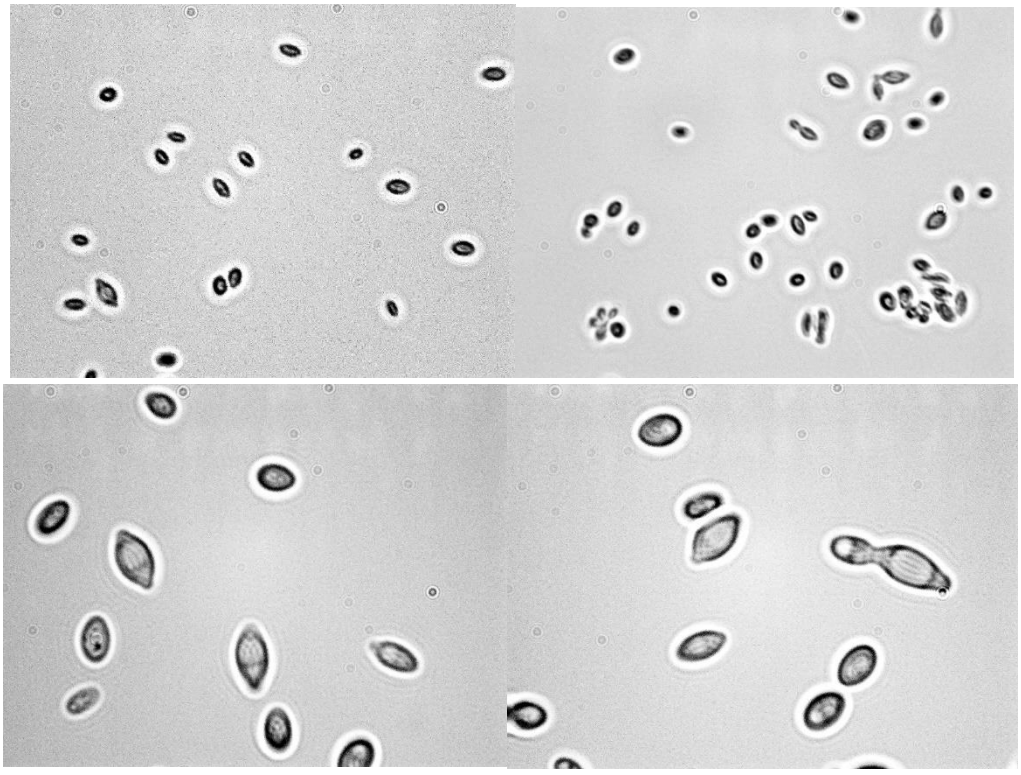
Hanseniaspora uvarum

Genus/species (aliases): *Hanseniaspora uvarum (Kloeckera appiculata* anamorph*; Kloeckera austriaca, Kloeckera brevis, Kloeckera lodderi, Hanseniaspora apiculata)*

Classification: Ascomycete; teleomorph

Morphology:

- Cell: Reproduces by budding; apiculate, spheroidal to ovoidal, elongate, (1.5-5.0)x(2.5-11.5)µm, and single or in pairs.
- Colony: Glucose-yeast extract-peptone agar after one month at 25°C: white to creamy, smooth, glossy, and slightly raised at the center.
- Spore: Saturn to helmet-shaped with a convex base and have an equatorial or subequatorial ledge, sometimes warty.
- Zygote: Apiculate, spheroidal to ovoidal, elongate.
- Ascus: One to two ascospores are formed per ascus; asci persistent.
- Liquid Growth: Sediment formed and a very thin ring after one month.



Physiological Traits:

- Fermentation: Glucose

- Assimilation: Cellobiose; variable use of: Salicin, Arbutin, D-glucono-1,5-lactone, 2-keto-D-gluconate, Ethanol; No assimilation of nitrate; uses ethylamine, L-Lysine, cadaverine as sole N source, some strains weakly; no growth in vitamin-free medium, requires imositiol, pantothenate, pyroxidine and niacin; some strains also require biotin and thiamin;
- Growth: 35 and 37 C: variable
- Growth sensitivities: grows on 0.01% cycloheximide, some strains grow on 0.1% cycloheximide

Ecological Traits:

Found on fruit, particularly grapes, but also found in soil, fresh and salt water, mollusks, mammals.

Distinguishing Features:

Apiculate growth due to terminal budding, high DMDC tolerance

Role in wine:
Normal grape/fermentation flora – present early in the fermentation and produces ethyl acetate, normally *Saccharomyces cerevisiae* takes over by ~4% ethanol.
Sensitivities:

- SO_2: 100 mg/L
- Sorbate: 250 mg/L at pH 5.0, no growth at pH 3.0
- DMDC*: K. appiculata*: 200 mg/L *H. uvarum*: 400 mg/L
- pH: 1.5-7.5 – *K. appiculata* more tolerant at low pHs
- Ethanol: *H. uvarum*: 3.4-6.7% *K. appiculata*: 9-12.5% temperature dependent
- Anaerobiosis: Ferments glucose to produce glycerol and ethanol
- Heat: Growth: 8°C-36°C. Survives 20 min at 55°C, not 10 min at 60°C

http://wineserver.ucdavis.edu/industry/enology/winemicro/wineyeast/hanseniaspora_uvarum.html

Saccharomyces cerevisiae

Genus/species (aliases): *Saccharomyces cerevisiae (Candida robusta,* anamorph*, Cryptococcus fermentans, Saccharomyces (*several species*), Torula cerevisiae, Torulopsis fermentans, Torulopsis sexta)*

Classification (ascomycete/basidiomycete): Ascomycete, teleomorph

Morphology:

Cell: Reproduce by budding, spherical to ovoid, no or simple pseudohyphae

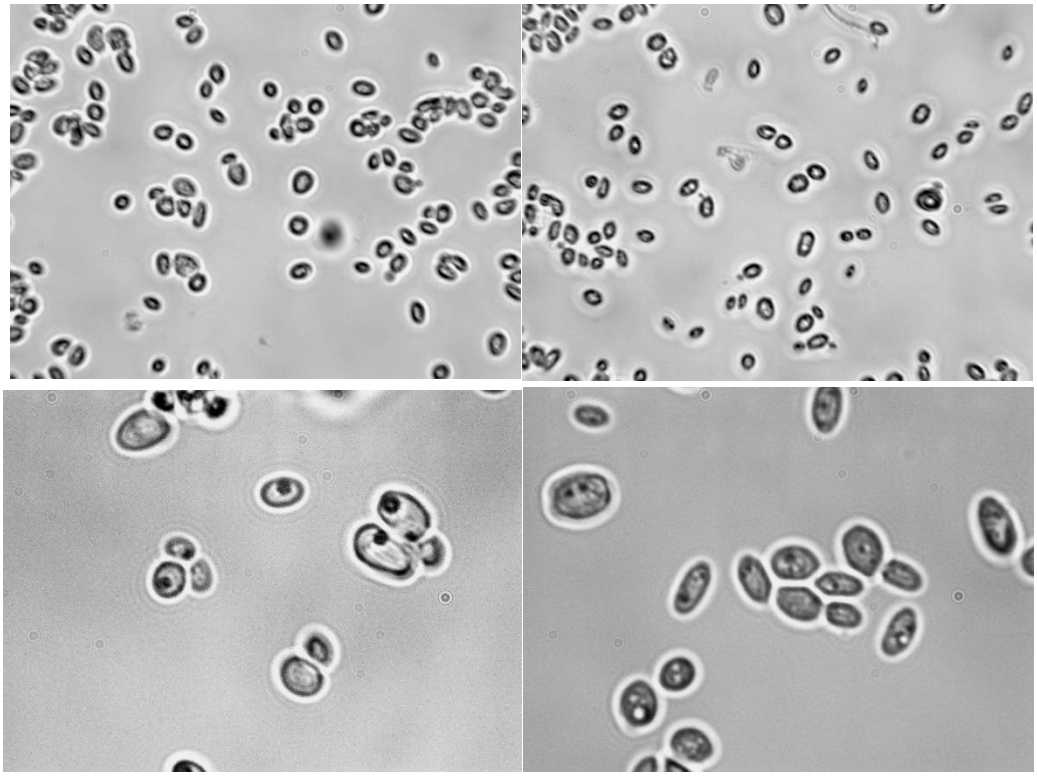
Colony:

- Malt agar: Medium sized white convex circular
- WL**:** green flat circular colony

Reproduction:

- Spore: Spherical often in groups of four
- Zygote: Dumbell-shaped
- Ascus**:** Group of four spores arranged in a tetrad conformation

Liquid Growth: Dispersed



Physiological Traits:

- Fermentation: Glucose, variable fermentation of: Galactose, Sucrose, Maltose, Trehalose, Melibiose, Raffinose, Melezitose, Starch.
- Assimilation of: Galactose, Sucrose, Maltose, Trehalose, Melibiose, Raffinose, Melezitose, Starch, Glycerol, Lactate, Ethanol; No assimilation of nitrate or nitrite; no use of ethylamine, lysine or cadaverine as sole N source; variable growth in vitamin-free medium, most strains require biotin and/or thiamin.
- Growth 37, 40, 42 C: variable
- Growth Sensitivities: variable resistance to high glucose and NaCl; sensitive to cycloheximide
- Chromosome bands: 16
- Glucose is the primary substrate and in anaerobic environments the end products are carbon dioxide, ethanol and heat.

Ecological Traits:

S. cerevisiae is found in nature associated with man and, more rarely, found on the skins of grapes.

Distinguishing Features:

S. cerevisiae was the first yeast to have its entire genome sequenced. This makes it possible to positively identify the organism by genetic analysis. Other traits such as its inability to utilize lysine as a nitrogen source and a high tolerance to $SO_2$and ethanol can be used to differentiate between *S. cerevisiae* and other yeasts.

Role in wine:

S. cerevisiae is the most common yeast used to carry out alcoholic fermentations in wine production. It is generally part of normal grape, fermentation and winery flora.

Sensitivities:

- SO_2:
- Sorbate: Yes
- DMDC: Yes
- pH:
- Acids:
- Ethanol:

- Anaerobiosis:
- Heat: Yes

http://wineserver.ucdavis.edu/industry/enology/winemicro/wineyeast/saccharomyces_cerevisiae.html