

What Yeast Do

GRAPES 101

Grapes 101 is a series of brief articles highlighting the fundamentals of cool climate grape and wine production.

By Chris Gerling



Fermentation 101: micro-organisms (yeast) convert grape sugars into ethanol and carbon dioxide, and happy winemakers and consumers follow. But grape juice with sugar removed and alcohol added would never be confused with wine. Many critical flavor compounds are produced only through the process of fermentation. Fermentation can be unpredictable and challenging, and the role of a winemaker is to coax yeast through fermentation and reveal the sometimes hidden potential of the grapes at hand.

Ethanol production is a critical feature of fermentation. In most wineries, *Saccharomyces cerevisiae*, the yeast species also associated with beer brewing and bread baking, carries out the conversion of sugar to alcohol. Yeast are able to grow aerobically (with oxygen) or anaerobically (without oxygen), but in the oxygen-poor environment of a tank of grape juice, they are forced to choose the anaerobic path. Glucose and fructose become ethanol and carbon dioxide, with approximately half of the initial sugar content becoming the final alcohol percentage by volume. Yeast have a preference for glucose, and when a fermentation stalls with residual sugar, it tends to be overwhelmingly fructose that remains.

To ensure a complete fermentation, a winemaker must optimize conditions wherever possible, because the fermentation process is difficult for yeast. Anaerobic respiration generates less energy than aerobic respiration, and the waste product (ethanol) is toxic to them. The primary means of aiding yeast are controlling temperature and supplementing nutrition. Besides sugar, yeast need

macro and micro-nutrients; nitrogen is one of the most important and is frequently lacking in New York. Nitrogen supplementation in stages rather than a single addition can provide a steady nutrient supply and prevent huge biomass growth that could quickly consume all of the nutrients and risk subsequent starvation. Finally and perhaps counterintuitively, oxygen is a nutrient that can be of great use to yeast at certain points in fermentation.

Winemakers usually wish to ensure a complete (or very close to complete) conversion of sugar to ethanol without creating any unwanted aromas. Avoiding stress is one way to improve the odds of success. Another way is to use a selected strain of yeast. Yeast are ubiquitous, and an unguarded tank of juice will most likely begin fermenting without intervention. The microbes that volunteer to start the fermentation may not be the best-suited for the job, however. They may include spoilage yeasts--organisms that are better equipped to manufacture off-aromas than ethanol. Inoculating the juice with purchased strains of yeast that have been selected and isolated from vineyards and wineries around the world can take some chance out of the equation. Some wineries forego the yeast in favor of a "spontaneous" fermentation, but they often have built up a large population of a strain that has suited them well over the years and will likely have other controls in place.

But yeast do much more than convert sugar into alcohol. Consider Sauvignon Blanc grapes and juice: They are slightly grassy and slightly sweet--but not particularly interesting or even distinctive. It would be possible to mistake Sauvignon Blanc juice for Chardonnay juice. Consider Sauvignon Blanc wine: A wide variety of styles and aromas are possible, from boxwood to grapefruit to green pepper, and it is far less likely to be mistaken for Chardonnay. The juice has sugar and the wine has alcohol, of course, but neither removing sugar nor adding alcohol is going to make the juice become wine.

Yeast don't care if a wine will score 90 points from a wine critic. Rather, in search of nutrients, yeast are breaking down compounds in the juice and converting them into other compounds which are often more volatile (have the potential to be smelled). In the case of Sauvignon Blanc, the thiols and esters that are created in fermentation complement the vegetal smelling methoxypyrazines that came in with the grapes, adding grapefruit or passion fruit to the green bean or pepper aromas.

In summary, wine is much more than juice with alcohol. Fermentation is a very complex process, and it's impossible to take juice X, add yeast Y and be able to predict exactly what will happen. Good fermentation management can help improve the odds of success dramatically, however. A microbial process with some human help can produce far better results than either on their own. There's probably a lesson there.

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