

No Sex Please We're Yeast

FUNDAMENTALS OF WINEMAKING: ZYMOLOGY

by John Harris, Winemaker: J. Harris Wines

O.K., your experience with yeast so far can be summed up as: you buy yeast [maybe you don't -- read on] — you don't know or care which yeast — tear open the foil packet — dump it in your grapes/juice/fruit/ concentrate/dandelion greens/ carrot tops/ etc. and let 'err rip. God speed, Live long and Prosper, it works — truly amazing! WHAT — you want more — O.K., fellow wine weenies you asked for it, read on.

History

[skip this stuff it's boring and won't help you]

Zymology, neat name for yeast stuff, means the Chemistry of Fermentation. It's a Greek word in phonetic origin — Zymoun — “to leaven, ferment”.

Fermentation and yeasts were largely not understood until 1857, when Pasteur started his researches and linked yeast with fermentation [which Pasteur defined as respiration without air]. Pasteur's observations and partial conclusions were “... I am of the opinion that alcoholic fermentation never occurs without simultaneous organization, development and multiplication of cells...if asked, in what consists the chemical act whereby the sugar is decomposed... I am completely ignorant of it...” [Ed. note -- me too]

Later, at the turn of the century, Eduard Buchner showed fermentation is not caused by yeast per se, but rather by a yeast secretion. A substance he called zymase; consisting of enzymes.

Fermentation can be simply described as the conversion of grape sugar molecules largely into alcohol and carbon dioxide in the presence of yeast enzymes.[that's why your air lock bubbles] Time to move on to yeast info you can actually use.

Why Use Yeast

I know, the Greeks, Romans, French — gee almost anyone who has made wine for centuries did not use cultured yeasts. They all used natural yeasts. Well if your grapes come from a centuries old vineyard where you know the grape quality and the natural yeast bloom is excellent, then go ahead. Unless the quality is known, wild yeasts tend to be unreliable and do weird things to your wine. ["weird" -- technical term meaning read the article and do what you're told] The point of using some SO₂ at crush is to dominate any wild yeasts; either that or you could use a yeast with a high killer factor.

A cultured yeast will be consistently active, dominate the fermentation and introduce no undesirable side effects. As the bouquet of the finished wine is created during fermentation, the right yeast choice is critical.

How To Use

Wine yeasts are available in dehydrated form, on agar slants and in liquid culture. The most common is Wine Active Dry Yeast [WADY] or better known as those little foil packs.

Correct starter preparation of the WADY is the most important step in the performance of yeast. Most wine makers give this only casual importance, preferring to merely sprinkle the yeast over the must. Smarten — up and read on.

The procedure is simple; rehydrate the yeast in warm water, gently reduce the temperature to match the must, let the starter grow and then inoculate your must.

To rehydrate — open the pack and sprinkle over warm water. The water temp. should be 100-109°F. Cold water instead of warm will kill cells. Give a slight stir to break up any clumps and let

rest for 15 minutes. Note maximum rehydration time is 30 minutes., after that you are killing yeast cells.

The yeast slurry must be transferred to the juice or must, however the cold shock of transferring the slurry directly to chilled must will also kill yeast cells. Therefore the starter should be acclimatized to the must temp. and built up by adding small amounts of the must to the yeast slurry. This has the added advantage of creating a good size starter so your must will take off quickly.

For one carboy this means, rehydrate 5 grams of yeast in 50 mL of 105°F water for 15 minutes, [if taking temp. is too difficult, then approximate by checking the water for baby bottle temp. -- you know water on the wrist etc.] mix the slurry with 100 mL of must, wait 30 minutes and add a pinch of nutrient plus 500 mL of must. After two hours add 500 mL of must and wait overnight before adding to your must. Don't be afraid to shake the bottle a few times. It makes sense to start this process before you need the yeast.

A good container to use is an old [but clean] pop bottle with a cotton ball stuck in the mouth to keep out fruit flies but let in air. Two litre PET bottles are useful to keep for this purpose. So far so good, you know how to start your yeast, lets now look at what's happening as the yeast grows.

Yeast Growth

The point of using a commercial yeast is to supplement and dominate any wild yeasts. Yeast fermentation actually is a three stage affair, with the second and third stage the most interesting to us. The second stage [4-8% alcohol] is largely aerobic, meaning the yeast cells are rapidly multiplying due to the dissolved oxygen in the must as well as converting sugar to alcohol. Actively growing starters [doubling cell count every two hours] take up oxygen rapidly.

Simple agitation or pumping over may not be enough to increase the oxygen levels in commercial wines, but is probably sufficient for home wine makers. If you insist, sterile compressed air can be bubbled directly into the must. Warning, do not use pure oxygen; it is toxic to yeast.

The third stage, sometime after 5 degrees Brix remaining, is an anaerobic stage. the oxygen has been used up, cell multiplication is finished and the yeast carries on to dryness very efficiently [usually].

Yeasts need some food to grow; normally this is available — however lets be safe! Lack of nitrogen is the major potential problem. Add nutrient before there is a problem, best done at the beginning of fermentation when the yeast slurry is added. The best form is a combination of all — ammonium phosphate [DAP] and yeast extract. The benefits include improved yeast growth, reduced hydrogen sulphide, shorter fermentations and generally less risk of stuck fermentations.

For those of you who “donna yuse no kemilcals” and think additives are wrong, go ahead but don't complain when there is a problem.[by the way I "donna yuse no kemikals" either, yup, I can safely say my wine is completely free of 2-4-D!]

Seriously, the creation of hydrogen sulphide [rotten egg smell] in young wine is probably due to a lack of nitrogen containing nutrients in the must. However if you must be paranoid, added ammonia can increase certain amino acids such as histidine [rhymes with histamine]. I'd stick to levels suggested on the package.

Sulphur Warning

This is a whole different topic, but remember two points. First, do not use excessive levels of S02 at the crush. Levels over 100 ppm can interfere with the start of fermentation. Levels over 200 ppm will interfere with fermentation plus increase acetaldehyde.[sorry, you'll have to look this word up yourself -- fascinating reading really -- try carbonyl compounds if you are really stuck for something to do.]

Second, do not add S02 during fermentation. It will not stop the fermentation by itself plus will probably increase acetaldehyde.

Temperature

The growth rate of yeast is normally related to temperature. While most yeast will survive cold temperatures, growth rate is very slow. Optimum temperature range is 60-85°F. [depending on the yeast] Lower temps. are difficult to handle and can lead to increased levels of SO₂, volatile acid and hydrogen sulphide. It can also lead to fruity wines; try some batches — see what happens! Temperatures above 95F will usually stick most fermentations. At 105F most yeast has one hour to live and at 140F yeast dies within minutes.

You will hear people talking about hot fermentation for red wine; they probably mean 80-85°F. [go ahead though ask questions] At normal temperatures, most fermentations are over in one or two weeks, assuming you've been following the rules.

Sugar

High sugar levels actually retard the growth of yeast; yeast works fastest at about 1-2% sugar concentration. For practical purposes, concentrations above 25% are problems. In practical terms this means if you insist on making rocket fuel, then syrup your fermentation over several days rather than dumping in the sugar all at once. Add sugar at 1.040, bringing must up to 1.060-65, let it go until 1.040 and syrup again up to 1.060 and so on until you've added the sugar you want. If you've been reading this article you will know the syrup addition is during the yeasts most active period. If you have no choice on initial sugar level, such as ice wine must, then good luck! Hey, you didn't think I'd give you all the answers did you? Actually, if you read carefully, you can figure out what to do, or at least where to look for the answers to that question.

An interesting thought is the concept that yeasts ferment glucose faster than fructose. If true, this means that stopping the fermentation early results in a sweeter taste than sweetening the wine after fermentation has finished. This is because fructose tastes sweeter than glucose. Sounds like some experimentation is required here.

Yeast Selection

Sauterne yeast does not make Sauterne, Riesling yeast does not make Riesling and so on. You choose a yeast for what it can or cannot do, rather than where it came from. This does suppose you have a plan for your wine.

Some factors to consider include:

- alcohol tolerance — are you making port or a light wine.
- sugar/ alcohol yield — some yeasts are very efficient converting sugar to alcohol.
- aroma impact — different yeasts, different effects — also dependent on the grapes and maybe fermentation temp. Do not expect to create a special wine with a fancy sounding yeast when you are using junk for raw ingredients — yeast isn't a miracle worker.
- speed of fermentation and the amount of foam. Interesting to know for head space requirements — Chanson, for instance, tends to foam quite alot.
- ability to restart stuck fermentations if that's what you require.
- temperature sensitivity and optimum range — at what temp. are you planning to ferment at. [and why?]
- killer factor, meaning the ability to dominate other yeasts in starting the fermentation.

There are lots of questions to consider, getting answers is harder. If possible ask for a data sheet on the yeast — yes it's part propaganda — but it will help quite alot. Talk to other AWO members, ask what they are using and why.

Other basic information to know is the generic names of yeast. Most yeasts will either be *Saccharomyces Cerevisiae* [SC] or *S. Bayanus* [SB]. SB is traditionally but not necessarily used for Champagnes, indeed it is sometimes called Champagne yeast. *Prise de Mousse*, for example, is an all purpose commonly available example of *S. Bayanus*.

Yeasts for Sherries [*S. Fermentati* is a common strain] are different; they form a flor on the surface which oxidizes alcohol to acetaldehyde [there's that word again] and other products to give Sherries their distinctive character.

O.K. — time to jump in, blow the cobwebs out the purse and actually buy some yeast — does the fun never stop?

What's Available & Where

The Winter 1994 issue of Better Winemaking lists at least 8 suppliers of yeast. It makes sense to support those companies that support us. You will have found by now that most places stock the basic Lalvin line 1116-11221118. I'll leave you to investigate specific properties [and urge you to do so] however, I'll help a little.

L1116 is an all purpose yeast — can be used for red or white — good killer factor, wide temp. range. and nice fresh aromatics. L1118 is often called Prise de Mousse — good white wine yeast often used for Chardonnay. Be careful, this yeast comes from the Oenological Institut of Champagne [OI of Ch] at Epernay. At least one Calif. supplier assumes you know that and calls the yeast Epernay from the OI of Ch. Do not confuse this with Epernay 2 which is a completely different yeast from the Geisenheim Research Institute. L1122 [71-B] has the ability to metabolize malic acid and thus may be of interest for high acid musts. Other yeasts are available, your mission should you accept it — is to find these other yeasts and try them.

For those of you making wines from grapes, plan ahead, research what is available and what might be interesting to use. Buy in advance so you are ready to make wine. NOTE — after you buy, store the yeast in the refrig. [cool and dry] Activity loss is 5% per year at 41F but 20% per year at 73F.

Experiments

Don't get in a rut making wine. Experimenting lets you find out what works better and sometimes worse than what you normally make. Let me share some of the trials I've made.

Pinot Gris

In 1993 I purchased Pinot Gris grapes from John Watson and used two yeasts to see if there would be any differences.

The yeasts were Lalvin 1118 — Prise de Mousse — a yeast I use often for whites and hence am familiar with; and Lalvin 1108-UCD595 — also a SB variety. It's notes read — Clean fermentation, low S02 and acetaldehyde [there's that word again] primarily for white wines and fruit. Identical fermentation techniques was used.

The two yeasts did have different effects. Prise de Mousse resulted in a restrained nose, some fruit on the nose and no obvious defects. Lalvin 1108 resulted in a strong nose suggesting dried fruit and generally seemed less attractive. The same malo culture [Chris Hansen] was used on both. Lalvin 1108 seemed to accentuate the malo taste, again in a less attractive manner than the Prise de Mousse.

What did I learn? — no the answer is not that 1108 is a bad yeast. What I learned is that for the style of wine I was attempting to make 1108 was not a good choice. In fact if I reach a little and assume 1108 is a stronger version of P de M. in aromatics,[both are SB yeasts] then perhaps I should be doing more tests next year on Pinot Gris, both on fermentation style and appropriate yeast to use in an effort to move away from the style of fermentation I used and/ or Prise de Mousse. That's the beauty of experimentation, there's always next year.

Concentrate Tip

You've read this article, rushed out, bought a concentrate kit and you're ready to make wine. You follow the kit instructions, meaning you open the foil packet and sprinkle the yeast on the must. STOP you know better, you've read this article and begin to think. Rehydrate the yeast, adjust temp. and build a starter! Notice the instructions tell you to rack in the S.G. range of 1.040 to 1.020. You know the reason is that this is about the end of the aerobic growth stage and that last racking will ensure a bit of air so the yeast can grow one last time if necessary before the anaerobic stage; which will finish the fermentation.

Rack too late and you'll be adding air after the yeast has entered the anaerobic stage and the air won't help — might even hurt. Back to the yeast starter. Open the kit and take out 250 mL of concentrate. If you're using a bag in a box kit, no problem to reseal. If a can, then cover the surface [not the can -- though you could cover the can with foil] with saran wrap to keep out air and put in the refrig. Rehydrate the yeast per instructions and use the concentrate to make a syrup, i.e. dilute the stuff and build your starter. Note — put a pinch of the acid blend in the starter. Don't forget to keep track of how big you make the starter so you can subtract the starter volume from the water you dilute the concentrate with.

The next day or two, start your kit and then add the starter; your kit should be firing in one or two hours. Why all the trouble? Think about orange juice from concentrate. Tastes great when you first make it, but not so good after it's been sitting out for a day or two? well same with your reconstituted must before the yeast and resulting CO2 go in.

Feeling strangely confident now? Well you should be after all you're in charge now. For instance, making two batches at once is the perfect opportunity to experiment. Try different yeasts, different temps., with or without lees contact, there are lots of options and you will be amazed at the results. [some may even be drinkable] Also a good time to remind you to keep a record so you don't forget what you do. I use a notebook so I can go back over the years to see what I've done or not done. While tasting a wine the expert was asked his thoughts: "A bit fruity, then woody, with a boring finish," he said. Yes, yes — we know that, but what about the wine?

Important Notes

Back to the title, "No Sex Please We're Yeast." In yeast reproduction, sex is not involved; yeasts reproduce by fission and sporulation. [I've been waiting years for this question to be asked on Jeopardy -- no luck so far]

I apologize for the errors, omissions and outright lies [at least one maybe more] contained herein. My only defenses are the brevity of the article and my hope that you don't know any better. If you do know better, then I would urge you to share your info with other members of the AWO beyond your own club. One of our strengths is and should continue to be, the sharing of information on winemaking.

Have fun, and good winemaking!

Bibliography

Philip Jackisch, Modern Winemaking, New York: Cornell University Press, 1985.

Lallemand Inc., Sluggish & Stuck Fermentations: Their Causes & Remedies, Quebec.

Lallemand Inc., Active and Dry Yeast Technical Information, Quebec.

Practical Winery & Vineyard, Successful preparation: yeast, by K.C. Fugelsang, May/June 1992.

Practical Winery & Vineyard, Yeast Guide, July/August 1992.

Philip M. Wagner, Grapes into Wine, New York: Knopf, 1976.

Alan Young, Chardonnay, Great Britain: Sidgwick & Jackson Limited, 1988.