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Low input winemaking—let nature do the work

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Abstract

Recent decades of new world winemaking have been informed by university research and directed toward making clean, sound wines with an emphasis on fruit flavours. As our technical confidence has grown, some producers in the USA, as well as in Australia and New Zealand, have begun examining the rationales behind traditional old world winemaking practices, and finding sound bases. Many of the goals of modern wine processing may be achieved using gentler, traditional methods, such as heat, cold and microbial stabilities, resistance to browning, and clarity in white wines; and microbial and cold stabilities, phenolic stability, and clarity in red wines. The goal of these methods is not to disregard the necessity of bottling clear, stable wine, but to achieve stability goals while leaving intact the maximum flavour of the wine and perhaps adding desirable secondary complexities. Many of these techniques substitute time for immediate manipulation and so may be more suitable for limited quantity, higher-priced wines. Some methods, though, may benefit wines on any scale of production.

Techniques for white wines which may be adopted include the following: direct pressing without skin contact or even without crushing and destemming to minimize phenolic extraction; eliminating or delaying sulfur dioxide addition, thus allowing enzymatic phenolic oxidation of the juice to further reduce tannins; use of indigenous yeast; barrel fermentation; malolactic fermentation for complexity, texture and microbial stability; yeast lees contact to integrate oak and diaetyl flavours, and to preserve freshness by scavenging oxygen; and fining to further remove tannins and clarify sufficiently to minimize or eliminate filtration.

Traditional red winemaking techniques include the following: eliminating acidification to allow the fermentation to adjust acid naturally; fermentation with indigenous yeast; going to barrel early and 'dirty' to better integrate oak flavours; blending early to promote stability—microbiological, phenolic, and bitartrate; aerative racking for clarity and phenolic polymerization; keeping the level of free sulfur dioxide low to promote phenolic polymerization; and egg white fining for clarity and to avoid phenolic precipitation in bottle.

An underlying principle is to utilize the barrel ageing period as an active period of stabilization rather than a passive period of oak flavour extraction.

Introduction

I have been asked to speak about low input winemaking, that is, the traditional, minimalist approach. I sometimes call it 'nouvelle retro' winemaking. I find that the further along I progress, the less I do and winemaking becomes more and more minimalist and traditional.

Questions which we might ask include: What does low input winemaking mean? Is it simply marketing hype? More and more often, the words 'unfined' and 'unfiltered' appear on labels. Do these techniques have technical credibility? Can it be done? What does it mean? How do you do it?

The answers are: yes, it can be done; and yes, it provides real and not imagined benefits. To make these techniques work, though, one can not make a simple decision to adopt low input techniques at the time of preparation for bottling. The low input winemaking process must be planned from the beginning.

Let us assume that we have a simple goal, for example, to bottle a wine without filtration, and that this goal defines the successful minimal intervention program. To enable a successful unfiltered bottling to proceed, however, stability and clarity must be induced without the intervention of filtration processes.

The industrial approach to achieving these goals has been rather aggressive. I want to explore the traditional approach to achieving these goals. In discussing these techniques, I will concentrate on dry, barrel-aged reds and whites, and let you extrapolate from these to other styles of wine.

It is helpful to think of the barrel ageing period as an active processing period rather than a passive, oak flavouring period. I think that we in the 'New World' have thought of barrels simply as a source of oak flavour for too long. It is helpful to think of the traditional French word for barrel maturation, *élevage*, which means to elevate or raise; the French use it in the context of raising children, as well as wine. Students are called *élèves*. The period of barrel ageing is an active period of raising the wine to achieve the goals of clarity and stability.

Before I move on to discuss specific techniques, I should add the caveat that it helps enormously to work with good grapes. We all know that bad grapes from the wrong site need extensive manipulation to make acceptable wine. The object inherent in the concept of *terroir*, or site specific winemaking, is to have a good site with the appropriate rootstock and variety, as well as appropriate trellising, row orientation and spacing, so that the fruit has a reasonable chemical balance at harvest. This balance is a starting point in the use of low input techniques.

Techniques

White wine and red wine processing techniques present different challenges, so I shall consider each style separately. I will now discuss some of the key points in achieving our goal of bottling unfiltered wine that is stable.

The first point that I would make regarding white wine processing is that it is desirable to press uncrushed fruit or to crush with minimal tearing and grinding of the berry. In California, I can say that the pendulum has swung from no skin contact prior to 1975 to a ten-year fad of skin contact and now back again to whole-cluster pressing, similar to *methode champenoise*, where no crushing or destemming takes place. Fruit is either dumped directly into the press or pumped gently over a short distance into it. The objective is then to separate the juice from the skins as rapidly as possible

to minimize the extraction of phenolic materials. It is better to minimize phenolic extraction at this stage than to remove these undesirable compounds at a later stage using polyvinyl polypyrrolidone (PVPP), casein or another protein fining agent. There is a school of thought that maintains that full bodied wines result from skin contact, but I prefer to use truly mature fruit and not be afraid of a higher concentration of alcohol. I would rather get power and richness from ripe fruit, and delicacy from low tannins.

Sulfur dioxide

The next technique I employ is to defer the addition of sulfur dioxide (SO_2). My former colleague, Zelma Long, spoke on this issue about 10 years ago in Australia. I know that several people here are working with this technique and are finding it successful. The theory is that crushing without SO_2 lets the polyphenol oxidase enzymes scavenge the oxygen, and transfer it rapidly and specifically to phenols. The phenols then acquire a partial negative charge, turn brown, and precipitate out on the yeast cells following fermentation. This work was originally done by Müller-Spath in Germany in the early 1970s. In California today, this technique is so popular that winemakers working with green, unoxidized juice are extremely rare.

Acidification

The next technique is to minimize acidification. I have analyzed several Australian Chardonnay wines and have found an average of 6.6 g/L total acidity and a pH value of 3.2. I know that extensive juice acidification with tartaric acid is carried out in Australia, as it is in California, and I would like to make three points about this technique. First, in relation to our goal of minimizing the stabilization processes required to allow us to bottle a clear, unstable wine without filtration, addition of excessive tartaric acid creates an instability that will have to be dealt with later by cold stabilization. One way to avoid this is not to add as much acid in the first place. Second, some palates may detect a hard, sharp taste in wines extensively acidified with tartaric acid. In some of the Australian wines that I have analyzed, this acidity is being balanced by a small amount (2.5 g/L) of residual sugar. Lowering the acid addition will allow the wine to be fermented to dryness and the addition of sugar becomes unnecessary. The last point is that white Burgundies, in years of good maturity, have an average total acidity of perhaps 5.8 g/L (as tartaric) and a pH value of perhaps 3.3. This titratable acidity (TA) is considerably lower than in many Australian and Californian wines, so if you are concerned about world standards for these wine styles, it is a point to remember. I will return to this and address it later.

I think that here in Australia there was much work done with making clean wines from hot country fruit, and now I think that you as a nation are moving on, as we are in California, to trying to make world class wines. As part of that, you are planting vineyards in much cooler areas. Perhaps some of an earlier acidification ethic has been carried over to fruit which may not need it so much.

Fermentation

Let us consider yeast for a moment. The use of native yeast, cultured yeast or industrial yeast does not really have a bearing on whether or not wine can be bottled without filtration, but the use of native yeast is another part of minimal input winemaking. This technique is one that I use, and after five years of work, the data that I have accumulated indicate that native yeast produce less SO_2; a slightly higher concentration of residual sugar; a slightly higher volatile acidity; and a lower absorbance at 280 nm which indicates a lower concentration of tannin. From an organoleptic viewpoint, I find better integration of oak with native yeast, as well as better integration of diacetyl; thus the overt effect of malolactic fermentation (MLF) is reduced. Most significantly, in the mouth, I find a richer, fuller, rounder palate impression, coupled with greater delicacy. This is what I am aiming for in making wine—a full, rich mouthfeel, with delicacy and without coarseness. These are the characteristics I consistently find in wines made from native yeast.

The only concern I have with the use of native yeast is vigour. Industrial yeast tend to have a lot of vigour, due probably to the way they have been propagated with sufficient nutrient and oxygenation. They tend to roll right through fermentation and scavenge nutrients effectively. They also do not appear to mind the presence of malolactic bacteria. The French maintain that it is not wise to carry out simultaneous primary and secondary fermentation, yet it is often done in California. Fermentations in California, however, have commonly been carried out with industrial yeast whereas in France, native yeast have traditionally been utilized. With native yeast, bacteria can and will interfere with the completion of fermentation. The mechanism may be either toxin production or nutrient depletion. I had considered nutrient depletion to be the most likely, but Professor Feuillat maintains that toxin production by the bacteria may also be an important factor. I have now come back to using 25 mg/L of SO_2 prior to fermentation to keep the bacteria under control following pressing, to allow some measure of phenolic oxidation. The yeast complete the fermentation, and our wines contain less than 1 g/L of residual sugar on a consistent basis.

I have found that the native yeast technique works well for me, and I would encourage all of you to try the technique in the future. It is something that can be introduced gradually. I built up from 5% of our production five years ago. It can be incorporated into a winemaking program on an gradual basis; it need not be all or nothing, that is, black and white.

Barrel fermentation is another technique that I favour for complex wines. This is a method with which Australians appear to have a lot experience. It helps integrate the oak and adds flavour complexity.

I also aim for a complete MLF. I sense that a lot of Australian Chardonnays undergo partial MLF. If the goal is to bottle wine without filtration, the fermentation must be complete. If it is incomplete, the wine will not be microbiologically stable. My own perspective is that the sensory characters generated by a full MLF are also desirable; this is certainly the practice in Burgundy. This technique may not be suitable for all fruit; grapes grown in high vigour vineyards can contain a high concentration of malic acid. A full MLF can cause a large acid drop with a resulting need for re-acidification. If the content of malic acid is less than 50% of the total acid content, a full MLF will generally produce good results.

I also use yeast lees contact for white wines. This technique can be misunderstood. It can be seen simply as a process where the dead yeast fall to the bottom of the barrel and produce autolysis characters with time. This does not appear to be the case, as we have found that 30 to 70% of cells are viable six months after the completion of fermentation. Professor Feuillat has obtained similar results. This period of yeast lees contact can be seen as an active period and not a passive period. There does appear to be some amino

acids leaking through the cell membrane, as the concentration of nitrogen-containing compounds increases during lees contact.

There are, however, several active functions of yeast contact in this period, when the wine is oxidatively vulnerable and going through MLF. The first, which is assisted by *batonnage* or stirring of the lees, is the scavenging of oxygen. This helps to keep the wine fresh during this vulnerable period. Second, the yeast help to integrate oak characters in some fashion that is not entirely clear; it may be due to the formation of polysaccharides which envelop tannins or merely an electrostatic fining effect between yeast protein and oak tannin. Third, the level of diacetyl is reduced by yeast enzyme action (diacetyl reductase) during this period. This allows MLF without a unidimensional butterscotch character which may be considered undesirable. We stir the yeast lees once a week during the period of MLF. When the fermentation is completed it is not necessary to rack the wine (if the juice was free of excessive grape solids), but it is also not necessary to carry out *batonnage* any more, as the above functions have been performed and the wine has been sulfited.

As part of this process of making minimally handled wines, one may try using longer periods in barrel. Again, think of barrel ageing as an active stabilization process. The wine does not necessarily become woodier, perhaps because it is *sur lie*. It certainly does become more complex.

It is during this period that some cold stability is obtained, by exposure to low temperatures in the first winter. Cold stability can be obtained by long exposure to only moderately low temperatures and this appears to be the case in wines handled for long periods in barrel. There also appears to be a process of heat stabilization going on in this period. A tank fermented Chardonnay may need 200 to 300 mg/L bentonite, while an 11-month-old barrel fermented Chardonnay may need only 30 to 60 mg/L to obtain stability.

Fining

The next issue is fining. Here I disagree with the school of thought that wants wine to be unfiltered and unfined. I think of fining as a traditional fine wine art. I am not talking about the new industrial fining agents such as PVPP or kieselsol; I mean agents such as isinglass, egg white, casein and milk. We have used the following technique successfully with a Chardonnay blend of 45 000 cases. The wine is blended six weeks prior to bottling. As soon as the blend is made, we fine with 10 mg/L of isinglass and 30 to 45 mg/L of bentonite. That seems to neutralize charges and the yeast precipitate cleanly, within five days. We then let the wine settle for two weeks prior to racking. After this, we fine again, this time based on sensory testing. We might use 1 to 2 µg/L whole milk and again 8 to 10 mg/L of isinglass, along with arpproximately 30 mg/L bentonite. I think that the two successive finings are a key, as opposed to doubling the quantities with one fining. In each sequential fining, a significant proportion of the particulate matter present is removed which gives the clarity that is required in the end product. I believe that fining in white wines is under appreciated. The Burgundians routinely add 100 g/barrel of casein powder, without doing any trials. This is an enormous quantity of casein, almost 0.5 g/L. In comparison, the small quantities of isinglass and milk that I use are gentle, and yet they really make a difference to the palate texture of the wine. They contribute to a silky, smooth mouthfeel as well as provide a clarifying effect. That is why I consider these traditional fining agents to be so important.

Filtration

The last step before bottling is to minimize or eliminate filtration. If the wine treated with the techniques that I have described is sufficiently clear enough, it can be bottled without filtration. It will be heat stable, cold stable and microbially stable. If it is not sufficiently clear to be bottled without filtration, membrane standard brightness can be achieved by using a single pass through Seitz K150 pads or their equivalent. No diatomaceous earth, sterile grade pads or membrane filters are required. The filtration process is thus minimized.

Specific techniques for a wine style/type

Now, let us consider some techniques that can be used with red wines. In reds, there is a different chemistry all together. One of the first essentials for success is to harvest fully mature fruit, with some tannin polymerization already taking place in the berry on the vine. The French have been aware of this for some time. They are highly concerned with having mature, supple tannins and we in California are only just coming to terms with this. It is not the quantity of tannin that is paramount, but the quality of tannin. If one has quality tannins, that is mature, supple tannins, then the quantity is not so important which depends, of course, on the style of wine that is being made.

As with whites, grinding and tearing of the fruit should be avoided to minimize the extraction of undesirable tannins. Light crushing is best, perhaps with the inclusion of some whole berries. Pump overs must be gentle; I know that a lot of submerged cap fermentation is used is here, but keep in mind that pumps need to be gentle in action. I would also advise against pumping the drained pomace to the press. Other techniques such as belt conveyers or transfer into bins will help to prevent the extraction of unwanted tannins.

With whites, I recommended that acidification be minimized. With reds, I recommend that acidification be eliminated. One of the tools that can be realized with this technique is that acidity can undergo a natural increase during fermentation. When routine acidification is carried out, for example, to a pH value of 3.4, this effect is not observed because a tartaric acid addition causes an instability. Subsequent potassium bitartrate deposition during fermentation causes a reduction in the total acidity. Prior to fermentation, wine makers can be unduly alarmed by a low TA value of 3.6 or 4 and make an acid addition because they consider that the acid will be even lower after primary and secondary fermentation. In fact, this does not happen. In my experience, must with a TA value of of 4 can finish fermentation with a TA value of 7. After MLF, the acidity drops back to approximately 5.8, with a pH value of approximately 3.6 or 3.7. These levels are typically found in the world benchmark wines of Bordeaux.

I also want to point out that there is an unhappy synergy between tannin and acid. Low tannin reds, such as Pinot Noir can support a higher acidity. High tannin reds such as Cabernet Sauvignon and Shiraz have a much softer mouthfeel with a lower acidity. In wines from Australia that I have analyzed I see an average TA value of approximately 6.7 g/L, and an average pH value of approximately 3.35. That is one of the most significant facts I have noted here after tasting a broad range of wines: that the level of acid is relatively high compared with the classic international models with which they might be compared.

I have several times referred to world benchmarks for wine, and I can understand the point of view that Australian

winemakers may have in wanting to make Australian wines and not copy the French. But wine made from Australian grapes will never be French, just as wine made from California grapes will never be French. If you really want to make Australian wine, why not let the *terroir* speak for itself, rather than routinely manipulating the wine to a pH value of 3.4? Let the soil and grape express themselves. This will produce a wine that is truly typical of its place of origin.

We use native yeast for reds as well as whites. What we see is a less aggressive fermentation. It is slower and steadier, so more time can be spent at 27 to 29°C, rather than quickly peaking at 33°C. There is a longer prefermentation maceration, all of which affects the extraction.

Placing the wines in barrel early helps to integrate the oak rapidly. Early blending is a key point. This technique is not common in California and I do not believe that it is common in Australia. By blending early, both microbial and cold stability are promoted. The wine goes through two winters as a single chemical unit. What is going to happen in the bottle that has not happened after 22 months in barrel? The key point is to put the chemistry together early so that the wine becomes a unit and has a chance to stabilize itself.

We rack and aerate reds on a quarterly basis. This is done for clarity and also for phenolic polymerization and stability. A following speaker is going to discuss bottle deposits, which I am surprised to see in so many Australian red wines. I am convinced that this is due to handling without sufficient air exposure, so that the phenolics are not as fully developed as they could be. Some egg white fining may also help to prevent this phenomenon. I understand, too, that various producers routinely add oenological tannin to the fermentations, and I would be surprised if that did not also contribute to lacquer deposits.

We add minimal SO_2. I understand that this is a popular technique in Australia, but especially at a higher pH value it is important to maintain a minimum level. We maintain about 12 to 15 mg/L free SO_2 by aspiration analysis. Above that, according to the PhD thesis of Paul Pontallier, phenolic polymerization is inhibited during ageing. Below that, there is an opportunity for microbial spoilage.

We use egg white fining with red wine, three to eight egg whites/barrel. This is the final touch for clarity. The repeated racking has removed the bulk of suspended solids and the egg whites make the wine brilliantly clear. The egg whites contribute two other factors. These are a silky smoothness on the palate and phenolic stability in the bottle. The French approach is a minimum of three egg whites/barrel.

After all these techniques have been carried out, the red wine can be bottled without filtration. The wine will be clear and stable. Even more than with white wines, I am convinced that filtration does strip flavour and character from red wines. However, I will point out that we have a 100 micron stainless steel screen on our bottling line right where a membrane would normally be, just to catch gnats and pieces of tartrate that may inadvertently be present in the wine.

In summary, can stable, unprocessed wines be made commercially? Yes, I think so and I have tried to share some ways of doing so with you. It is inadvisable, however, to wait until the last minute and roll the dice; it must be a planned process from the beginning, using some of the methods I have described. Is it worth the effort, or is the concept just marketing hype? After 15 years of controlled experiments, I have come to the conclusion that traditional, minimal handling methods make a superior wine, that is, fresher, more vibrant and vital, with a fuller, richer mouthfeel and greater complexity, as well as more harmony and balance. These qualities sometimes seem to elude wines that have been pushed through the processing mill or manufactured from a chemical engineering perspective.

Finally, I would encourage winemakers to focus on making wine 'right', and on making wine that is sensually appealing and pleasing, rather than focusing excessive energy on that which may go wrong.