

Australian & New Zealand Grapegrower & Winemaker

Heat treatment stars in rescue of laccase wine

Laccase. One small word of seven letters; a virtual death sentence for young wines if left untreated. That's how Australia's winemakers felt about this insidious, botrytis-derived enzyme after it gave many regions of their industry such a hard time during vintage 2011.

Laccase is no placid protein. Its primary role is to promote the oxidation of phenolic compounds in grape juice. The presence of even small concentrations of laccase in red and white wine musts - and ultimately in finished wines - will result in rapid browning and significant loss of aroma and flavour. Indeed, a telltale oily film also frequently forms on the surface of an affected wine if left to stand in a glass for a short while.

But properly identified, laccase activity and its devastating effects on wine quality can be reduced and even eliminated by careful fermentation management. The enzyme is sensitive to changes in temperature, and can be effectively denatured if subjected to pasteurisation in the winery. Additions of bentonite and/or tannin may also mitigate some of the enzyme's effects, but it is excluding oxygen that provides the key to managing botrytis-affected fruit from the beginning of the winemaking process. Laccase can only function oxidatively in the presence of oxygen. Thus, foregoing cold soaks and extended skins contact in favour of early yeast inoculation and shorter fermentation times also figure among the winemaking strategies that are available for use.

But how can an industry carry out the kinds of large scale pasteurisations that are needed during a challenging vintage like 2011, when so few wineries are equipped to deal effectively with the strategy's most critical undertaking, that of rapidly heating and cooling affected batches of must or wine?

That's the question Memstar's David Wollan found himself puzzling over during what turned out to be South-eastern Australia's toughest season since 1974.

Memstar - an acronym for Membrane Separation Treatment And Recombination - is the brainchild of the former Tarrawarra winemaker and his fellow Wine Network director and principal consultant, Gary Baldwin. Already specialists in alcohol adjustment - as well as removing smoke and *brettanomyces* taint, volatile acidity

reduction, flavour concentration, and electro dialysis - Memstar added inactivation of laccase in wines to its range of business services during 2011.

“We knew pretty early on that problems were going to crop up,” Wollan recalled.

“I mean, if you’ve got botrytis problems during vintage, you’re going to have laccase issues. It wasn’t long before we were approached and asked whether we had any equipment that we could address the problems with. At the time, I didn’t think we had.

“One of the first things that I did was to approach a colleague in New Zealand who had a pasteurisation machine on the back of a trailer. I asked him how much it would cost to lease the machine and bring it to Australia. When he told me, I thought, ‘No, there must be another way to do this.’

“We had learned from previous experiences and from our reading that relatively short exposure to moderately high temperature would, in fact, deactivate laccase enzymes. We then had a look at the problem again, and found out that with some minimum modifications to our existing alcohol adjustment machinery, we had most of the capabilities that we needed for pasteurisation, in terms of heat exchange. We knew that we could take liquid up to a moderately high temperature, hold it for a short period, and then quickly and efficiently take it back down again to temperature.

“Of course, we also knew that we were going to be addressing some associated problems in our business anyway. One of the issues you encounter when working through rot-affected vintages is that there is often a less than desirable concentration of sugar in the grapes that you’re harvesting, due to the fact that they often have to be picked earlier than planned.

“In weighing up our options, we received some recommendations from the Australian Wine Research Institute in relation to the sorts of things we could do in dealing with laccase. We then began doing some calibrations of our system using information obtained from some of the prevailing enzyme detection kits that were around at the time. When we looked more closely, we found the AWRI’s recommended treatment temperature of 65°C was a little bit conservative. In fact, their recommendations for both temperature and time periods were significantly more than we subsequently found were really necessary.

“Of course, a lot of the Institute’s information was based on trials carried out quite a long time ago when winemakers and researchers didn’t have the control over the system that we have today. Basically, they could only treat their wines at certain

temperatures because they were being driven by the technology that was available to them. As a result, I think they ended up working at higher temperatures than was really necessary.

“What we did was to carry out our own program of trial work, to bring a little bit of discipline and science to the job by doing some careful calibrations. We looked at treating affected wines at different temperatures for different periods, and we tested them both before and afterwards for laccase activity. What we ended up with was data that followed an exponential curve. It showed that the higher the temperature you held the liquid, the shorter the time period that was needed to carry out the pasteurisation. That essentially followed a similar set of results which we found had been established by expert research in United States many years ago.

“For one particular parcel of red wine from the Limestone Coast, for example, we found that treatment at 65°C resulted in laccase inactivation for all holding times from 39 seconds down to 16 seconds. In fact, for a holding time of 17 seconds, even a treatment temperature of 57.9°C resulted in laccase inactivation. We had to go down to 54°C for 15 seconds before we got a ‘fail’ result.”

See table below:

Batch Number	Description	Laccase Result	Treatment Temp (°C)	W/Flow in (l/hr)	Hold time (sec)	Temp in (°C)	Temp out (°C)
#1	Control	0.2 0.3	-	-	-	26.9	-
#2	Treatment	0	65.4	2478	16	27.0	34.1
#3	Treatment	0	65.4	2160	18	27.1	33.8
#4	Treatment	0	65.1	1584	25	27.0	33.4
#5	Treatment	0	65.4	991	39	27.1	32.7
#6	Treatment	0	62.3	1022	38	27.1	32.3
#7	Treatment	0	61.9	2346	17	27.1	33.2
#8	Treatment	0	57.9	2346	17	27.6	33.1
#9	Treatment	0.2	54.0	2617	15	27.4	33.3

Table of results dated April 8th showing treatment of 2011 Petit Verdot from the Limestone Coast. Laccase activity assessed at 0.6 when tested post press on April 6th using Dolmar kit.

“In the end, during our treatment program, we aimed to heat the wine to at least 60°C and hold it there for at least 20 seconds,” Wollan added.

“It was a matter of being practical. We just had to press on. We didn’t have time to carry out a major research project. We were basically there to help people get over a problem during a difficult vintage. Taking liquid to 60°C and back down again quickly certainly worked well with the technology we had.

“The cold wine coming in from its tank was basically being pre-warmed by wine that was leaving the tank post-treatment at an increased temperature. And of course, the warm wine leaving the tank was also being cooled by the cold wine coming in, so that you got this double whammy effect that allowed for good energy efficiency. The wine being treated was coming in and going back out again in a very short period. Not much more than half a minute.

“If we had wanted to go to a temperature higher than 60°C, then we would’ve had to run the machine a lot slower. Clearly, we wanted to get as much wine through the process as we could possibly manage. The alternative would have been to have had some potential customers being unable to have had their wine treated by our technology.

“A lot of people noticed that there was a huge improvement in wine quality after heat treatment. I mean, if you've got a wine that has experienced major botrytis infection, of course it is not going to be that flash. After treatment, the wine was certainly much more stable and acceptable, and that was what people were basically looking for from the process.”

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