Increase of the Heat Stability of White Wine by Surface Engineered Silica (SES)



FINAL REPORT to

Increase of the Heat Stability of White Wine by Surface Engineered Silica (SES)

Project Number: **USA 0902**

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Research Organisation: **University of South Australia and Australian Wine Research Institute**

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1. Abstract

Current oenological control of haze forming proteins in white wine is achieved through adsorption of wine proteins onto bentonite which, however, has adverse economic and ecological effects and can negatively affect the quality of the treated wine. In this study Surface Engineered Silica (SES) was used to increase the heat stability of white wine. Heat stability tests show that haze forming proteins can be removed resulting in turbidity of the tested wines of below 1 NTU at doses of 10-20 g/L. A sensory trial shows that SES treatment has no negative effect on the sensory characteristics of the wine.

2. Executive summary

In this study Surface Engineered Silica (SES) developed by the CI Peter Majewski was used to increase the heat stability of white wine. The removal of haze forming proteins was tested using Sauvignon Blanc and Riesling wine vintage 2010 donated by Orlando Wines. The treated wines were analysed with respect to their heat stability and additional characteristics in order to assess the effect of SES on the treated wine.

The tests were performed in batches of 0.75 L and different doses of SES per litre wine. The results clearly show that the heat stability of white wine can be increased up to the required level. The analyses also show that other characteristics of the treated wines were not or only very slightly affected. In most cases a very small decrease of the free sulphur content, total phenolics, and flavonoid extract was observed.

The heat stability tests indicated that SES doses of about 10 to 20 g/L achieve a net turbidity of below 1 NTU after a heat test in static batch treatments.

Riesling wine was also fined in a flow through filter set-up. The filter consisted of a filter cartridge filled with SES which was placed in a filter cartridge holder. The achieved net turbidity was 1.9 NTU after a heat test indicating that lower flow rates at a given dose of SES in the filter would be necessary to achieve NTU levels of below 1 after a heat test.

Riesling and Sauvignon Blanc wines were batch treated with SES and used for the sensory trial against the same wines after bentonite treatment performed at the Australian Wine Research Institute. The heat stability of the wines was analysed to be below 1 NTU after a heat test and the results of the sensory trial was considered as inconclusive showing that SES treatment has no negative affect on the sensory characteristics of the treated wine.

An assessment of the costs of bentonite fining for Australia’s wine industry shows that bentonite fining results in losses of about $ 60 M per year (about $ 0.1 per litre wine) considering export prices for white wine of $ 3/L. In order to have a net gain out of using SES for wine fining, the cost of SES should not exceed about $ 10/kg which is difficult to achieve at the current costs for the chemicals needed for the manufacturing of SES.

3. Background

Denaturation of wine proteins leads to protein aggregation and the formation of haze. Current oenological control is achieved through adsorption of wine proteins onto bentonite. This, however has adverse effects through

- additional removal of colour, flavour and texture compounds
- swelling of bentonite and related loss of wine
- handling and disposal of spent bentonite (high labour input, high cost, occupational health and safety issues, environmental issues, and legislative requirements)

The development of novel, economically-viable fining technologies would therefore be highly desirable and warrants further research.

The development of a novel wine fining method via SES presents an opportunity to address some of the disadvantages of using bentonite. The haze forming components are removed by the charged surface of the SES. Recent research by the CI Majewski and his team at UniSA has shown the following:

- The heat stability of white wine can be increased by SES treatment
- Levels of thaumatin-like proteins and chitinases decrease through SES treatment
- Sensory characteristics of the wine are not or minimally affected by the fining with SES
- SES is recyclable
- Fining of white wine can be performed in a flow-through filter design

Several alternative techniques to bentonite fining have been studied [8-12]. However, the results obtained to date have not been successful on an industrial scale and thus bentonite appears to be the only commercially acceptable, practical solution at present[12]. The CIs believe that SES provides a promising cost-competitive alternative to bentonite fining due to its easy handling, scalability, and recyclability.

4. Project Aims and Performance targets

The main objective of the proposed project is to develop an alternative and fit-for-purpose wine fining technology to replace bentonite fining and eliminate its related economic and ecological effects for the wine industry. The new technology is based on scientific studies of the interaction of haze forming proteins with charged particles, performed by the CI's research team.

The proposed project has the following objectives:

- Development and optimization of a fit-for-purpose wine fining process based on SES in a flow-through filter design
- Assessment of the influence of SES fining on the sensory characteristics of treated wine via wine tasting trials
- Quantification of the cost / benefit ratio of wine fining by SES.

Performance targets

Year 1	Output	Due Date mm/yy	Activities
a	SES production	31/10/2009	Hire research assistant, purchase chemicals and laboratory equipment/consumables, production, quality analysis
b	Set up of wine fining facility	30/11/2009	Purchase related equipment
c	Preliminary fining trials for optimisation of the process performed	31/02/2010	Wine fining with small amounts of wine, heat stability tests and normalized turbidity analysis for optimising process parameters
d	Wine fining and wine tasting trials	30/05/2010	Wine fining of appropriate amounts of wine and performing wine tasting trials at AWRI
e	Cost analysis and report submission	30/06/2010	Cost benefit analysis for SES and report writing

The project was delayed for about three months, because the granted research assistant position could not be filled until mid October 2009.

5. Methods

Wine Fining Trial

SES powder was produced using commercial silica powder. The powder was coated with a functionalised self-assembled monolayer using commercially available surfactants and water as the solvent by a method developed by the CI's Majewski team [1-7].

For batch trials, SES was added to the wine in bottles and left there for the given contact time.

For the flow through filter trial, SES was filled in commercial filter cartridges approved for beverage and water filtration (Figure 1) and placed in front of a 5 micron filter pad in order to avoid the presence SES in the treated wine (Figure 2). The flow rate of the system was 5.2 L/h at a filter diameter of 20 mm and pump pressure of 2 bars (0.0166 L/h per mm^2 and p(bars)).



Figure 1: Commercially available filter cartridge (left) filled with SES and cartridge holder (right) used for the setup of the flow through filter.

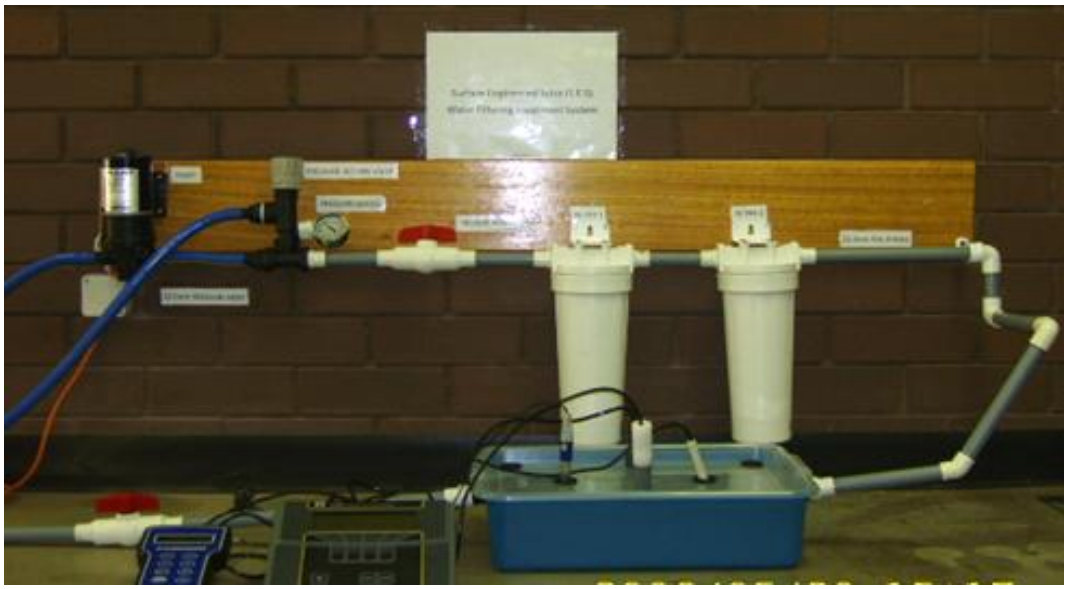


Figure 2: Setup of the flow through filter using two cartridge holder filed with a filter cartridge with SES (left) and with a commercially available 5 micron filter (right).

Sensory Trial

Wine preparation

Two unfined wines (Sauvignon Blanc and Riesling) from the 2010 vintage from Adelaide Hills (South Australia) were used. The wines were donated by Orlando Wines and were made using standard winemaking practices and on a commercial scale. After assessing their bentonite requirements (800 mg/L for Riesling and 1100 mg/L for Sauvignon Blanc using Vitiben), three 750 mL bottles of each wine were fined with bentonite, while another three 750 mL bottles were fined with 30 g/L of surface-active silica powder (SAS). The bentonite was left in contact with the wines for 2 hours (at 20 °C), while the SAS was left in contact with the wines for 24 h (at 20 °C) during which the bottles were constantly mixed by means of an orbital shaker. Prior to sensory assessment, both fining agents were removed from the wines via centrifugation (5000g, 10 minutes, 10 °C). It has to be noted that both wines were cloudy before the fining, but the wines treated with bentonite were clear after centrifugation, while those treated with SAS were still cloudy.

Sensory assessment

The triangle test was applied, following the Australian Standard: Sensory analysis of foods - Specific methods – Triangle Test AS 2542.2.2. The triangle test is a forced choice test and is not valid for determining preferences, nor the character or degree of any perceived difference.

In a preliminary assessment the wines were evaluated by four experienced AWRI tasters prior to the test. There appeared to be little or no difference in aroma and flavour between the silica treated and bentonite treated wines for either wine type. However, it was noted that

the silica treated wines were quite cloudy in appearance compared to the bentonite treated wines and hence no lights were used for assessment to minimise the visual bias.

Two 750 ml bottles and one 500 ml screw cap sealed glass bottle (Schott) was supplied for each wine which were blended and returned to the original bottles for pouring.

Assessors were asked to evaluate the wines for aroma and palate, selecting the sample in the set that was different from the other two. Panellists were also asked to comment on any differences between the wines if possible. An example of the instructions provided to the assessors is presented in Appendix 1.

Thirty experienced, screened and qualified assessors were presented with one tray, with two triangle sets on that tray (one set for each wine). Belinda Bramley was the test supervisor and the testing was carried out on 25 August 2010.

Samples were presented to panellists in 30 mL aliquots in 3-digit-coded, covered ISO standard wine glasses at 22 – 24°C, in isolated booths under minimal lighting, with randomised presentation order across judges. After the first set, the assessors were forced to have a 30 second rest before assessing the next set.

Data analysis to determine statistical significance was carried out using the binomial model as specified in AS 2542.2.4.

Compositional analysis
Wine compositional analysis was undertaken by the AWRI Commercial Services using standard test procedures.

6. Result/Discussion

Wine fining trials

The wine fining trials show that the heat stability of the treated wines decrease with increasing dose rate at contact times of 24 h (Figure 3, Table 1). For both wines, after heat testing, a net turbidity of below 1 was achieved at doses of about 10 to 20 g/L at static batch treatment (Figure 4).

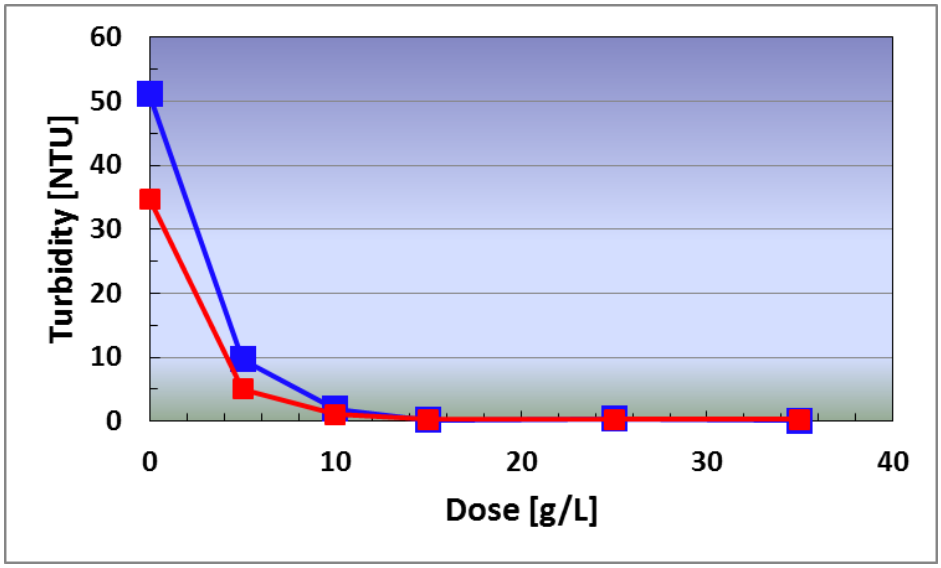


Figure 3: Dose vs. turbidity after a heat test of the treated Riesling wine (blue) and Sauvignon Blanc wine (red).

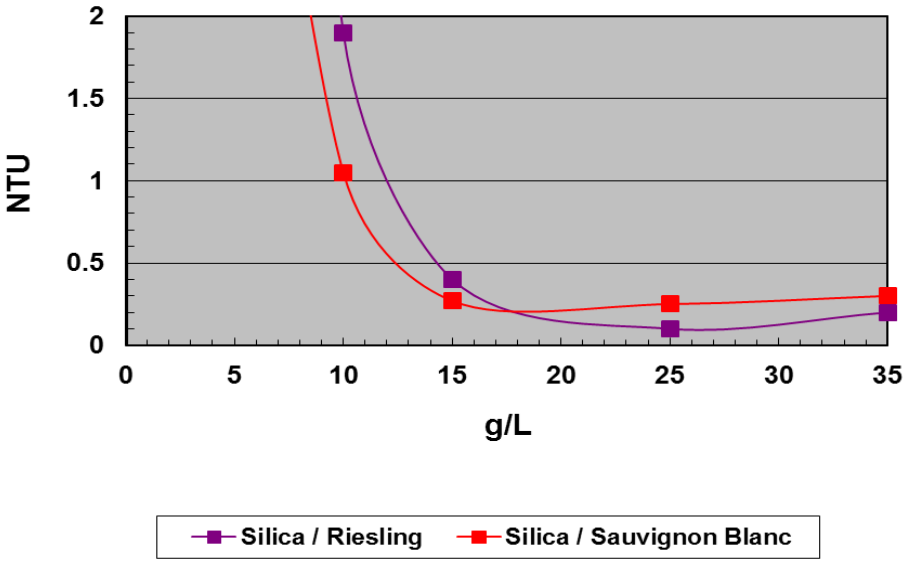


Figure 4: Dose vs. turbidity for the Reisling and Sauvignon Blanc wine.

Table 1: Turbidity of treated wines after heat tesing at different SES doses and contact times of 24 h for the static batch treatment.

SES dose [g/L]	Riesling, turbidity [NTU]	Sauvignon Blanc, turbidity [NTU]
0	51.06	34.77
5	9.7	5
10	1.9	1.05
15	0.2	0.25
25	0.4	0.27
35	0.1	0.3

The analyses of the wine also show that key parameters of the wine are not or only slightly affected by the SES treatment (see data for the treated Riesling wine in Figure 5).

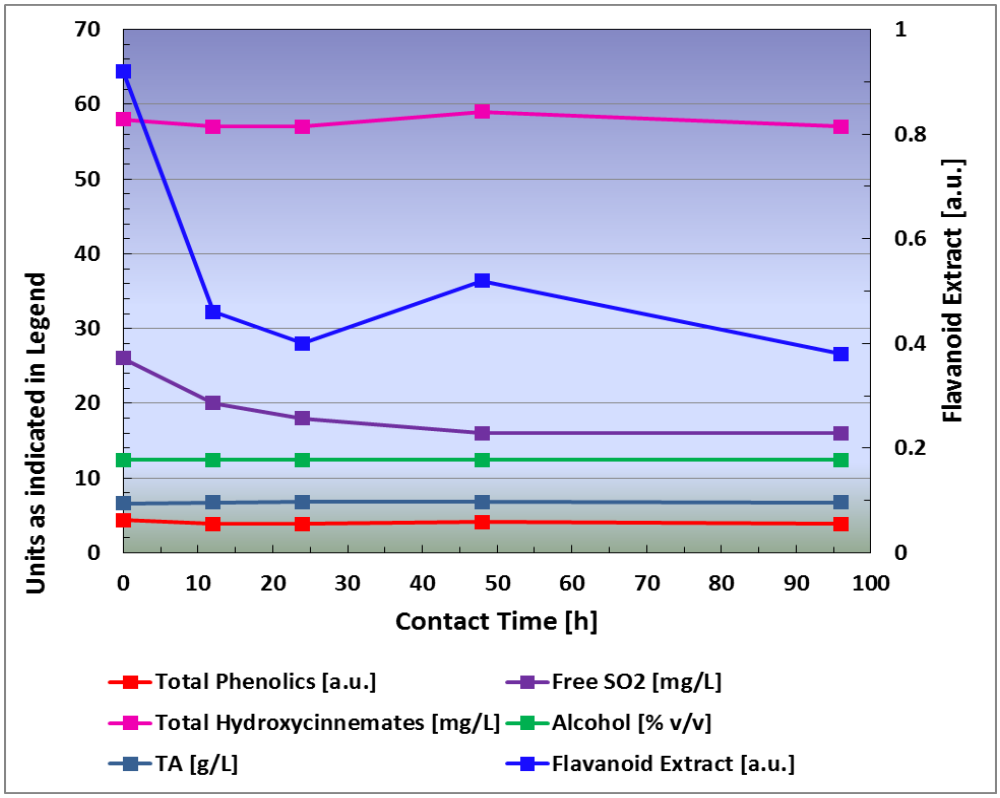


Figure 5: The effect of contact time at a SES dose of 25g/L on the treated Riesling wine composition.

When testing different contact times at a constant dose of 25 g/L of SES the results indicate that in static batch mode contact times of up to 30 h are necessary to achieve net turbidity of below 1 NTU after a heat test (Figure 6, Table 2).

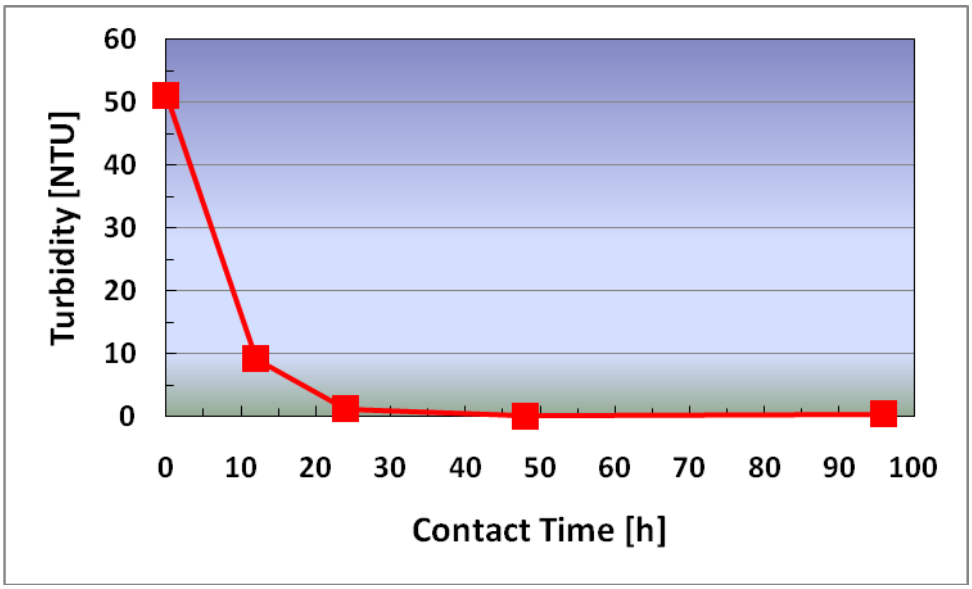


Figure 6: Contact time vs net turbidity after a heat test for the Riesling wine.

Table 2: Turbidity of the Riesling wine after a heat test vs. contact time at a SES dose of 25 g/L.

Contact time [h]	Riesling, turbidity [NTU]
0	51.06
12	9.2
24	1.17
48	0.1
96	0.4

Flow Through Filter Set-Up

Contrary to the results shown in Figure 5, the flow through filter approach resulted in a net turbidity of the treated Riesling wine of 2 NTU after a heat test after 30 min of filtering (Figure 7, Table 3)

Table 3: Turbidity of the Riesling wine after various filter times and related amount of filtered wine.

Riesling, turbidity [NTU]	Amount wine [L]	Time of filtering [min]
1.9	3.52	45
2.2	2.64	30
6.3	1.76	20
12.3	0.88	10
48.3	0	0

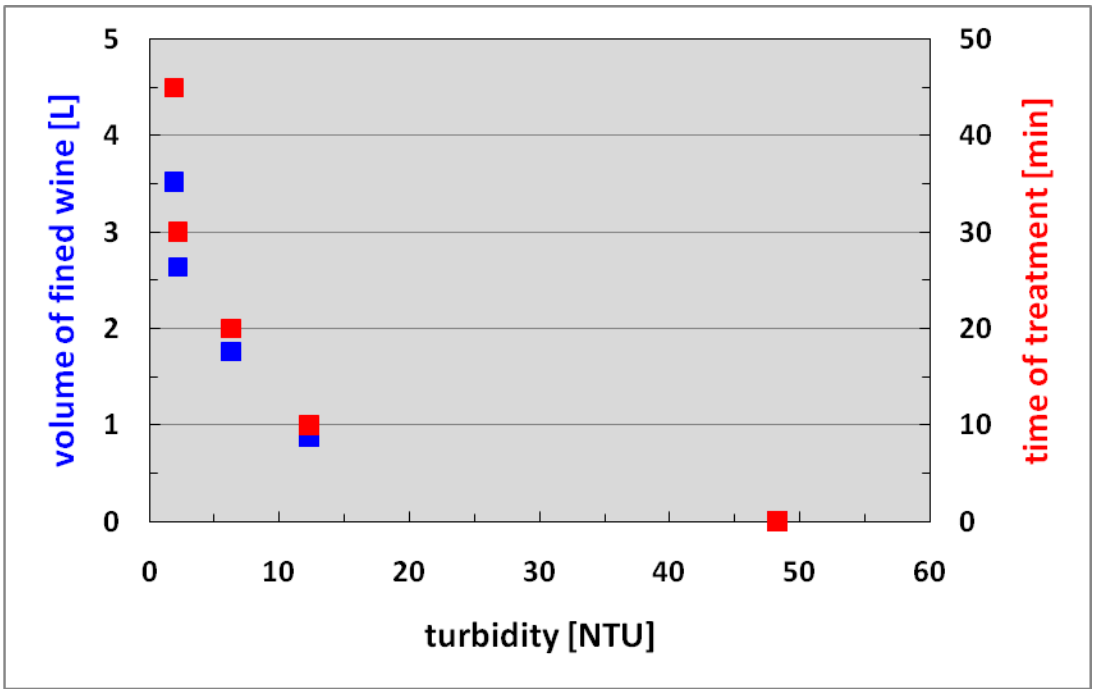


Figure 7: Turbidity of the treated Riesling wine after a heat test vs. the volume of the treated wine (left) and the contact time on the filter (right).

The reason for this different results are believed to be due to the likelihood that during the static batch fining the SES powder sat at the bottom of the bottle for most of the time and the uptake of the haze forming proteins by the SES particles was mainly controlled by diffusion of the haze forming proteins into the SES powder layer. During the flow through filter test the wine was flowing around the particles which allowed a much quicker uptake of the haze forming proteins by the particles.

Sensory trial

In a preliminary assessment the wines were evaluated by four experienced AWRI tasters prior to the test. There appeared to be little or no difference in aroma and flavour between the silica treated and bentonite treated wines for either wine type. However, it was noted that the silica treated wines were quite cloudy in appearance compared to the bentonite treated wines and hence no lights were used for assessment to minimise the visual bias.

Table 4 provides the results from each triangle test. It can be seen that there was a significant difference between the bentonite and silica treatments for the Sauvignon Blanc wine, but the treatments for the Riesling wine were not significantly different.

Table 4: Results of the triangle tests, n=30 responses.

Set	Comparison	Correct Answers	Significance
1	Sauvignon Blanc - bentonite vs silica	20	*P*<0.001
2	Riesling - bentonite vs silica	13	n.s.

n.s.: Not significant.

Comments from the tasters did not yield any additional information.

The result can be considered inconclusive. The non-significant difference determined for Set 2 would indicate that the surface treated silica had no sensory effect compared to the bentonite treated wine. The significant result for Set 1 may either relate to an effect on the Sauvignon Blanc wine different to that of the Riesling, or a result of a difference in the cloudy appearance. While the test was conducted under minimal lighting and any visual difference was negligible under these conditions, this possibility cannot be discounted. For this test black glasses were not available.

Overall, considering the non-significant effect of test 2, the possibility of a visual difference affecting test 1, and the preliminary evaluation indicating minimal aroma or flavour difference, it can be suggested that the silica treatment is not likely to substantially affect the sensory properties of a white wine. This will need to be confirmed using either a fully clarified wine or using black glasses.

Cost assessment

The total costs of bentonite fining of Australia's white wine was comprehensively assessed in the frame of a Final Year Student Project conducted by Adam Barbalet and supervised by Peter Majewski [13]. The study shows that the costs of bentonite fining is mainly defined by the loss of wine. As the Lees volume significantly varies depending on the procedure of wine fining, the costs resulting from batch fining with Rotary Drum Vacuum filtering can be estimated to be $ 60 million per year for Australia's wine industry considering only an export price of white wine of $ 3.1 per litre. If only in line dosing is applied the costs can be reduced down to about $ 15 million. Other costs due to purchase of bentonite and disposal costs for bentonite and perlite from RDV filters are contributing only minimally and can be ignored.

Considering the wine fining trials of this study, in order to have a net gain out of using SES for wine fining, the cost of SES should not exceed about $ 10/kg which is believed to be

difficult to achieve at present taking costs for the materials necessary to manufacture SES of about $ 9 per kg into account.

Therefore, other methods of wine fining by SES have to be studied, such as in line dosing of SES.

7. Outcome/Conclusion

The study clearly shows that

- The heat stability of white wine can be significantly increased by SES treatment resulting in net turbidity of less than 1 NTU after a heat test
- The application of SES in a flow through filter system provides an appropriate increase of the heat stability of white wine
- Turbulent conditions due to wine flowing through a SES filter bed or stirring SES in the wine (or equivalently slow setting times of SES in large wine tank) during the wine treatment significantly increases the efficiency of the wine fining by SES
- SES treatment of white wine is unlikely to affect the sensory characteristics of the treated wine
- At the current costs of the materials necessary for the manufacturing of SES wine fining by SES is not competitive compared to bentonite treatment (considering export prices of white wine of $ 3/L).

The conclusion out of these outcomes is that additional wine fining methods by SES have to be tested in order to reduce the amount of SES necessary to properly increase the heat stability of the treated wine, such as

- in line dosing of SES,
- batch fining using wine in containers that model the dimensions used for batch fining in large tanks, such that the sedimentation time of SES is longer and thus provides more efficient uptake of haze forming proteins by SES
- circular pumping of wine through a flow through filter or pumping through a filter cascade with SES

8. Recommendations

The recommendations out of these outcomes is that additional wine fining methods by SES have to be tested in order to reduce the amount of SES necessary to properly increase the heat stability of the treated wine, such as

- in line dosing of SES,
- batch fining using wine in containers that model the dimensions used for batch fining in large tanks, such that the sedimentation time of SES is longer and thus provides more efficient uptake of haze forming proteins by SES
- circular pumping of wine through a flow through filter or pumping through a filter cascade with SES

9. Appendix 1: Communication

The results of this study will not be published within the near future.

10. Appendix 2: Intellectual Property

The increase of the heat stability of white wine by fining with SES was agreed to be background IP and is, therefore, no IP generated by this project. The concept of using SES in a flow through filter set up represents valuable information arising from this project and may be used for further developments of filter systems suitable for fining white wine by SES and generating of related IP.

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12. Appendix 4: Staff

Staff involved in this project were

CI Prof. Peter Majewski, UniSA

Co-CI Dr. Elizabeth Waters, AWRI

Research Assistant Maria Chuang, UniSA

13. Appendix 5:

13.1 AWRI analysis

28 April 2010

SES dose of 1 g/L.

		Heat stability	Turbidity (control)	Turbidity (difference)	Turbidity (heated)	Sulphur Dioxide (free)	Sulphur Dioxide (total)	pH	Titratable acid pH 7.0	Titratable acid pH 8.2	Alcohol	Total Phenolics
SBY1	AC59047	Fail - Level 3	1.61	33.24	34.85	19	80	3.11	7.1	7.5	13.3	7.95
SBY2	AC59048	Fail - Level 3	1.59	33.91	35.5	18	80	3.07	7.1	7.6	13.3	7.7
SBY4	AC59049	Fail - Level 3	0.99	27.41	28.4	12	71	2.68	8.7	9.2	13.2	5.67
SB1	AC59050	Fail - Level 3	1.08	39.42	40.5	22	89	3.14	6.9	7.3	13.3	3.34
SB2	AC59051	Fail - Level 3	1.22	40.58	41.8	22	90	3.15	6.9	7.3	13.3	3.28
SB4	AC59052	Fail - Level 3	1.38	42.32	43.7	21	89	3.13	6.9	7.4	13.4	3.18
SB6	AC59053	Fail - Level 3	0.6	81.2	81.8	20	88	3	7.4	7.8	13.3	3.02
RC1	AC59054	Fail - Level 3	0.74	52.76	53.5	16	75	2.98	6.9	7.4	12.6	5.11
RC2	AC59055	Fail - Level 3	0.79	53.61	54.4	16	76	2.99	6.9	7.3	12.5	4.92
RC4	AC59056	Fail - Level 3	0.43	88.67	89.1	15	74	2.87	7.2	7.6	12.4	4.49
RC6	AC59057	Fail - Level 3	0.56	57.85	58.4	16	76	2.97	6.9	7.3	12.5	4.85
RE1	AC59058	Fail - Level 3	1.48	28.12	29.6	18	74	2.91	7.6	7.9	11.8	4.44
RE2	AC59059	Fail - Level 3	1.56	36.94	38.5	16	74	2.84	7.8	8.2	11.7	4.28
RE4	AC59060	Fail - Level 3	3.03	16.57	19.6	14	74	2.41	9.4	9.8	11.8	4
RE6	AC59061	Fail - Level 3	4.87	52.93	57.8	15	73	2.57	8.9	9.2	11.7	4.32

7 May 2010

SES doses of 10 and 20 g/L.

		Heat stability	Turbidity (control)	Turbidity (difference)	Turbidity (heated)	Sulphur Dioxide (free)	Sulphur Dioxide (total)	pH	Titratable acid pH 7.0	Titratable acid pH 8.2	Alcohol	Total Phenolics	Flavonoid Extractives
R30 RAW	AC60596	Fail - Level 3	0.99	51.06	52.05	26	87	3.06	6.6	6.9	12.5	4.36	0.92
R3010	AC60597	Fail - Level 1	0.67	1.89	2.56	19	81	3.02	6.6	6.9	12.4	3.97	0.5
R3020	AC60598	Fail - Level 1	0.7	0.46	1.16	16	77	3.02	6.7	7.1	12.4	3.83	0.38
SB30 RAW	AC60599	Fail - Level 3	1.53	34.77	36.3	18	87	3.15	6.5	7	13.3	3	1.11
SB3010	AC60600	Fail - Level 1	0.67	1.05	1.72	16	82	3.12	6.6	7.1	13.3	2.59	0.74
SB3020	AC60601	Fail - Level 1	1.08	0.27	1.35	13	76	3.09	6.6	7.1	13.3	2.47	0.64

SES dose of 20 g/L at various contact times

		Heat stability	Turbidity (control)	Turbidity (difference)	Turbidity (heated)	Sulphur Dioxide (free)	Sulphur Dioxide (total)	pH	Titratable acid pH 7.0	Titratable acid pH 8.2	Alcohol	Total Phenolics	Flavonoid Extractives
R 30 20 12	AC60896	Fail - Level 2	0.99	9.21	10.2	20	83	3.01	6.7	7	12.4	3.88	0.46
R 30 20 24	AC60897	Fail - Level 1	0.68	1.17	1.85	18	82	3.01	6.8	7.1	12.4	3.85	0.4
R 30 20 48	AC60898	Passed	1.02	0.07	1.09	16	78	3.01	6.8	7.1	12.4	4.09	0.52

22 July 2010
250g Unimin Sand S4
100g RS3
6L wine R

		Heat stability	Turbidity (control)	Turbidity (difference)	Turbidity (heated)	Sulphur Dioxide (free)	Sulphur Dioxide (total)	pH	Titratable acid pH 7.0	Titratable acid pH 8.2	Alcohol	Total Phenolics	Flavonoid Extractives
R201	AC61976	Fail - Level 2	0.36	20.99	21.35	6	61	2.75	6.8	7.1	11.4	2.24	Not Detected
R202	AC61977	Fail - Level 2	0.44	7.06	7.5	6	61	2.59	7.4	7.8	11.9	2.34	Not Detected
R203	AC61978	Fail - Level 2	0.73	4.1	4.83	7	63	2.83	7.1	7.4	12.2	2.93	Not Detected
R204	AC61979	Fail - Level 2	0.51	2.11	2.62	8	65	2.99	6.7	7	12.3	3.18	0.12

13.2 Sensory trial report from AWRI

The Australian Wine Research Institute

The effect of a novel surface-active silica protein fining treatment on the sensory properties of white wine.

Belinda Bramley
Matteo Marangon
Leigh Francis

26 August 2010

Introduction

The aim of this study was to determine whether there was a significant effect on the aroma and flavour properties of a protein unstable Sauvignon blanc or Riesling wine, treated with a novel silica fining agent, compared to the same wine treated conventionally with bentonite.

Materials and Methods

Wine preparation
Two unfined wines (Sauvignon Blanc and Riesling) from the 2010 vintage from Adelaide Hills (South Australia) were used. The wines were donated by Orlando Wines and were made using standard winemaking practices and on a commercial scale. After assessing their bentonite requirements (800 mg/L for Riesling and 1100 mg/L for Sauvignon Blanc using Vitiben), three 750 mL bottles of each wine were fined with bentonite, while another three 750 mL bottles were fined with 30 g/L of surface-active silica powder (SAS). The bentonite was left in contact with the wines for 2 hours (at 20 °C), while the SAS was left in contact with the wines for 24 h (at 20 °C) during which the bottles were constantly mixed by means of an orbital shaker. Prior to sensory assessment, both fining agents were removed from the wines via centrifugation (5000g, 10 minutes, 10 °C). It has to be noted that both wines were cloudy before the fining, but the wines treated with bentonite were clear after centrifugation, while those treated with SAS were still cloudy.

Sensory assessment
The triangle test was applied, following the Australian Standard: Sensory analysis of foods - Specific methods – Triangle Test AS 2542.2.2. The triangle test is a forced choice test and is

not valid for determining preferences, nor the character or degree of any perceived difference.

In a preliminary assessment the wines were evaluated by four experienced AWRI tasters prior to the test. There appeared to be little or no difference in aroma and flavour between the silica treated and bentonite treated wines for either wine type. However, it was noted that the silica treated wines were quite cloudy in appearance compared to the bentonite treated wines and hence no lights were used for assessment to minimise the visual bias.

Two 750 ml bottles and one 500 ml screw cap sealed glass bottle (Schott) was supplied for each wine which were blended and returned to the original bottles for pouring.

Assessors were asked to evaluate the wines for aroma and palate, selecting the sample in the set that was different from the other two. Panellists were also asked to comment on any differences between the wines if possible. An example of the instructions provided to the assessors is presented in Appendix 1.

Thirty experienced, screened and qualified assessors were presented with one tray, with two triangle sets on that tray (one set for each wine). Belinda Bramley was the test supervisor and the testing was carried out on 25 August 2010.

Samples were presented to panellists in 30 mL aliquots in 3-digit-coded, covered ISO standard wine glasses at 22 – 24°C, in isolated booths under minimal lighting, with randomised presentation order across judges. After the first set, the assessors were forced to have a 30 second rest before assessing the next set.

Data analysis to determine statistical significance was carried out using the binomial model as specified in AS 2542.2.4.

Results

Table 1 provides the results from each triangle test. It can be seen that there was a significant difference between the bentonite and silica treatments for the Sauvignon Blanc wine, but the treatments for the Riesling wine were not significantly different.

Table 1. Results of the triangle tests, n=30 responses.

Set	Comparison	Correct Answers	Significance
1	Sauvignon Blanc - bentonite vs silica	20	*P*<0.001
2	Riesling - bentonite vs silica	13	n.s.

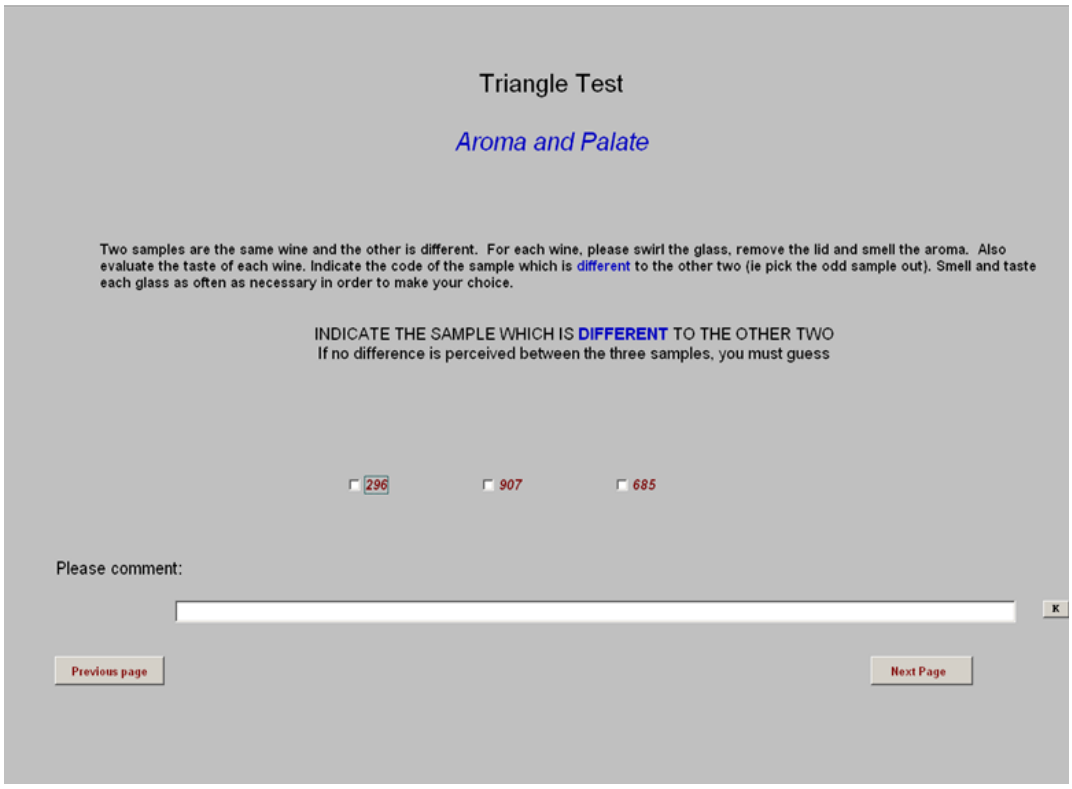
n.s.: Not significant.

Comments from the tasters did not yield any additional information.

The result can be considered inconclusive. The non-significant difference determined for Set 2 would indicate that the surface treated silica had no sensory effect compared to the bentonite treated wine. The significant result for Set 1 may either relate to an effect on the Sauvignon Blanc wine different to that of the Riesling, or a result of a difference in the cloudy appearance. While the test was conducted under minimal lighting and any visual difference was negligible under these conditions, this possibility cannot be discounted. For this test black glasses were not available, due to issues of delay in treating and clarifying the wines for the test.

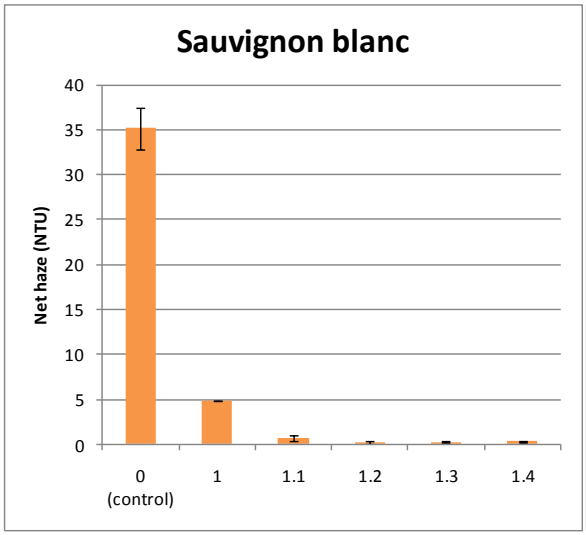
Overall, considering the non-significant effect of test 2, the possibility of a visual difference affecting test 1, and the preliminary evaluation indicating minimal aroma or flavour difference, it can be suggested that the silica treatment is not likely to substantially affect the sensory properties of a white wine. This will need to be confirmed using either a fully clarified wine or using black glasses.

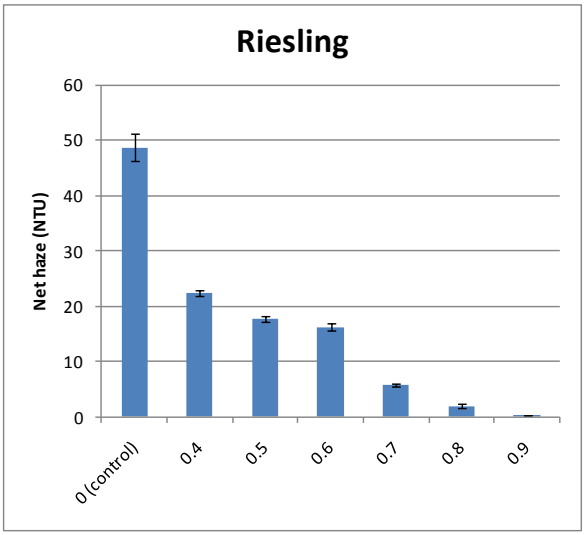
Appendix Screen shot of an example of the test page provided to the assessors.


Triangle Test
Aroma and Palate
Two samples are the same wine and the other is different. For each wine, please swirl the glass, remove the lid and smell the aroma. Also evaluate the taste of each wine. Indicate the code of the sample which is different to the other two (ie pick the odd sample out). Smell and taste each glass as often as necessary in order to make your choice.
INDICATE THE SAMPLE WHICH IS DIFFERENT TO THE OTHER TWO
If no difference is perceived between the three samples, you must guess
296
907
685
Please comment:
Previous page
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HEAT STABILITY TEST

Results indicated that the Riesling required 0.8 g/L of bentonite to be stabilized while the Sauvignon Blanc 1.1 g/L (see graphs below).





The same two wines treated with SES for 24 h were heat tested as well. They were both stable after treatment.

Sample	**Heat stability (net NTU)**
Riesling treated with silica for 24 h	0.3 ± 0.06
Sauvignon blanc treated with silica for 24 h	0.4 ± 0.06