

# **Supporting Information for**

## **Changes in metal ion concentrations in a Chardonnay wine related to oxygen exposure during vinification**

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**Table S1. Average and standard deviation (Stdev) values of the metal ion concentrations (mg/Kg) in juice and wine supernatants.**

|                                                           | Inert – Reductive <sup>4</sup> |                          | Inert - Oxidative |              | Aerobic – Reductive <sup>4</sup> |              | Aerobic - Oxidative |              |
|-----------------------------------------------------------|--------------------------------|--------------------------|-------------------|--------------|----------------------------------|--------------|---------------------|--------------|
| <b>Aluminium<sup>1</sup> (LOQ 0.10 mg/Kg)<sup>2</sup></b> | <b>Average</b>                 | <b>Stdev<sup>5</sup></b> | <b>Average</b>    | <b>Stdev</b> | <b>Average</b>                   | <b>Stdev</b> | <b>Average</b>      | <b>Stdev</b> |
| Press start <sup>3</sup>                                  | 0.707                          | 0.047                    | 1.267             | 0.058        | 1.020                            | 0.069        | 0.767               | 0.023        |
| Press end                                                 | 0.360                          | 0.017                    | 0.437             | 0.046        | 0.430                            | 0.010        | 0.403               | 0.031        |
| Post Juice Rack                                           | 0.437                          | 0.093                    | 0.507             | 0.183        | 0.340                            | 0.090        | 0.407               | 0.110        |
| After enzyme                                              | 0.100                          | 0.000                    | 0.100             | 0.000        | 0.100                            | 0.000        | 0.100               | 0.000        |
| Ferment Start                                             | 0.100                          | 0.000                    | 0.100             | 0.000        | 0.107                            | 0.006        | 0.103               | 0.006        |
| Bentonite                                                 | 0.757                          | 0.090                    | 0.773             | 0.196        | 0.683                            | 0.085        | 0.587               | 0.071        |
| Ferment End                                               | 0.193                          | 0.006                    | 0.220             | 0.010        | 0.273                            | 0.075        | 0.227               | 0.015        |
| SO <sub>2</sub>                                           | 0.353                          | 0.025                    | 0.257             | 0.023        | 0.360                            | 0.139        | 0.297               | 0.133        |
| Post Cold Stab.                                           | 0.447                          | 0.081                    | 0.383             | 0.025        | 0.470                            | 0.087        | 0.383               | 0.025        |
| After Bottling                                            | 0.383                          | 0.025                    | 0.383             | 0.023        | 0.350                            | 0.017        | 0.433               | 0.006        |
| <b>Calcium (LOQ 2.00 mg/Kg)</b>                           |                                |                          |                   |              |                                  |              |                     |              |
| Press start                                               | 120.667                        | 2.517                    | 135.000           | 1.732        | 123.333                          | 2.309        | 106.333             | 1.528        |
| Press end                                                 | 106.333                        | 0.577                    | 108.667           | 0.577        | 100.667                          | 2.517        | 114.333             | 5.774        |
| Post Juice Rack                                           | 107.000                        | 1.000                    | 106.667           | 0.577        | 105.000                          | 1.732        | 101.000             | 2.646        |
| After enzyme                                              | 101.000                        | 1.732                    | 100.000           | 2.000        | 101.000                          | 2.646        | 97.000              | 2.646        |
| Ferment Start                                             | 101.667                        | 2.082                    | 101.667           | 2.082        | 101.333                          | 2.082        | 101.000             | 1.732        |
| Bentonite                                                 | 111.333                        | 0.577                    | 127.667           | 11.372       | 113.333                          | 2.309        | 111.333             | 1.155        |
| Ferment End                                               | 78.333                         | 2.082                    | 77.333            | 1.528        | 77.000                           | 1.732        | 76.333              | 1.155        |
| SO <sub>2</sub>                                           | 79.333                         | 2.082                    | 79.667            | 4.726        | 80.000                           | 1.000        | 84.000              | 11.358       |
| Post Cold Stab.                                           | 59.333                         | 0.577                    | 58.000            | 1.732        | 61.667                           | 0.577        | 63.000              | 6.083        |
| After Bottling                                            | 58.667                         | 2.082                    | 57.333            | 1.155        | 61.000                           | 3.606        | 59.667              | 1.155        |
| <b>Cobalt (LOQ 0.001 mg/Kg)</b>                           |                                |                          |                   |              |                                  |              |                     |              |
| Press start                                               | 0.005                          | 0.000                    | 0.006             | 0.000        | 0.005                            | 0.000        | 0.004               | 0.000        |
| Press end                                                 | 0.003                          | 0.000                    | 0.003             | 0.000        | 0.003                            | 0.000        | 0.003               | 0.000        |
| Post Juice Rack                                           | 0.004                          | 0.000                    | 0.004             | 0.000        | 0.004                            | 0.000        | 0.004               | 0.000        |
| After enzyme                                              | 0.004                          | 0.000                    | 0.004             | 0.000        | 0.004                            | 0.000        | 0.003               | 0.000        |
| Ferment Start                                             | 0.004                          | 0.000                    | 0.004             | 0.000        | 0.003                            | 0.001        | 0.003               | 0.000        |
| Bentonite                                                 | 0.002                          | 0.001                    | 0.003             | 0.001        | 0.003                            | 0.000        | 0.003               | 0.000        |

|                                   |       |       |       |       |       |       |       |       |
|-----------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Ferment End                       | 0.005 | 0.001 | 0.005 | 0.000 | 0.004 | 0.000 | 0.004 | 0.000 |
| SO <sub>2</sub>                   | 0.005 | 0.000 | 0.005 | 0.000 | 0.005 | 0.000 | 0.005 | 0.001 |
| Post Cold Stab.                   | 0.006 | 0.000 | 0.006 | 0.000 | 0.006 | 0.000 | 0.006 | 0.000 |
| After Bottling                    | 0.006 | 0.000 | 0.006 | 0.000 | 0.006 | 0.001 | 0.006 | 0.000 |
| <b>Chromium (LOQ 0.001 mg/Kg)</b> |       |       |       |       |       |       |       |       |
| Press start                       | 0.005 | 0.003 | 0.004 | 0.001 | 0.003 | 0.001 | 0.002 | 0.000 |
| Press end                         | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.000 | 0.001 | 0.000 |
| Post Juice Rack                   | 0.003 | 0.001 | 0.004 | 0.001 | 0.002 | 0.001 | 0.003 | 0.001 |
| After enzyme                      | 0.002 | 0.000 | 0.002 | 0.001 | 0.005 | 0.004 | 0.002 | 0.001 |
| Ferment Start                     | 0.002 | 0.001 | 0.007 | 0.006 | 0.002 | 0.000 | 0.003 | 0.002 |
| Bentonite                         | 0.004 | 0.001 | 0.003 | 0.000 | 0.003 | 0.001 | 0.002 | 0.000 |
| Ferment End                       | 0.003 | 0.001 | 0.003 | 0.001 | 0.002 | 0.001 | 0.002 | 0.000 |
| SO <sub>2</sub>                   | 0.024 | 0.007 | 0.011 | 0.010 | 0.009 | 0.006 | 0.003 | 0.002 |
| Post Cold Stab.                   | 0.023 | 0.006 | 0.013 | 0.013 | 0.009 | 0.005 | 0.004 | 0.001 |
| After Bottling                    | 0.029 | 0.008 | 0.016 | 0.010 | 0.008 | 0.002 | 0.013 | 0.006 |
| <b>Copper (LOQ 0.01 mg/Kg)</b>    |       |       |       |       |       |       |       |       |
| Press start                       | 0.690 | 0.010 | 0.693 | 0.006 | 0.667 | 0.012 | 0.733 | 0.006 |
| Press end                         | 0.973 | 0.006 | 0.970 | 0.010 | 0.830 | 0.026 | 0.917 | 0.057 |
| Post Juice Rack                   | 0.667 | 0.025 | 0.673 | 0.035 | 0.777 | 0.015 | 0.783 | 0.006 |
| After enzyme                      | 0.613 | 0.012 | 0.700 | 0.010 | 0.740 | 0.017 | 0.730 | 0.017 |
| Ferment Start                     | 0.490 | 0.017 | 0.460 | 0.026 | 0.527 | 0.021 | 0.563 | 0.015 |
| Bentonite                         | 0.310 | 0.010 | 0.227 | 0.025 | 0.233 | 0.015 | 0.213 | 0.023 |
| Ferment End                       | 0.087 | 0.006 | 0.033 | 0.006 | 0.020 | 0.010 | 0.013 | 0.006 |
| SO <sub>2</sub>                   | 0.143 | 0.006 | 0.023 | 0.006 | 0.030 | 0.000 | 0.033 | 0.015 |
| Post Cold Stab.                   | 0.073 | 0.006 | 0.020 | 0.000 | 0.010 | 0.000 | 0.040 | 0.010 |
| After Bottling                    | 0.080 | 0.010 | 0.023 | 0.006 | 0.020 | 0.010 | 0.020 | 0.000 |
| <b>Iron (LOQ 0.10 mg/Kg)</b>      |       |       |       |       |       |       |       |       |
| Press start                       | 1.020 | 0.072 | 1.600 | 0.000 | 1.267 | 0.058 | 0.893 | 0.021 |
| Press end                         | 0.440 | 0.000 | 0.517 | 0.029 | 0.483 | 0.015 | 0.563 | 0.181 |
| Post Juice Rack                   | 0.540 | 0.082 | 0.603 | 0.197 | 0.410 | 0.085 | 0.467 | 0.136 |

|                                   |          |         |          |         |          |         |          |         |
|-----------------------------------|----------|---------|----------|---------|----------|---------|----------|---------|
| After enzyme                      | 0.200    | 0.000   | 0.183    | 0.021   | 0.187    | 0.006   | 0.130    | 0.017   |
| Ferment Start                     | 0.197    | 0.015   | 0.210    | 0.026   | 0.163    | 0.006   | 0.117    | 0.015   |
| Bentonite                         | 0.710    | 0.075   | 0.717    | 0.117   | 0.697    | 0.055   | 0.627    | 0.025   |
| Ferment End                       | 0.920    | 0.080   | 0.933    | 0.076   | 1.020    | 0.072   | 0.957    | 0.059   |
| SO <sub>2</sub>                   | 1.133    | 0.058   | 1.023    | 0.068   | 1.233    | 0.058   | 1.133    | 0.058   |
| Post Cold Stab.                   | 1.500    | 0.100   | 1.500    | 0.173   | 1.867    | 0.058   | 1.567    | 0.252   |
| After Bottling                    | 1.467    | 0.058   | 1.467    | 0.058   | 1.600    | 0.100   | 1.700    | 0.000   |
| <b>Potassium (LOQ 1.00 mg/Kg)</b> |          |         |          |         |          |         |          |         |
| Press start                       | 597.071  | 25.062  | 678.090  | 12.469  | 595.305  | 13.670  | 623.700  | 12.128  |
| Press end                         | 1570.000 | 10.000  | 1653.333 | 5.774   | 1403.333 | 101.160 | 1696.667 | 115.902 |
| Post Juice Rack                   | 1146.667 | 40.415  | 932.667  | 118.728 | 1120.000 | 87.178  | 1080.000 | 17.321  |
| After enzyme                      | 1100.000 | 10.000  | 1203.333 | 32.146  | 1056.667 | 23.094  | 1073.333 | 46.188  |
| Ferment Start                     | 947.000  | 144.108 | 1016.667 | 41.633  | 1000.667 | 35.233  | 1024.333 | 55.194  |
| Bentonite                         | 906.000  | 31.097  | 1021.000 | 181.199 | 972.667  | 27.465  | 1036.667 | 28.868  |
| Ferment End                       | 378.333  | 6.658   | 392.000  | 29.462  | 383.333  | 45.884  | 394.000  | 11.136  |
| SO <sub>2</sub>                   | 732.333  | 16.166  | 404.333  | 50.063  | 727.667  | 38.940  | 480.000  | 65.000  |
| Post Cold Stab.                   | 637.667  | 14.844  | 632.000  | 20.075  | 630.333  | 10.786  | 656.333  | 33.650  |
| After Bottling                    | 581.000  | 15.716  | 597.000  | 7.937   | 586.333  | 14.468  | 567.667  | 23.965  |
| <b>Magnesium (LOQ 1.00 mg/Kg)</b> |          |         |          |         |          |         |          |         |
| Press start                       | 114.047  | 2.113   | 120.750  | 0.867   | 117.700  | 2.158   | 106.600  | 1.483   |
| Press end                         | 115.193  | 0.372   | 117.057  | 1.147   | 109.963  | 2.159   | 120.400  | 7.467   |
| Post Juice Rack                   | 116.153  | 0.300   | 116.457  | 0.356   | 112.683  | 3.846   | 105.970  | 2.156   |
| After enzyme                      | 108.473  | 0.560   | 107.203  | 1.353   | 107.517  | 2.403   | 104.790  | 2.440   |
| Ferment Start                     | 109.710  | 0.329   | 107.947  | 1.861   | 107.943  | 1.972   | 107.607  | 1.531   |
| Bentonite                         | 120.550  | 0.200   | 126.430  | 11.434  | 120.693  | 1.695   | 119.523  | 1.328   |
| Ferment End                       | 133.280  | 1.153   | 120.983  | 10.780  | 109.903  | 3.302   | 111.707  | 0.708   |
| SO <sub>2</sub>                   | 117.543  | 0.820   | 115.683  | 0.922   | 117.370  | 0.624   | 116.100  | 0.539   |
| Post Cold Stab.                   | 121.903  | 1.142   | 118.860  | 2.721   | 119.297  | 1.167   | 118.817  | 1.803   |
| After Bottling                    | 118.720  | 0.586   | 117.000  | 1.146   | 114.857  | 0.354   | 116.650  | 0.908   |
| <b>Manganese (LOQ 0.01 mg/Kg)</b> |          |         |          |         |          |         |          |         |

|                                |        |       |        |       |        |       |        |       |
|--------------------------------|--------|-------|--------|-------|--------|-------|--------|-------|
| Press start                    | 0.840  | 0.010 | 1.113  | 0.006 | 0.923  | 0.015 | 0.687  | 0.006 |
| Press end                      | 0.547  | 0.006 | 0.583  | 0.006 | 0.530  | 0.010 | 0.623  | 0.042 |
| Post Juice Rack                | 0.620  | 0.000 | 0.643  | 0.006 | 0.607  | 0.015 | 0.600  | 0.010 |
| After enzyme                   | 0.577  | 0.006 | 0.600  | 0.000 | 0.577  | 0.012 | 0.567  | 0.015 |
| Ferment Start                  | 0.573  | 0.006 | 0.593  | 0.006 | 0.577  | 0.006 | 0.580  | 0.010 |
| Bentonite                      | 0.610  | 0.000 | 0.670  | 0.052 | 0.603  | 0.006 | 0.610  | 0.000 |
| Ferment End                    | 0.627  | 0.006 | 0.667  | 0.015 | 0.613  | 0.021 | 0.637  | 0.012 |
| SO <sub>2</sub>                | 0.663  | 0.006 | 0.677  | 0.012 | 0.663  | 0.006 | 0.660  | 0.017 |
| Post Cold Stab.                | 0.627  | 0.006 | 0.643  | 0.012 | 0.620  | 0.010 | 0.620  | 0.010 |
| After Bottling                 | 0.617  | 0.012 | 0.627  | 0.006 | 0.597  | 0.006 | 0.600  | 0.000 |
| <b>Sodium (LOQ 1.00 mg/Kg)</b> |        |       |        |       |        |       |        |       |
| Press start                    | 27.977 | 0.990 | 32.537 | 3.071 | 30.723 | 1.972 | 56.610 | 1.596 |
| Press end                      | 26.293 | 0.099 | 28.300 | 4.632 | 24.650 | 0.383 | 40.583 | 2.559 |
| Post Juice Rack                | 19.923 | 0.558 | 19.967 | 0.155 | 19.720 | 0.798 | 18.200 | 0.333 |
| After enzyme                   | 18.583 | 0.536 | 18.113 | 0.122 | 18.743 | 0.528 | 18.017 | 0.396 |
| Ferment Start                  | 20.490 | 0.173 | 19.287 | 0.408 | 22.007 | 0.461 | 21.390 | 0.748 |
| Bentonite                      | 24.647 | 0.304 | 28.250 | 3.700 | 26.013 | 0.137 | 25.787 | 0.508 |
| Ferment End                    | 26.723 | 0.636 | 27.207 | 0.680 | 26.653 | 1.272 | 27.550 | 0.581 |
| SO <sub>2</sub>                | 28.493 | 0.597 | 31.390 | 2.160 | 29.267 | 0.720 | 28.660 | 0.220 |
| Post Cold Stab.                | 47.327 | 0.566 | 45.230 | 1.717 | 46.820 | 0.716 | 44.610 | 2.200 |
| After Bottling                 | 46.937 | 1.119 | 45.357 | 0.598 | 44.417 | 2.389 | 46.750 | 0.243 |
| <b>Nickel (LOQ 0.01 mg/Kg)</b> |        |       |        |       |        |       |        |       |
| Press start                    | 0.010  | 0.000 | 0.010  | 0.000 | 0.010  | 0.000 | 0.010  | 0.000 |
| Press end                      | 0.050  | 0.069 | 0.010  | 0.000 | 0.010  | 0.000 | 0.010  | 0.000 |
| Post Juice Rack                | 0.010  | 0.000 | 0.010  | 0.000 | 0.010  | 0.000 | 0.010  | 0.000 |
| After enzyme                   | 0.010  | 0.000 | 0.010  | 0.000 | 0.010  | 0.000 | 0.010  | 0.000 |
| Ferment Start                  | 0.010  | 0.000 | 0.010  | 0.000 | 0.010  | 0.000 | 0.010  | 0.000 |
| Bentonite                      | 0.010  | 0.000 | 0.013  | 0.006 | 0.017  | 0.012 | 0.010  | 0.000 |
| Ferment End                    | 0.013  | 0.006 | 0.013  | 0.006 | 0.010  | 0.000 | 0.010  | 0.000 |
| SO <sub>2</sub>                | 0.010  | 0.000 | 0.010  | 0.000 | 0.010  | 0.000 | 0.010  | 0.000 |
| Post Cold Stab.                | 0.010  | 0.000 | 0.013  | 0.006 | 0.010  | 0.000 | 0.010  | 0.000 |

|                              |       |       |       |       |       |       |       |       |
|------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| After Bottling               | 0.020 | 0.000 | 0.017 | 0.006 | 0.013 | 0.006 | 0.020 | 0.000 |
| <b>Tin (LOQ 0.002 mg/Kg)</b> |       |       |       |       |       |       |       |       |
| Press start                  | 0.003 | 0.001 | 0.004 | 0.002 | 0.002 | 0.000 | 0.006 | 0.006 |
| Press end                    | 0.005 | 0.002 | 0.003 | 0.001 | 0.006 | 0.003 | 0.003 | 0.000 |
| Post Juice Rack              | 0.003 | 0.001 | 0.009 | 0.002 | 0.003 | 0.001 | 0.002 | 0.001 |
| After enzyme                 | 0.005 | 0.005 | 0.002 | 0.000 | 0.002 | 0.000 | 0.003 | 0.001 |
| Ferment Start                | 0.002 | 0.000 | 0.003 | 0.001 | 0.003 | 0.001 | 0.003 | 0.002 |
| Bentonite                    | 0.002 | 0.001 | 0.002 | 0.001 | 0.002 | 0.000 | 0.002 | 0.000 |
| Ferment End                  | 0.003 | 0.001 | 0.002 | 0.000 | 0.004 | 0.003 | 0.002 | 0.000 |
| SO <sub>2</sub>              | 0.002 | 0.000 | 0.002 | 0.000 | 0.002 | 0.000 | 0.002 | 0.000 |
| Post Cold Stab.              | 0.002 | 0.000 | 0.002 | 0.000 | 0.002 | 0.000 | 0.002 | 0.000 |
| After Bottling               | 0.006 | 0.002 | 0.006 | 0.002 | 0.003 | 0.001 | 0.008 | 0.003 |
| <b>Zinc (LOQ 0.01 mg/Kg)</b> |       |       |       |       |       |       |       |       |
| Press start                  | 0.480 | 0.017 | 0.577 | 0.006 | 0.520 | 0.000 | 0.370 | 0.010 |
| Press end                    | 0.397 | 0.006 | 0.370 | 0.010 | 0.343 | 0.032 | 0.393 | 0.025 |
| Post Juice Rack              | 0.403 | 0.006 | 0.417 | 0.047 | 0.427 | 0.029 | 0.380 | 0.000 |
| After enzyme                 | 0.393 | 0.015 | 0.367 | 0.006 | 0.407 | 0.023 | 0.387 | 0.006 |
| Ferment Start                | 0.300 | 0.036 | 0.267 | 0.023 | 0.273 | 0.035 | 0.190 | 0.026 |
| Bentonite                    | 0.040 | 0.010 | 0.107 | 0.083 | 0.060 | 0.010 | 0.067 | 0.035 |
| Ferment End                  | 0.367 | 0.006 | 0.387 | 0.038 | 0.345 | 0.005 | 0.280 | 0.026 |
| SO <sub>2</sub>              | 0.437 | 0.021 | 0.450 | 0.053 | 0.440 | 0.000 | 0.440 | 0.079 |
| Post Cold Stab.              | 0.410 | 0.000 | 0.390 | 0.017 | 0.420 | 0.010 | 0.393 | 0.006 |
| After Bottling               | 0.467 | 0.032 | 0.430 | 0.010 | 0.437 | 0.031 | 0.447 | 0.015 |

<sup>1</sup>Element analysed using ICP-MS; <sup>2</sup> LOQ: limit of quantitation; <sup>3</sup>Analysis point during vinification; <sup>4</sup>Oxygen exposure regime; <sup>5</sup>STDEV: standard deviation.

**Table S2. Average and standard deviation (Stdev) values of the metal ion concentrations (mg/Kg) in juice and wine lees.**

|                                                           | <b>Inert – Reductive<sup>4</sup></b> |                          | <b>Inert - Oxidative</b> |              | <b>Aerobic - Reductive</b> |              | <b>Aerobic - Oxidative</b> |              |
|-----------------------------------------------------------|--------------------------------------|--------------------------|--------------------------|--------------|----------------------------|--------------|----------------------------|--------------|
| <b>Aluminium<sup>1</sup> (LOQ 5.00 mg/Kg)<sup>2</sup></b> | <b>Average</b>                       | <b>Stdev<sup>5</sup></b> | <b>Average</b>           | <b>Stdev</b> | <b>Average</b>             | <b>Stdev</b> | <b>Average</b>             | <b>Stdev</b> |
| Juice Lees <sup>3</sup>                                   | 237.84                               | 63.86                    | 198.67                   | 53.52        | 239.00                     | 36.50        | 228.23                     | 35.99        |
| Wine Lees                                                 | 462.79                               | 103.60                   | 348.58                   | 48.73        | 458.75                     | 86.92        | 351.44                     | 39.28        |
| <b>Calcium (LOQ 100 mg/Kg)</b>                            |                                      |                          |                          |              |                            |              |                            |              |
| Juice Lees                                                | 523.95                               | 94.72                    | 403.50                   | 84.90        | 483.91                     | 10.39        | 453.95                     | 84.57        |
| Wine Lees                                                 | 2551.34                              | 1215.37                  | 4157.32                  | 839.87       | 2793.52                    | 1406.12      | 2685.58                    | 1488.70      |
| <b>Cobalt (LOQ 0.05 mg/Kg)</b>                            |                                      |                          |                          |              |                            |              |                            |              |
| Juice Lees                                                | 0.08                                 | 0.02                     | 0.07                     | 0.02         | 0.09                       | 0.01         | 0.09                       | 0.02         |
| Wine Lees                                                 | 0.29                                 | 0.08                     | 0.24                     | 0.04         | 0.28                       | 0.06         | 0.26                       | 0.05         |
| <b>Chromium (LOQ 0.05 mg/Kg)</b>                          |                                      |                          |                          |              |                            |              |                            |              |
| Juice Lees                                                | 0.56                                 | 0.15                     | 0.45                     | 0.12         | 0.53                       | 0.09         | 0.55                       | 0.13         |
| Wine Lees                                                 | 0.41                                 | 0.02                     | 0.41                     | 0.02         | 0.40                       | 0.04         | 0.41                       | 0.04         |
| <b>Copper (LOQ 0.50 mg/Kg)</b>                            |                                      |                          |                          |              |                            |              |                            |              |
| Juice Lees                                                | 59.07                                | 14.68                    | 36.97                    | 8.39         | 30.81                      | 0.15         | 25.99                      | 1.13         |
| Wine Lees                                                 | 94.83                                | 8.07                     | 123.89                   | 18.26        | 207.06                     | 5.02         | 198.33                     | 18.40        |
| <b>Iron (LOQ 5.00 mg/Kg)</b>                              |                                      |                          |                          |              |                            |              |                            |              |
| Juice Lees                                                | 309.58                               | 67.12                    | 268.51                   | 67.05        | 320.20                     | 34.84        | 317.66                     | 48.08        |
| Wine Lees                                                 | 357.61                               | 47.50                    | 304.94                   | 38.75        | 325.34                     | 46.96        | 294.78                     | 65.60        |
| <b>Potassium (LOQ 50.0 mg/Kg)</b>                         |                                      |                          |                          |              |                            |              |                            |              |
| Juice Lees                                                | 21719.45                             | 11485.87                 | 16621.74                 | 11625.48     | 19640.77                   | 6482.17      | 24295.89                   | 2517.38      |
| Wine Lees                                                 | 19860.91                             | 5789.87                  | 32423.14                 | 13189.56     | 20496.99                   | 10933.66     | 17959.79                   | 11128.36     |
| <b>Magnesium (LOQ 50.0 mg/Kg)</b>                         |                                      |                          |                          |              |                            |              |                            |              |
| Juice Lees                                                | 290.67                               | 17.61                    | 242.48                   | 14.18        | 317.40                     | 36.60        | 181.19                     | 14.65        |
| Wine Lees                                                 | 496.02                               | 215.12                   | 354.83                   | 114.96       | 466.92                     | 168.79       | 494.85                     | 80.59        |
| <b>Manganese (LOQ 5.00 mg/Kg)</b>                         |                                      |                          |                          |              |                            |              |                            |              |
| Juice Lees                                                | 17.78                                | 3.05                     | 13.34                    | 3.21         | 15.99                      | 1.91         | 15.57                      | 1.93         |
| Wine Lees                                                 | 10.75                                | 1.22                     | 10.41                    | 1.66         | 10.33                      | 1.58         | 11.84                      | 1.06         |
| <b>Sodium (LOQ 50.0 mg/Kg)</b>                            |                                      |                          |                          |              |                            |              |                            |              |

|                                |       |       |       |       |       |       |       |       |
|--------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Juice Lees                     | 50.31 | 18.87 | 29.44 | 0.58  | 39.59 | 7.73  | 16.93 | 2.29  |
| Wine Lees                      | 65.46 | 59.29 | 31.90 | 14.56 | 68.61 | 46.50 | 46.17 | 18.87 |
| <b>Nickel (LOQ 0.50 mg/Kg)</b> |       |       |       |       |       |       |       |       |
| Juice Lees                     | 0.50  | 0.00  | 0.50  | 0.00  | 0.50  | 0.00  | 0.50  | 0.00  |
| Wine Lees                      | 0.74  | 0.14  | 0.57  | 0.07  | 0.69  | 0.11  | 0.62  | 0.08  |
| <b>Zinc (LOQ 0.50 mg/Kg)</b>   |       |       |       |       |       |       |       |       |
| Juice Lees                     | 3.84  | 0.86  | 2.45  | 0.35  | 3.55  | 0.31  | 3.01  | 0.90  |
| Wine Lees                      | 10.59 | 3.55  | 9.33  | 2.67  | 14.26 | 4.42  | 14.85 | 3.50  |

<sup>1</sup>Element analysed using ICP-MS; <sup>2</sup> LOQ: limit of quantitation; <sup>3</sup>Analysis point during vinification; <sup>4</sup>Oxygen exposure regime; <sup>5</sup>STDEV: standard deviation.

**Table S3a. Summary of the significant effects of oxygen exposure during pressing and handling on the metal ion concentrations in juice and wine supernatants.**

|                                   | Aluminium        |         | Calcium          |         | Cobalt           |         | Chromium         |         | Copper           |         | Iron             |         |
|-----------------------------------|------------------|---------|------------------|---------|------------------|---------|------------------|---------|------------------|---------|------------------|---------|
| Tukey's multiple comparisons test | Adjusted P Value |         | Adjusted P Value |         | Adjusted P Value |         | Adjusted P Value |         | Adjusted P Value |         | Adjusted P Value |         |
| <b>Press start</b>                |                  |         |                  |         |                  |         |                  |         |                  |         |                  |         |
| IR vs. IO <sup>1</sup>            | ****             | <0.0001 | ****             | <0.0001 | ****             | <0.0001 | ns               | 0.9997  | ns               | 0.9950  | ****             | <0.0001 |
| IR vs. AR                         | ****             | <0.0001 | ns               | 0.7766  | ns               | >0.9999 | ns               | 0.9798  | ns               | 0.3329  | **               | 0.0042  |
| IR vs. AO                         | ns               | 0.7221  | ****             | <0.0001 | ****             | <0.0001 | ns               | 0.8639  | *                | 0.0121  | ns               | 0.2825  |
| IO vs. AR                         | ***              | 0.0003  | ***              | 0.0004  | ****             | <0.0001 | ns               | 0.9913  | ns               | 0.2208  | ****             | <0.0001 |
| IO vs. AO                         | ****             | <0.0001 | ****             | <0.0001 | ****             | <0.0001 | ns               | 0.9039  | *                | 0.0240  | ****             | <0.0001 |
| AR vs. AO                         | ***              | 0.0002  | ****             | <0.0001 | ****             | <0.0001 | ns               | 0.9798  | ****             | <0.0001 | ****             | <0.0001 |
| <b>Press end</b>                  |                  |         |                  |         |                  |         |                  |         |                  |         |                  |         |
| IR vs. IO                         | ns               | 0.5415  | ns               | 0.8384  | ns               | >0.9999 | ns               | >0.9999 | ns               | 0.9950  | ns               | 0.6982  |
| IR vs. AR                         | ns               | 0.6148  | ns               | 0.1879  | ns               | >0.9999 | ns               | 0.9997  | ****             | <0.0001 | ns               | 0.9271  |
| IR vs. AO                         | ns               | 0.8736  | *                | 0.0274  | ns               | >0.9999 | ns               | 0.9997  | ***              | 0.0005  | ns               | 0.3054  |
| IO vs. AR                         | ns               | 0.9994  | *                | 0.0274  | ns               | >0.9999 | ns               | 0.9997  | ****             | <0.0001 | ns               | 0.9648  |
| IO vs. AO                         | ns               | 0.9372  | ns               | 0.1879  | ns               | >0.9999 | ns               | 0.9997  | **               | 0.0012  | ns               | 0.9110  |
| AR vs. AO                         | ns               | 0.9664  | ****             | <0.0001 | ns               | >0.9999 | ns               | >0.9999 | ****             | <0.0001 | ns               | 0.6693  |
| <b>Post Juice Rack</b>            |                  |         |                  |         |                  |         |                  |         |                  |         |                  |         |
| IR vs. IO                         | ns               | 0.6148  | ns               | 0.9994  | ns               | >0.9999 | ns               | 0.9997  | ns               | 0.9624  | ns               | 0.8057  |
| IR vs. AR                         | ns               | 0.3369  | ns               | 0.8911  | ns               | >0.9999 | ns               | 0.9913  | ****             | <0.0001 | ns               | 0.2607  |
| IR vs. AO                         | ns               | 0.9531  | ns               | 0.1485  | ns               | >0.9999 | ns               | 0.9974  | ****             | <0.0001 | ns               | 0.7264  |
| IO vs. AR                         | *                | 0.0237  | ns               | 0.9332  | ns               | >0.9999 | ns               | 0.9798  | ****             | <0.0001 | *                | 0.0370  |
| IO vs. AO                         | ns               | 0.3072  | ns               | 0.1879  | ns               | >0.9999 | ns               | 0.9913  | ****             | <0.0001 | ns               | 0.2204  |
| AR vs. AO                         | ns               | 0.6512  | ns               | 0.4854  | ns               | >0.9999 | ns               | 0.9997  | ns               | 0.9624  | ns               | 0.8525  |

|                        |    |         |      |         |      |         |      |         |      |         |      |         |
|------------------------|----|---------|------|---------|------|---------|------|---------|------|---------|------|---------|
| <b>After enzyme</b>    |    |         |      |         |      |         |      |         |      |         |      |         |
| IR vs. IO              | ns | >0.9999 | ns   | 0.9843  | ns   | >0.9999 | ns   | 0.9997  | **** | <0.0001 | ns   | 0.9953  |
| IR vs. AR              | ns | >0.9999 | ns   | >0.9999 | ns   | >0.9999 | ns   | 0.8639  | **** | <0.0001 | ns   | 0.9976  |
| IR vs. AO              | ns | >0.9999 | ns   | 0.4854  | **** | <0.0001 | ns   | 0.9997  | **** | <0.0001 | ns   | 0.7539  |
| IO vs. AR              | ns | >0.9999 | ns   | 0.9843  | ns   | >0.9999 | ns   | 0.8172  | *    | 0.0240  | ns   | >0.9999 |
| IO vs. AO              | ns | >0.9999 | ns   | 0.7078  | **** | <0.0001 | ns   | 0.9974  | ns   | 0.1378  | ns   | 0.8736  |
| AR vs. AO              | ns | >0.9999 | ns   | 0.4854  | **** | <0.0001 | ns   | 0.9039  | ns   | 0.8862  | ns   | 0.8525  |
| <b>Ferment Start</b>   |    |         |      |         |      |         |      |         |      |         |      |         |
| IR vs. IO              | ns | >0.9999 | ns   | >0.9999 | ns   | >0.9999 | ns   | 0.5875  | ns   | 0.1378  | ns   | 0.9976  |
| IR vs. AR              | ns | 0.9994  | ns   | 0.9994  | **   | 0.0026  | ns   | 0.9997  | *    | 0.0452  | ns   | 0.9648  |
| IR vs. AO              | ns | >0.9999 | ns   | 0.9952  | **** | <0.0001 | ns   | 0.9974  | **** | <0.0001 | ns   | 0.6693  |
| IO vs. AR              | ns | 0.9994  | ns   | 0.9994  | **   | 0.0026  | ns   | 0.5263  | **** | <0.0001 | ns   | 0.9110  |
| IO vs. AO              | ns | >0.9999 | ns   | 0.9952  | **** | <0.0001 | ns   | 0.7083  | **** | <0.0001 | ns   | 0.5506  |
| AR vs. AO              | ns | >0.9999 | ns   | 0.9994  | ns   | 0.2690  | ns   | 0.9913  | *    | 0.0452  | ns   | 0.9110  |
| <b>Bentonite</b>       |    |         |      |         |      |         |      |         |      |         |      |         |
| IR vs. IO              | ns | 0.9914  | **** | <0.0001 | ns   | 0.2690  | ns   | 0.9974  | **** | <0.0001 | ns   | 0.9997  |
| IR vs. AR              | ns | 0.5781  | ns   | 0.8911  | **   | 0.0026  | ns   | 0.9913  | **** | <0.0001 | ns   | 0.9976  |
| IR vs. AO              | *  | 0.0202  | ns   | >0.9999 | **   | 0.0026  | ns   | 0.9619  | **** | <0.0001 | ns   | 0.6399  |
| IO vs. AR              | ns | 0.4008  | **** | <0.0001 | ns   | 0.2690  | ns   | 0.9997  | ns   | 0.9624  | ns   | 0.9920  |
| IO vs. AO              | ** | 0.0088  | **** | <0.0001 | ns   | 0.2690  | ns   | 0.9913  | ns   | 0.7676  | ns   | 0.5804  |
| AR vs. AO              | ns | 0.3369  | ns   | 0.8911  | ns   | >0.9999 | ns   | 0.9974  | ns   | 0.4705  | ns   | 0.7539  |
| <b>Ferment End</b>     |    |         |      |         |      |         |      |         |      |         |      |         |
| IR vs. IO              | ns | 0.9664  | ns   | 0.9843  | ns   | 0.2690  | ns   | >0.9999 | **   | 0.0012  | ns   | 0.9976  |
| IR vs. AR              | ns | 0.5052  | ns   | 0.9641  | **   | 0.0026  | ns   | 0.9997  | **** | <0.0001 | ns   | 0.4917  |
| IR vs. AO              | ns | 0.9372  | ns   | 0.8911  | **   | 0.0026  | ns   | 0.9974  | **** | <0.0001 | ns   | 0.9540  |
| IO vs. AR              | ns | 0.7883  | ns   | 0.9994  | **** | <0.0001 | ns   | 0.9997  | ns   | 0.7676  | ns   | 0.6102  |
| IO vs. AO              | ns | 0.9994  | ns   | 0.9843  | **** | <0.0001 | ns   | 0.9974  | ns   | 0.4705  | ns   | 0.9874  |
| AR vs. AO              | ns | 0.8474  | ns   | 0.9952  | ns   | >0.9999 | ns   | 0.9997  | ns   | 0.9624  | ns   | 0.8057  |
| <b>SO<sub>2</sub></b>  |    |         |      |         |      |         |      |         |      |         |      |         |
| IR vs. IO              | ns | 0.3369  | ns   | 0.9994  | ns   | >0.9999 | ***  | 0.0008  | **** | <0.0001 | ns   | 0.4071  |
| IR vs. AR              | ns | 0.9994  | ns   | 0.9952  | ns   | >0.9999 | **** | 0.0002  | **** | <0.0001 | ns   | 0.4917  |
| IR vs. AO              | ns | 0.7559  | ns   | 0.3479  | ns   | 0.2690  | **** | <0.0001 | **** | <0.0001 | ns   | >0.9999 |
| IO vs. AR              | ns | 0.2791  | ns   | 0.9994  | ns   | >0.9999 | ns   | 0.9798  | ns   | 0.9624  | *    | 0.0196  |
| IO vs. AO              | ns | 0.8974  | ns   | 0.4143  | ns   | 0.2690  | ns   | 0.1490  | ns   | 0.8862  | ns   | 0.4071  |
| AR vs. AO              | ns | 0.6871  | ns   | 0.4854  | ns   | 0.2690  | ns   | 0.3041  | ns   | 0.9950  | ns   | 0.4917  |
| <b>Post Cold Stab.</b> |    |         |      |         |      |         |      |         |      |         |      |         |
| IR vs. IO              | ns | 0.6871  | ns   | 0.9641  | ns   | >0.9999 | *    | 0.0134  | **   | 0.0012  | ns   | >0.9999 |
| IR vs. AR              | ns | 0.9770  | ns   | 0.8384  | ns   | >0.9999 | ***  | 0.0004  | **** | <0.0001 | **** | <0.0001 |
| IR vs. AO              | ns | 0.6871  | ns   | 0.5596  | ns   | >0.9999 | **** | <0.0001 | ns   | 0.0811  | ns   | 0.7804  |
| IO vs. AR              | ns | 0.4346  | ns   | 0.5596  | ns   | >0.9999 | ns   | 0.7083  | ns   | 0.8862  | **** | <0.0001 |
| IO vs. AO              | ns | >0.9999 | ns   | 0.2877  | ns   | >0.9999 | *    | 0.0495  | ns   | 0.4705  | ns   | 0.7804  |

|                       |    |         |    |        |    |         |      |         |     |         |     |         |
|-----------------------|----|---------|----|--------|----|---------|------|---------|-----|---------|-----|---------|
| AR vs. AO             | ns | 0.4346  | ns | 0.9641 | ns | >0.9999 | ns   | 0.4087  | ns  | 0.1378  | *** | 0.0003  |
| <b>After Bottling</b> |    |         |    |        |    |         |      |         |     |         |     |         |
| IR vs. IO             | ns | >0.9999 | ns | 0.9641 | ns | >0.9999 | **   | 0.0016  | *** | 0.0005  | ns  | >0.9999 |
| IR vs. AR             | ns | 0.9372  | ns | 0.8384 | ns | 0.2690  | **** | <0.0001 | *** | 0.0002  | ns  | 0.2400  |
| IR vs. AO             | ns | 0.8188  | ns | 0.9843 | ns | >0.9999 | ***  | 0.0001  | *** | 0.0002  | **  | 0.0075  |
| IO vs. AR             | ns | 0.9372  | ns | 0.5596 | ns | 0.2690  | ns   | 0.1217  | ns  | 0.9950  | ns  | 0.2400  |
| IO vs. AO             | ns | 0.8188  | ns | 0.8384 | ns | >0.9999 | ns   | 0.9039  | ns  | 0.9950  | **  | 0.0075  |
| AR vs. AO             | ns | 0.4695  | ns | 0.9641 | ns | 0.2690  | ns   | 0.4087  | ns  | >0.9999 | ns  | 0.4917  |

<sup>1</sup> The four combinations of oxygen exposure regimes during pressing and handling: inert-reductive (IR), inert-oxidative (IO), aerobic-reductive (AR), and aerobic-oxidative (AO).

**Table S3b. Summary of the significant effects of oxygen exposure during pressing and handling on the metal ion concentrations in juice and wine supernatants.**

|                                   | Potassium        |         | Magnesium        |         | Manganese        |         | Sodium           |         | Tin              |         | Zinc             |         |
|-----------------------------------|------------------|---------|------------------|---------|------------------|---------|------------------|---------|------------------|---------|------------------|---------|
| Tukey's multiple comparisons test | Adjusted P Value |         | Adjusted P Value |         | Adjusted P Value |         | Adjusted P Value |         | Adjusted P Value |         | Adjusted P Value |         |
| <b>Press start</b>                |                  |         |                  |         |                  |         |                  |         |                  |         |                  |         |
| IR vs. IO <sup>1</sup>            | ns               | 0.3069  | ns               | 0.0534  | ****             | <0.0001 | **               | 0.0016  | ns               | 0.7443  | ***              | 0.0005  |
| IR vs. AR                         | ns               | >0.9999 | ns               | 0.4936  | ****             | <0.0001 | ns               | 0.1088  | ns               | 0.9577  | ns               | 0.3243  |
| IR vs. AO                         | ns               | 0.9396  | *                | 0.0254  | ****             | <0.0001 | ****             | <0.0001 | ns               | 0.1135  | ****             | <0.0001 |
| IO vs. AR                         | ns               | 0.2884  | ns               | 0.6402  | ****             | <0.0001 | ns               | 0.4351  | ns               | 0.4339  | ns               | 0.0805  |
| IO vs. AO                         | ns               | 0.6459  | ****             | <0.0001 | ****             | <0.0001 | ****             | <0.0001 | ns               | 0.5897  | ****             | <0.0001 |
| AR vs. AO                         | ns               | 0.9280  | ***              | 0.0003  | ****             | <0.0001 | ****             | <0.0001 | *                | 0.0339  | ****             | <0.0001 |
| <b>Press end</b>                  |                  |         |                  |         |                  |         |                  |         |                  |         |                  |         |
| IR vs. IO                         | ns               | 0.2827  | ns               | 0.8881  | *                | 0.0106  | ns               | 0.3444  | ns               | 0.4339  | ns               | 0.6653  |
| IR vs. AR                         | **               | 0.0031  | ns               | 0.1871  | ns               | 0.4709  | ns               | 0.5214  | ns               | 0.9577  | ns               | 0.1108  |
| IR vs. AO                         | *                | 0.0382  | ns               | 0.1903  | ****             | <0.0001 | ****             | <0.0001 | ns               | 0.4339  | ns               | 0.9990  |
| IO vs. AR                         | ****             | <0.0001 | *                | 0.0365  | ****             | <0.0001 | *                | 0.0164  | ns               | 0.1897  | ns               | 0.6653  |
| IO vs. AO                         | ns               | 0.7867  | ns               | 0.5686  | **               | 0.0044  | ****             | <0.0001 | ns               | >0.9999 | ns               | 0.7506  |
| AR vs. AO                         | ****             | <0.0001 | ***              | 0.0007  | ****             | <0.0001 | ****             | <0.0001 | ns               | 0.1897  | ns               | 0.1495  |
| <b>Post Juice Rack</b>            |                  |         |                  |         |                  |         |                  |         |                  |         |                  |         |
| IR vs. IO                         | ****             | <0.0001 | ns               | 0.9994  | ns               | 0.1845  | ns               | >0.9999 | ****             | <0.0001 | ns               | 0.9405  |
| IR vs. AR                         | ns               | 0.9393  | ns               | 0.5378  | ns               | 0.6524  | ns               | 0.9983  | ns               | >0.9999 | ns               | 0.7506  |
| IR vs. AO                         | ns               | 0.4803  | ***              | 0.0010  | ns               | 0.3086  | ns               | 0.4802  | ns               | 0.9943  | ns               | 0.7506  |
| IO vs. AR                         | ***              | 0.0007  | ns               | 0.4652  | *                | 0.0106  | ns               | 0.9969  | ****             | <0.0001 | ns               | 0.9735  |
| IO vs. AO                         | *                | 0.0112  | ***              | 0.0006  | **               | 0.0017  | ns               | 0.4583  | ****             | <0.0001 | ns               | 0.4019  |
| AR vs. AO                         | ns               | 0.8242  | ns               | 0.0529  | ns               | 0.9375  | ns               | 0.5861  | ns               | 0.9943  | ns               | 0.1977  |
| <b>After enzyme</b>               |                  |         |                  |         |                  |         |                  |         |                  |         |                  |         |
| IR vs. IO                         | ns               | 0.1247  | ns               | 0.9607  | ns               | 0.1845  | ns               | 0.9794  | ns               | 0.1897  | ns               | 0.6653  |
| IR vs. AR                         | ns               | 0.7867  | ns               | 0.9825  | ns               | >0.9999 | ns               | 0.9991  | ns               | 0.1897  | ns               | 0.9405  |

|                        |      |         |      |         |      |         |    |         |    |         |      |         |
|------------------------|------|---------|------|---------|------|---------|----|---------|----|---------|------|---------|
| IR vs. AO              | ns   | 0.9393  | ns   | 0.4865  | ns   | 0.8195  | ns | 0.9649  | ns | 0.4339  | ns   | 0.9918  |
| IO vs. AR              | *    | 0.0117  | ns   | 0.9994  | ns   | 0.1845  | ns | 0.9527  | ns | >0.9999 | ns   | 0.3243  |
| IO vs. AO              | *    | 0.0317  | ns   | 0.7862  | *    | 0.0241  | ns | 0.9998  | ns | 0.9577  | ns   | 0.8274  |
| AR vs. AO              | ns   | 0.9840  | ns   | 0.7168  | ns   | 0.8195  | ns | 0.9299  | ns | 0.9577  | ns   | 0.8274  |
| <b>Ferment Start</b>   |      |         |      |         |      |         |    |         |    |         |      |         |
| IR vs. IO              | ns   | 0.4413  | ns   | 0.9032  | ns   | 0.3086  | ns | 0.7478  | ns | 0.8733  | ns   | 0.4867  |
| IR vs. AR              | ns   | 0.6556  | ns   | 0.9027  | ns   | 0.9914  | ns | 0.5878  | ns | 0.8733  | ns   | 0.6653  |
| IR vs. AO              | ns   | 0.3479  | ns   | 0.8473  | ns   | 0.9375  | ns | 0.8762  | ns | 0.7443  | **** | <0.0001 |
| IO vs. AR              | ns   | 0.9858  | ns   | >0.9999 | ns   | 0.4709  | ns | 0.1142  | ns | >0.9999 | ns   | 0.9918  |
| IO vs. AO              | ns   | 0.9984  | ns   | 0.9992  | ns   | 0.6524  | ns | 0.3031  | ns | 0.9943  | **   | 0.0082  |
| AR vs. AO              | ns   | 0.9565  | ns   | 0.9992  | ns   | 0.9914  | ns | 0.9555  | ns | 0.9943  | **   | 0.0034  |
| <b>Bentonite</b>       |      |         |      |         |      |         |    |         |    |         |      |         |
| IR vs. IO              | ns   | 0.0710  | ns   | 0.1118  | **** | <0.0001 | *  | 0.0182  | ns | >0.9999 | *    | 0.0277  |
| IR vs. AR              | ns   | 0.4803  | ns   | >0.9999 | ns   | 0.9375  | ns | 0.6662  | ns | 0.9943  | ns   | 0.8274  |
| IR vs. AO              | *    | 0.0305  | ns   | 0.9785  | ns   | >0.9999 | ns | 0.7776  | ns | 0.9943  | ns   | 0.6653  |
| IO vs. AR              | ns   | 0.7255  | ns   | 0.1260  | **** | <0.0001 | ns | 0.2512  | ns | 0.9943  | ns   | 0.1977  |
| IO vs. AO              | ns   | 0.9866  | *    | 0.0439  | **** | <0.0001 | ns | 0.1772  | ns | 0.9943  | ns   | 0.3243  |
| AR vs. AO              | ns   | 0.5158  | ns   | 0.9688  | ns   | 0.9375  | ns | 0.9976  | ns | >0.9999 | ns   | 0.9918  |
| <b>Ferment End</b>     |      |         |      |         |      |         |    |         |    |         |      |         |
| IR vs. IO              | ns   | 0.9910  | **** | <0.0001 | **   | 0.0044  | ns | 0.9777  | ns | 0.9577  | ns   | 0.8274  |
| IR vs. AR              | ns   | 0.9995  | **** | <0.0001 | ns   | 0.6524  | ns | >0.9999 | ns | 0.8733  | ns   | 0.7903  |
| IR vs. AO              | ns   | 0.9866  | **** | <0.0001 | ns   | 0.8195  | ns | 0.9009  | ns | 0.9577  | **   | 0.0021  |
| IO vs. AR              | ns   | 0.9977  | ***  | 0.0003  | **** | <0.0001 | ns | 0.9672  | ns | 0.5897  | ns   | 0.2889  |
| IO vs. AO              | ns   | >0.9999 | **   | 0.0031  | ns   | 0.0512  | ns | 0.9918  | ns | >0.9999 | ***  | 0.0001  |
| AR vs. AO              | ns   | 0.9957  | ns   | 0.8973  | ns   | 0.1845  | ns | 0.8774  | ns | 0.5897  | *    | 0.0334  |
| <b>SO<sub>2</sub></b>  |      |         |      |         |      |         |    |         |    |         |      |         |
| IR vs. IO              | **** | <0.0001 | ns   | 0.8886  | ns   | 0.6524  | ns | 0.0823  | ns | >0.9999 | ns   | 0.9405  |
| IR vs. AR              | ns   | 0.9996  | ns   | 0.9999  | ns   | >0.9999 | ns | 0.9170  | ns | >0.9999 | ns   | 0.9990  |
| IR vs. AO              | **** | <0.0001 | ns   | 0.9438  | ns   | 0.9914  | ns | 0.9990  | ns | >0.9999 | ns   | 0.9990  |
| IO vs. AR              | **** | <0.0001 | ns   | 0.9140  | ns   | 0.6524  | ns | 0.2949  | ns | >0.9999 | ns   | 0.9735  |
| IO vs. AO              | ns   | 0.3673  | ns   | 0.9985  | ns   | 0.4709  | ns | 0.1122  | ns | >0.9999 | ns   | 0.9735  |
| AR vs. AO              | **** | <0.0001 | ns   | 0.9607  | ns   | 0.9914  | ns | 0.9575  | ns | >0.9999 | ns   | >0.9999 |
| <b>Post Cold Stab.</b> |      |         |      |         |      |         |    |         |    |         |      |         |
| IR vs. IO              | ns   | 0.9993  | ns   | 0.6418  | ns   | 0.4709  | ns | 0.3059  | ns | >0.9999 | ns   | 0.8274  |
| IR vs. AR              | ns   | 0.9986  | ns   | 0.7441  | ns   | 0.9375  | ns | 0.9745  | ns | >0.9999 | ns   | 0.9735  |
| IR vs. AO              | ns   | 0.9778  | ns   | 0.6313  | ns   | 0.9375  | ns | 0.1149  | ns | >0.9999 | ns   | 0.8916  |
| IO vs. AR              | ns   | >0.9999 | ns   | 0.9983  | ns   | 0.1845  | ns | 0.5493  | ns | >0.9999 | ns   | 0.5758  |
| IO vs. AO              | ns   | 0.9529  | ns   | >0.9999 | ns   | 0.1845  | ns | 0.9548  | ns | >0.9999 | ns   | 0.9990  |
| AR vs. AO              | ns   | 0.9434  | ns   | 0.9977  | ns   | >0.9999 | ns | 0.2611  | ns | >0.9999 | ns   | 0.6653  |
| <b>After Bottling</b>  |      |         |      |         |      |         |    |         |    |         |      |         |
| IR vs. IO              | ns   | 0.9858  | ns   | 0.9094  | ns   | 0.8195  | ns | 0.5545  | ns | 0.9577  | ns   | 0.4019  |

|           |    |        |    |        |    |        |    |        |    |        |    |        |
|-----------|----|--------|----|--------|----|--------|----|--------|----|--------|----|--------|
| IR vs. AR | ns | 0.9995 | ns | 0.4443 | ns | 0.3086 | ns | 0.1614 | ns | 0.2969 | ns | 0.5758 |
| IR vs. AO | ns | 0.9917 | ns | 0.8533 | ns | 0.4709 | ns | 0.9986 | ns | 0.4339 | ns | 0.8274 |
| IO vs. AR | ns | 0.9957 | ns | 0.8399 | ns | 0.0512 | ns | 0.8615 | ns | 0.1135 | ns | 0.9918 |
| IO vs. AO | ns | 0.9213 | ns | 0.9991 | ns | 0.1011 | ns | 0.6524 | ns | 0.7443 | ns | 0.8916 |
| AR vs. AO | ns | 0.9778 | ns | 0.8988 | ns | 0.9914 | ns | 0.2175 | ** | 0.0082 | ns | 0.9735 |

<sup>1</sup> The four combinations of oxygen exposure regimes during pressing and handling: inert-reductive (IR), inert-oxidative (IO), aerobic-reductive (AR), and aerobic-oxidative (AO).

**Table S4a. Summary of the significant effects of oxygen exposure during pressing and handling on the metal ion concentrations in juice and wine supernatant.**

|                                                   | Aluminium        |         | Calcium          |         | Cobalt           |         | Chromium         |         | Copper           |         | Iron             |         |
|---------------------------------------------------|------------------|---------|------------------|---------|------------------|---------|------------------|---------|------------------|---------|------------------|---------|
| Tukey's multiple comparisons test                 | Adjusted P Value |         | Adjusted P Value |         | Adjusted P Value |         | Adjusted P Value |         | Adjusted P Value |         | Adjusted P Value |         |
| <b>Press conditions: Inert - Aerobic</b>          |                  |         |                  |         |                  |         |                  |         |                  |         |                  |         |
| Press start                                       | ns               | 0.7149  | ***              | 0.0002  | ****             | <0.0001 | ns               | 0.9992  | ns               | >0.9999 | *                | 0.0299  |
| Press end                                         | ns               | >0.9999 | ns               | >0.9999 | ns               | >0.9999 | ns               | >0.9999 | ns               | 0.9992  | ns               | 0.9997  |
| Post Juice Rack                                   | ns               | 0.6503  | ns               | 0.8692  | ns               | >0.9999 | ns               | >0.9999 | ns               | 0.9979  | ns               | 0.5711  |
| After enzyme                                      | ns               | >0.9999 | ns               | 0.9999  | ns               | 0.0541  | ns               | 0.9996  | ns               | 0.9999  | ns               | >0.9999 |
| Ferment Start                                     | ns               | >0.9999 | ns               | >0.9999 | ****             | <0.0001 | ns               | 0.9983  | ns               | >0.9999 | ns               | 0.9944  |
| Bentonite                                         | ns               | 0.2653  | ns               | 0.1316  | ns               | 0.0541  | ns               | >0.9999 | ns               | >0.9999 | ns               | 0.9990  |
| Ferment End                                       | ns               | 0.9981  | ns               | >0.9999 | ****             | <0.0001 | ns               | >0.9999 | ns               | >0.9999 | ns               | 0.9955  |
| SO <sub>2</sub> and rack                          | ns               | >0.9999 | ns               | 0.9923  | ns               | 0.9859  | **               | 0.0011  | ns               | >0.9999 | ns               | 0.8418  |
| Post Cold Stab                                    | ns               | >0.9999 | ns               | 0.8975  | ns               | >0.9999 | ***              | 0.0005  | *                | 0.0340  | *                | 0.0500  |
| After Bottling                                    | ns               | >0.9999 | ns               | 0.9955  | ns               | 0.9859  | ***              | 0.0007  | ns               | >0.9999 | ns               | 0.7409  |
| <b>Handling conditions: Reductive - Oxidative</b> |                  |         |                  |         |                  |         |                  |         |                  |         |                  |         |
| Press start                                       | ns               | 0.0988  | ns               | >0.9999 | ns               | >0.9999 | ns               | >0.9999 | ns               | >0.9999 | ns               | 0.8999  |
| Press end                                         | ns               | >0.9999 | ns               | 0.1035  | ns               | >0.9999 | ns               | >0.9999 | ns               | >0.9999 | ns               | 0.9835  |
| Post Juice Rack                                   | ns               | 0.9414  | ns               | 0.9987  | ns               | >0.9999 | ns               | >0.9999 | ns               | >0.9999 | ns               | 0.9979  |
| After enzyme                                      | ns               | >0.9999 | ns               | 0.9956  | ns               | 0.3226  | ns               | >0.9999 | ns               | >0.9999 | ns               | >0.9999 |
| Ferment Start                                     | ns               | >0.9999 | ns               | >0.9999 | ns               | 0.9987  | ns               | 0.9937  | ns               | >0.9999 | ns               | >0.9999 |
| Bentonite                                         | ns               | 0.9990  | ns               | 0.2001  | ns               | 0.9987  | ns               | >0.9999 | ns               | >0.9999 | ns               | >0.9999 |
| Ferment End                                       | ns               | >0.9999 | ns               | >0.9999 | ns               | 0.9987  | ns               | >0.9999 | ns               | >0.9999 | ns               | >0.9999 |
| SO <sub>2</sub>                                   | ns               | 0.8554  | ns               | 0.9987  | ns               | 0.9987  | *                | 0.0224  | ns               | >0.9999 | ns               | 0.8905  |
| Post Cold Stab                                    | ns               | 0.8980  | ns               | >0.9999 | ns               | >0.9999 | ns               | 0.1164  | *                | 0.0289  | ns               | 0.5021  |
| After Bottling                                    | ns               | 0.9985  | ns               | >0.9999 | ns               | 0.9987  | ns               | 0.9215  | ns               | >0.9999 | ns               | 0.8110  |

**Table S4b. Summary of the significant effects of oxygen exposure during pressing and handling on the metal ion concentrations in juice and wine supernatant.**

|                                                   | Potassium        |         | Magnesium        |         | Manganese        |         | Sodium           |         | Tin              |         | Zinc             |         |
|---------------------------------------------------|------------------|---------|------------------|---------|------------------|---------|------------------|---------|------------------|---------|------------------|---------|
| Tukey's multiple comparisons test                 | Adjusted P Value |         | Adjusted P Value |         | Adjusted P Value |         | Adjusted P Value |         | Adjusted P Value |         | Adjusted P Value |         |
| <b>Press conditions: Inert - Aerobic</b>          |                  |         |                  |         |                  |         |                  |         |                  |         |                  |         |
| Press start                                       | ns               | 0.9998  | ns               | 0.2567  | ****             | <0.0001 | ****             | <0.0001 | ns               | >0.9999 | ns               | 0.0740  |
| Press end                                         | ns               | 0.9237  | ns               | >0.9999 | ns               | >0.9999 | ns               | 0.3185  | ns               | >0.9999 | ns               | >0.9999 |
| Post Juice Rack                                   | ns               | 0.9332  | *                | 0.0176  | ns               | 0.9744  | ns               | 0.9999  | *                | 0.0280  | ns               | >0.9999 |
| After enzyme                                      | ns               | 0.6131  | ns               | 0.9994  | ns               | 0.9996  | ns               | >0.9999 | ns               | 0.9886  | ns               | 0.9999  |
| Ferment Start                                     | ns               | 0.9996  | ns               | >0.9999 | ns               | >0.9999 | ns               | 0.9915  | ns               | 0.9996  | ns               | 0.6300  |
| Bentonite                                         | ns               | 0.9956  | ns               | 0.8179  | ns               | 0.9265  | ns               | 0.9977  | ns               | >0.9999 | ns               | >0.9999 |
| Ferment End                                       | ns               | >0.9999 | ****             | <0.0001 | ns               | 0.9966  | ns               | >0.9999 | ns               | >0.9999 | ns               | >0.9999 |
| SO <sub>2</sub>                                   | ns               | 0.8287  | ns               | >0.9999 | ns               | >0.9999 | ns               | >0.9999 | ns               | >0.9999 | ns               | >0.9999 |
| Post Cold Stab                                    | ns               | >0.9999 | ns               | 0.9998  | ns               | 0.9999  | ns               | >0.9999 | ns               | >0.9999 | ns               | >0.9999 |
| After Bottling                                    | ns               | >0.9999 | ns               | 0.9933  | ns               | 0.9939  | ns               | >0.9999 | ns               | >0.9999 | ns               | >0.9999 |
| <b>Handling conditions: Reductive - Oxidative</b> |                  |         |                  |         |                  |         |                  |         |                  |         |                  |         |
| Press start                                       | ns               | 0.8218  | ns               | 0.9976  | ns               | >0.9999 | ****             | <0.0001 | ns               | 0.1418  | ns               | 0.9912  |
| Press end                                         | ****             | <0.0001 | ns               | 0.2953  | ns               | 0.3526  | ***              | 0.0006  | ns               | 0.2090  | ns               | >0.9999 |
| Post Juice Rack                                   | *                | 0.0137  | ns               | 0.9590  | ns               | >0.9999 | ns               | >0.9999 | *                | 0.0372  | ns               | 0.9998  |
| After enzyme                                      | ns               | 0.7313  | ns               | 0.9994  | ns               | >0.9999 | ns               | >0.9999 | ns               | 0.9805  | ns               | 0.9969  |
| Ferment Start                                     | ns               | 0.9261  | ns               | >0.9999 | ns               | >0.9999 | ns               | >0.9999 | ns               | 0.9992  | ns               | 0.4322  |
| Bentonite                                         | ns               | 0.2028  | ns               | 0.9956  | ns               | 0.9695  | ns               | 0.8929  | ns               | >0.9999 | ns               | 0.9221  |
| Ferment End                                       | ns               | >0.9999 | ns               | 0.5432  | ns               | 0.9786  | ns               | >0.9999 | ns               | 0.9449  | ns               | 0.0748  |
| SO <sub>2</sub>                                   | ****             | <0.0001 | ns               | 0.9994  | ns               | >0.9999 | ns               | 0.8092  | ns               | >0.9999 | ns               | >0.9999 |
| Post Cold Stab                                    | ns               | >0.9999 | ns               | 0.9997  | ns               | >0.9999 | ns               | 0.9893  | ns               | >0.9999 | ns               | 0.9969  |
| After Bottling                                    | ns               | >0.9999 | ns               | >0.9999 | ns               | >0.9999 | ns               | >0.9999 | ns               | 0.1418  | ns               | >0.9999 |

Table S5a. Summary of the significant effects of oxygen exposure during pressing and handling on the metal ion concentrations in juice and wine lees.

|                                   | Aluminium        | Calcium          | Cobalt           | Chromium         | Copper           | Iron             |
|-----------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| Tukey's multiple comparisons test | Adjusted P Value | Adjusted P Value | Adjusted P Value | Adjusted P Value | Adjusted P Value | Adjusted P Value |
| Juice Lees                        |                  |                  |                  |                  |                  |                  |

|                        |    |         |    |         |    |         |    |        |    |        |    |         |
|------------------------|----|---------|----|---------|----|---------|----|--------|----|--------|----|---------|
| IR vs. IO <sup>1</sup> | ns | 0.8706  | ns | 0.9983  | ns | 0.9897  | ns | 0.4953 | ns | 0.1252 | ns | 0.7828  |
| IR vs. AR              | ns | >0.9999 | ns | >0.9999 | ns | 0.9998  | ns | 0.9831 | *  | 0.0366 | ns | 0.9947  |
| IR vs. AO              | ns | 0.9976  | ns | 0.9997  | ns | 0.9995  | ns | 0.9996 | *  | 0.0132 | ns | 0.9976  |
| IO vs. AR              | ns | 0.8607  | ns | 0.9995  | ns | 0.9800  | ns | 0.7091 | ns | 0.9108 | ns | 0.6439  |
| IO vs. AO              | ns | 0.9383  | ns | 0.9999  | ns | 0.9753  | ns | 0.5553 | ns | 0.6513 | ns | 0.6784  |
| AR vs. AO              | ns | 0.9966  | ns | >0.9999 | ns | >0.9999 | ns | 0.9936 | ns | 0.9544 | ns | >0.9999 |

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|                  |    |         |    |        |    |        |    |         |      |         |    |        |
|------------------|----|---------|----|--------|----|--------|----|---------|------|---------|----|--------|
| <b>Wine Lees</b> |    |         |    |        |    |        |    |         |      |         |    |        |
| IR vs. IO        | ns | 0.1601  | ns | 0.1657 | ns | 0.4128 | ns | >0.9999 | *    | 0.0310  | ns | 0.6305 |
| IR vs. AR        | ns | 0.9998  | ns | 0.9869 | ns | 0.9945 | ns | 0.9972  | **** | <0.0001 | ns | 0.8793 |
| IR vs. AO        | ns | 0.1757  | ns | 0.9977 | ns | 0.8013 | ns | >0.9999 | **** | <0.0001 | ns | 0.4932 |
| IO vs. AR        | ns | 0.1824  | ns | 0.2801 | ns | 0.5518 | ns | 0.9990  | **** | <0.0001 | ns | 0.9650 |
| IO vs. AO        | ns | >0.9999 | ns | 0.2234 | ns | 0.9030 | ns | >0.9999 | **** | <0.0001 | ns | 0.9954 |
| AR vs. AO        | ns | 0.1997  | ns | 0.9988 | ns | 0.9103 | ns | 0.9982  | ns   | 0.7876  | ns | 0.8951 |

<sup>1</sup> The four combinations of oxygen exposure regimes during pressing and handling: inert-reductive (IR), inert-oxidative (IO), aerobic-reductive (AR), and aerobic-oxidative (AO).

**Table S5b. Summary of the significant effects of oxygen exposure during pressing and handling on the metal ion concentrations in juice and wine lees.**

|                                   | Potassium        |        | Magnesium        |         | Manganese        |         | Sodium           |        | Nickel           |         | Zinc             |        |
|-----------------------------------|------------------|--------|------------------|---------|------------------|---------|------------------|--------|------------------|---------|------------------|--------|
| Tukey's multiple comparisons test | Adjusted P Value |        | Adjusted P Value |         | Adjusted P Value |         | Adjusted P Value |        | Adjusted P Value |         | Adjusted P Value |        |
| Juice Lees                        |                  |        |                  |         |                  |         |                  |        |                  |         |                  |        |
| IR vs. IO <sup>1</sup>            | ns               | 0.9182 | ns               | 0.9486  | ns               | 0.0807  | ns               | 0.8124 | ns               | >0.9999 | ns               | 0.9091 |
| IR vs. AR                         | ns               | 0.9936 | ns               | 0.9904  | ns               | 0.7227  | ns               | 0.9677 | ns               | >0.9999 | ns               | 0.9990 |
| IR vs. AO                         | ns               | 0.9880 | ns               | 0.6233  | ns               | 0.5789  | ns               | 0.5078 | ns               | >0.9999 | ns               | 0.9784 |
| IO vs. AR                         | ns               | 0.9810 | ns               | 0.8370  | ns               | 0.4299  | ns               | 0.9724 | ns               | >0.9999 | ns               | 0.9522 |
| IO vs. AO                         | ns               | 0.7733 | ns               | 0.9019  | ns               | 0.5690  | ns               | 0.9503 | ns               | >0.9999 | ns               | 0.9929 |
| AR vs. AO                         | ns               | 0.9359 | ns               | 0.4500  | ns               | 0.9947  | ns               | 0.7727 | ns               | >0.9999 | ns               | 0.9940 |
|                                   |                  |        |                  |         |                  |         |                  |        |                  |         |                  |        |
| Wine Lees                         |                  |        |                  |         |                  |         |                  |        |                  |         |                  |        |
| IR vs. IO                         | ns               | 0.4210 | ns               | 0.4199  | ns               | 0.9971  | ns               | 0.5034 | *                | 0.0479  | ns               | 0.9313 |
| IR vs. AR                         | ns               | 0.9998 | ns               | 0.9878  | ns               | 0.9947  | ns               | 0.9991 | ns               | 0.7867  | ns               | 0.3362 |
| IR vs. AO                         | ns               | 0.9951 | ns               | >0.9999 | ns               | 0.9165  | ns               | 0.8449 | ns               | 0.1920  | ns               | 0.2214 |
| IO vs. AR                         | ns               | 0.4645 | ns               | 0.6060  | ns               | >0.9999 | ns               | 0.4289 | ns               | 0.2479  | ns               | 0.1306 |
| IO vs. AO                         | ns               | 0.3048 | ns               | 0.4269  | ns               | 0.8343  | ns               | 0.9289 | ns               | 0.8651  | ns               | 0.0789 |
| AR vs. AO                         | ns               | 0.9885 | ns               | 0.9891  | ns               | 0.8114  | ns               | 0.7778 | ns               | 0.6507  | ns               | 0.9920 |

<sup>1</sup> The four combinations of oxygen exposure regimes during pressing and handling: inert-reductive (IR), inert-oxidative (IO), aerobic-reductive (AR), and aerobic-oxidative (AO).

Table S6a. Summary of the significant effects of oxygen exposure during pressing and handling on the metal ion concentrations in juice and wine lees.

|                                            | Aluminium        |        | Calcium          |         | Cobalt           |        | Chromium         |        | Copper           |         | Iron             |        |
|--------------------------------------------|------------------|--------|------------------|---------|------------------|--------|------------------|--------|------------------|---------|------------------|--------|
| Sidak's multiple comparisons test          | Adjusted P Value |        | Adjusted P Value |         | Adjusted P Value |        | Adjusted P Value |        | Adjusted P Value |         | Adjusted P Value |        |
| Press conditions: Inert - Aerobic          |                  |        |                  |         |                  |        |                  |        |                  |         |                  |        |
| Juice Lees                                 | ns               | 0.9185 | ns               | >0.9999 | ns               | 0.9242 | ns               | 0.7287 | ns               | 0.0596  | ns               | 0.5507 |
| Wine Lees                                  | ns               | 0.9999 | ns               | 0.4490  | ns               | 0.9407 | ns               | 0.9907 | ****             | <0.0001 | ns               | 0.7362 |
| Handling conditions: Reductive - Oxidative |                  |        |                  |         |                  |        |                  |        |                  |         |                  |        |
| Juice Lees                                 | ns               | 0.7047 | ns               | 0.9870  | ns               | 0.9721 | ns               | 0.6276 | ns               | 0.8051  | ns               | 0.7122 |
| Wine Lees                                  | **               | 0.0061 | ns               | 0.3014  | ns               | 0.1852 | ns               | 0.9957 | ns               | 0.8831  | ns               | 0.3099 |

Table S6b. Summary of the significant effects of oxygen exposure during pressing and handling on the metal ion concentrations in juice and wine lees.

|                                            | Potassium        |        | Magnesium        |        | Manganese        |        | Sodium           |        | Nickel           |         | Zinc             |        |
|--------------------------------------------|------------------|--------|------------------|--------|------------------|--------|------------------|--------|------------------|---------|------------------|--------|
| Sidak's multiple comparisons test          | Adjusted P Value |        | Adjusted P Value |        | Adjusted P Value |        | Adjusted P Value |        | Adjusted P Value |         | Adjusted P Value |        |
| Press conditions: Inert - Aerobic          |                  |        |                  |        |                  |        |                  |        |                  |         |                  |        |
| Juice Lees                                 | ns               | 0.8555 | ns               | 0.9575 | ns               | 0.9824 | ns               | 0.7505 | ns               | >0.9999 | ns               | 0.9940 |
| Wine Lees                                  | ns               | 0.4033 | ns               | 0.6465 | ns               | 0.9114 | ns               | 0.8500 | ns               | 0.9937  | **               | 0.0064 |
|                                            |                  |        |                  |        |                  |        |                  |        |                  |         |                  |        |
| Handling conditions: Reductive - Oxidative |                  |        |                  |        |                  |        |                  |        |                  |         |                  |        |
| Juice Lees                                 | ns               | 0.9991 | ns               | 0.2817 | ns               | 0.1073 | ns               | 0.3120 | ns               | >0.9999 | ns               | 0.8196 |
| Wine Lees                                  | ns               | 0.6263 | ns               | 0.6053 | ns               | 0.8614 | ns               | 0.1579 | *                | 0.0120  | ns               | 0.9763 |