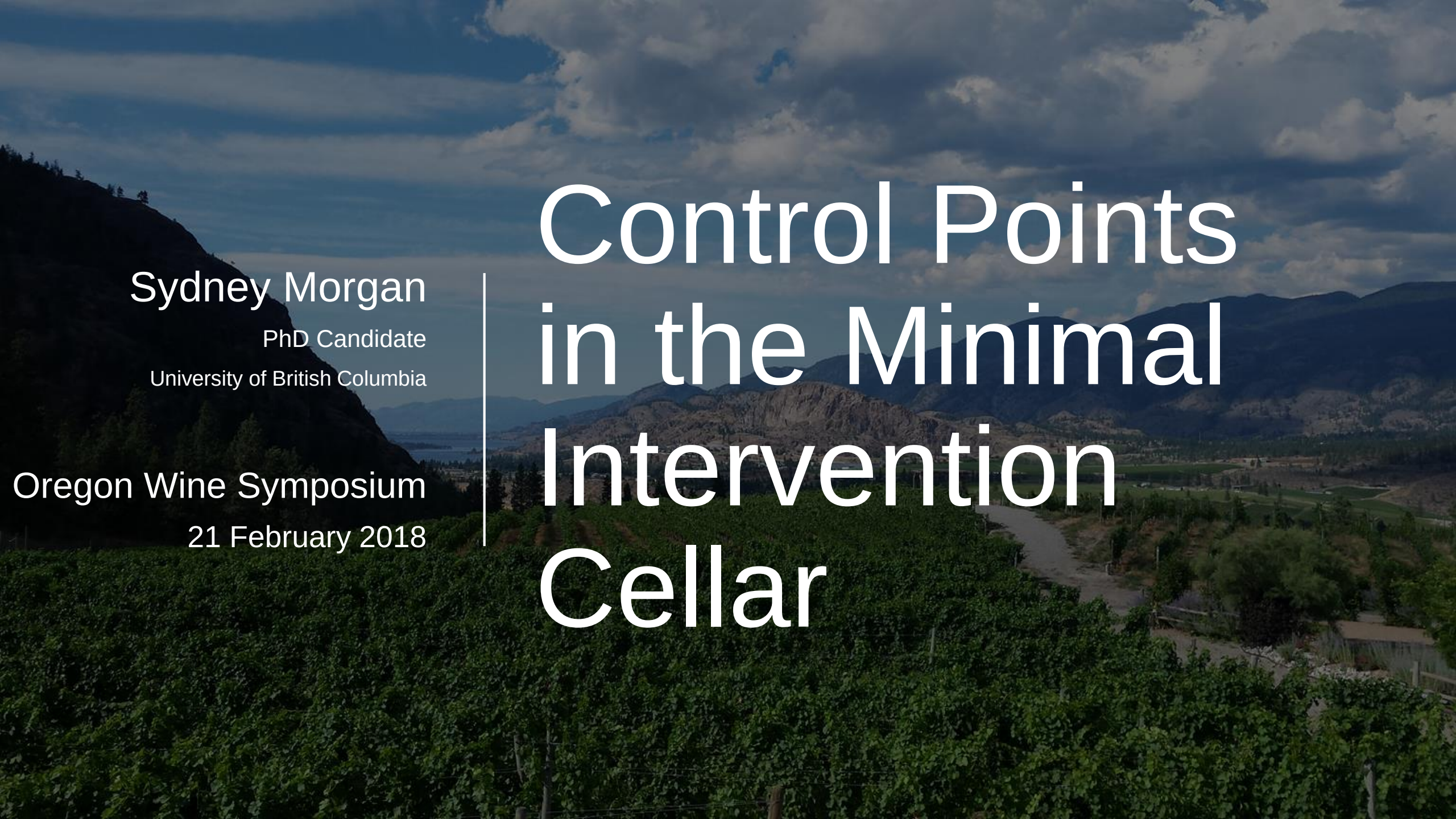


Control Points in the Minimal Intervention Cellar

Sydney Morgan

PhD Candidate

University of British Columbia

Oregon Wine Symposium

21 February 2018

Control Point: Crush

- Focus of my research is on decisions that winemakers can make at crush that will influence:
  - Which yeasts conduct the fermentations
  - The sensory profile of the finished wines
- Will be looking at three factors:
  - Uninoculated fermentations
  - Sulfur dioxide additions at crush
  - *Pied de cuve* inoculations

Uninoculated Fermentations

Goals (inoculated fermentations):

- Consistent finished product
- Decreased risk of stuck of sluggish fermentation

Goals (uninoculated fermentations):

- Increase yeast species and strain diversity during fermentation
- Introduce indigenous yeasts (expression of *terroir*)
- Improve wine complexity

Sulfur Dioxide Additions

Goals (adding SO_2):

- Antioxidant activity (prevent browning reactions)
- Antimicrobial activity
  - Remove potential spoilage bacteria + yeasts coming in from vineyard

Goals (not adding SO_2):

- Increase yeast species and strain diversity during fermentation
- Introduce indigenous yeasts (expression of *terroir*)
- Desired flavour profile

Pied de Cuve Inoculations

Definitions:

1. **Using vineyard-specific yeasts to initiate fermentation**
2. Using lees from previous fermentations as the starter culture

Goals:

- Increase indigenous yeast presence in fermentation (expression of *terroir*)
- Increase yeast species and strain diversity and improve complexity

Study Sites

Cedar Creek Estate Winery

2014 Vintage

Pinot gris (single vineyard)

Mission Hill Family Estate Winery

2015 Vintage

Chardonnay (single vineyard)

Cedar Creek (2014) Experimental Design

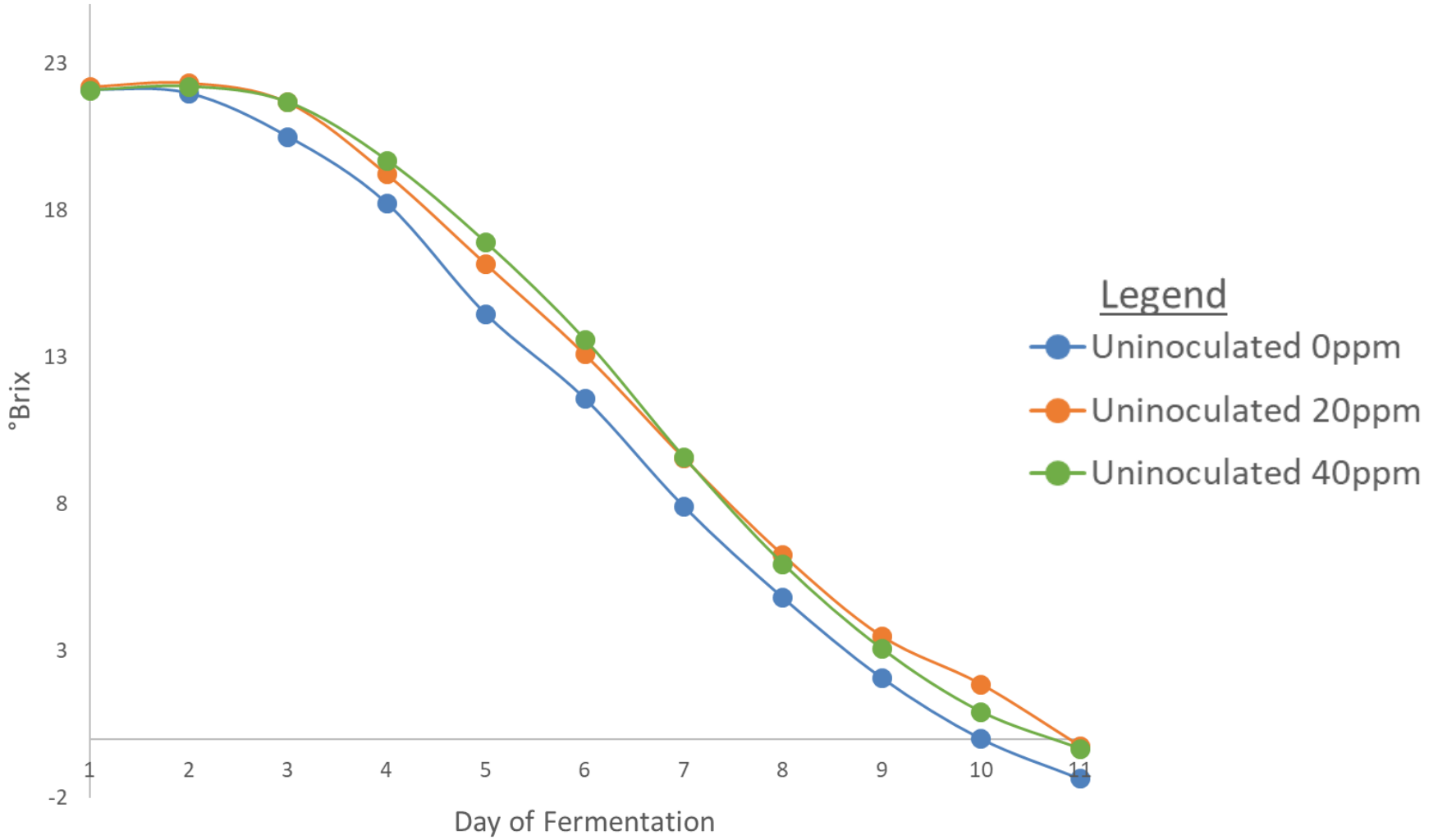
Pinot gris
(Single vineyard)

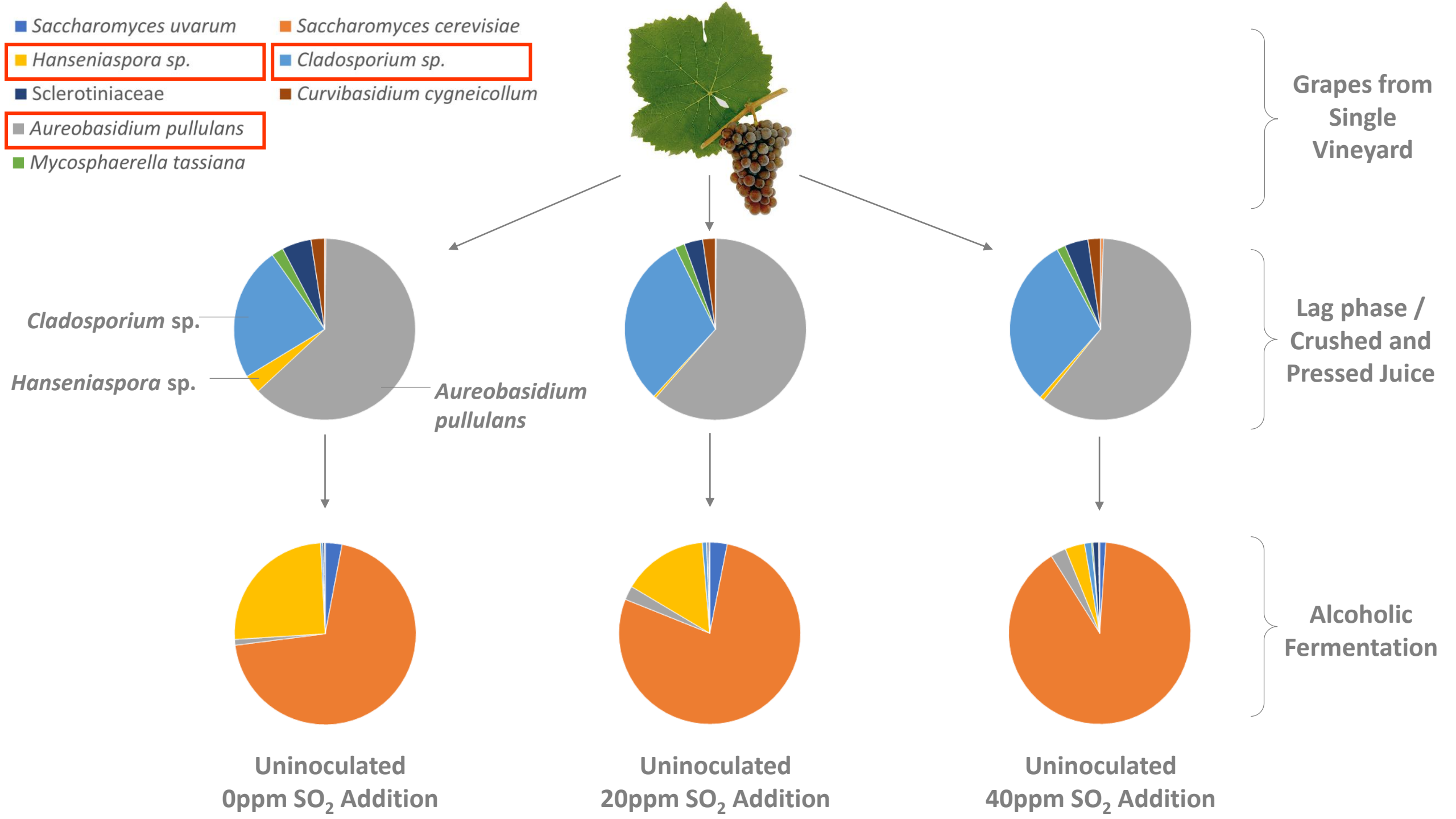
Uninoculated
0ppm SO_2 Addition
(at crush)

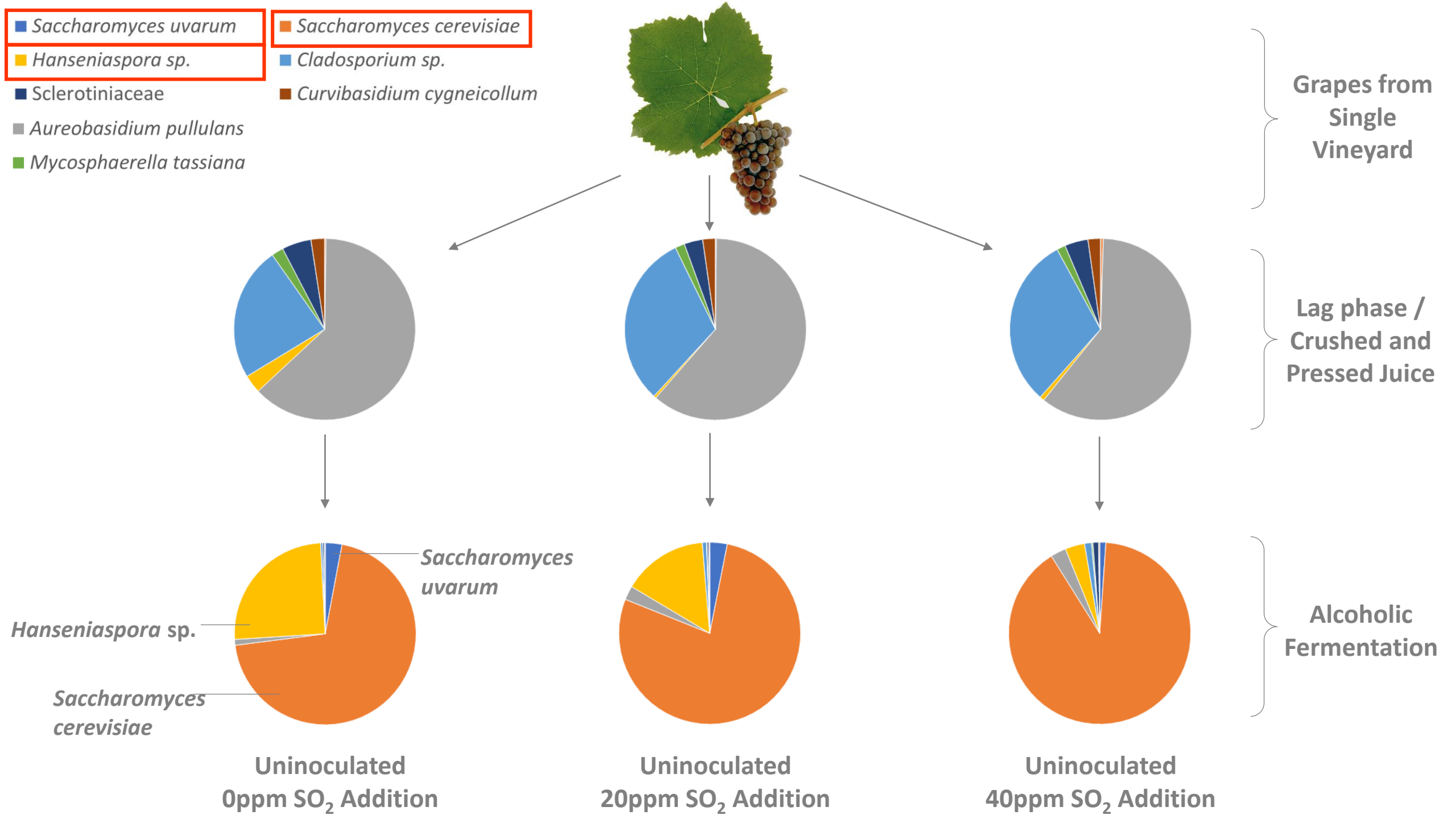
Uninoculated
20ppm SO_2 Addition
(at crush)

Uninoculated
40ppm SO_2 Addition
(at crush)

Fermentation Progression




Saccharomyces uvarum
Saccharomyces cerevisiae
Hanseniaspora sp.
Cladosporium sp.
Sclerotiniaceae
Curvibasidium cygneicollum
Aureobasidium pullulans
Mycosphaerella tassiana
Grapes from Single Vineyard
Cladosporium sp.
Hanseniaspora sp.
Aureobasidium pullulans
Lag phase / Crushed and Pressed Juice
Alcoholic Fermentation
Uninoculated 0ppm SO2 Addition
Uninoculated 20ppm SO2 Addition
Uninoculated 40ppm SO2 Addition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Alcoholic Fermentation
Saccharomyces uvarum
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Uninoculated 0ppm SO2 Addition
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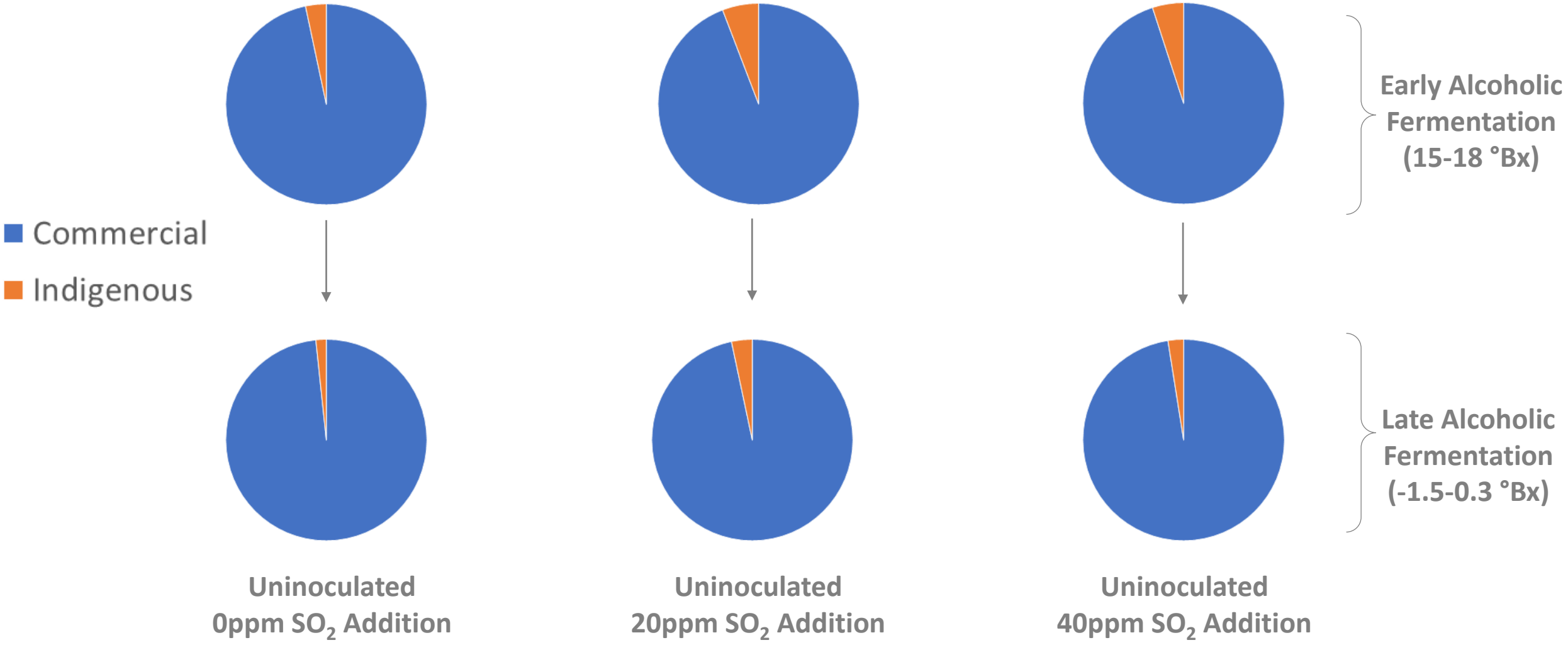
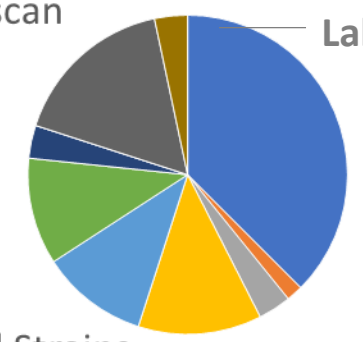
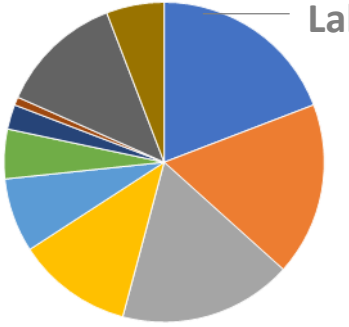
Saccharomyces cerevisiae strains

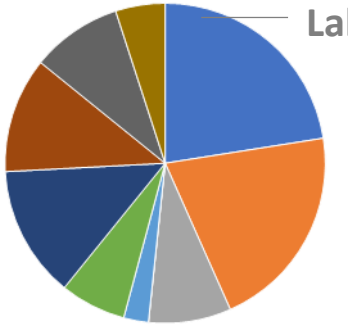


Saccharomyces cerevisiae strains

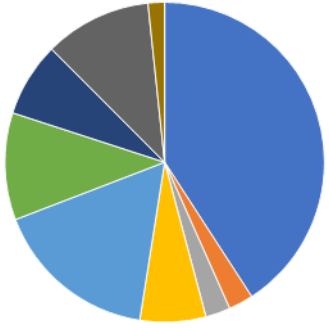
- Lallemand DV10
- Lalvin K1
- Enoferm Syrah
- Premium Supertuscan
- Vitilevure 3001
- Lalvin CY3079
- Lalvin RC212
- Lallemand D47
- Minor Commercial Strains
- Indigenous Strains

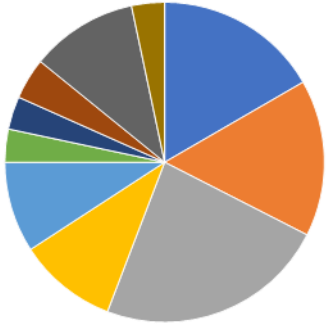


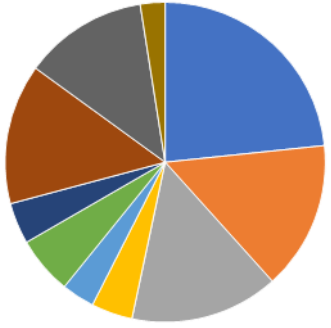




Early Alcoholic Fermentation (15-18 °Bx)







Late Alcoholic Fermentation (-1.5-0.3 °Bx)

Uninoculated 0ppm SO_2 Addition

Uninoculated 20ppm SO_2 Addition

Uninoculated 40ppm SO_2 Addition

Saccharomyces cerevisiae strains

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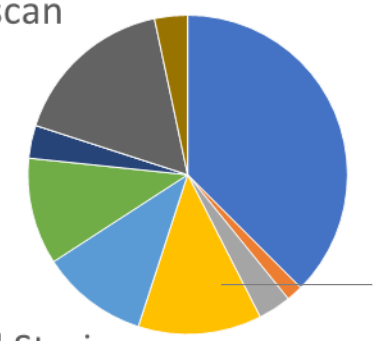
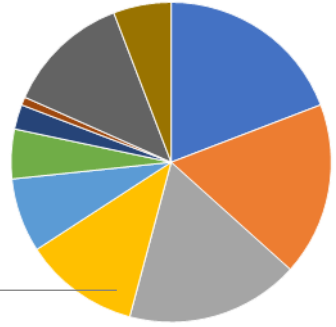
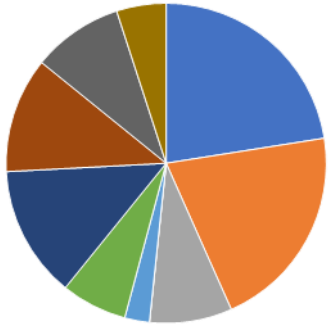
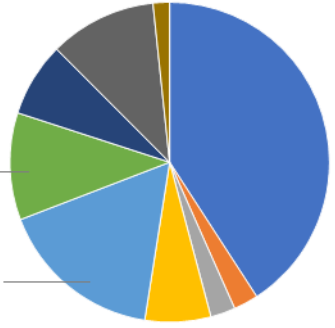




Premium Supertuscan

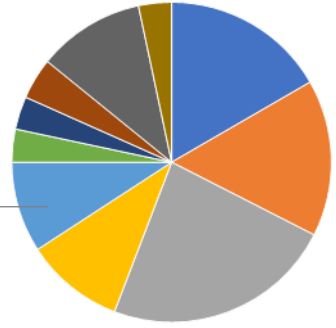


Early Alcoholic Fermentation (15-18 °Bx)

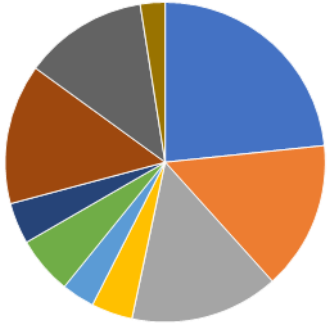


Lalvin CY3079

Vitilevure 3001



Vitilevure 3001



Late Alcoholic Fermentation (-1.5-0.3 °Bx)

Uninoculated 0ppm SO_2 Addition

Uninoculated 20ppm SO_2 Addition

Uninoculated 40ppm SO_2 Addition

Saccharomyces cerevisiae strains

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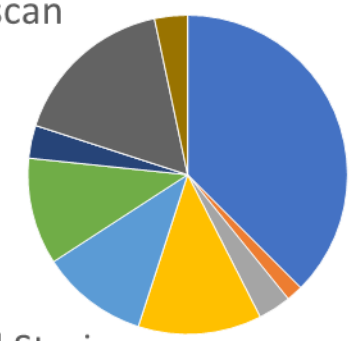
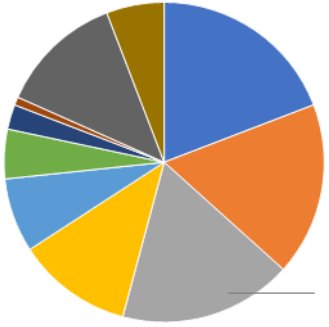
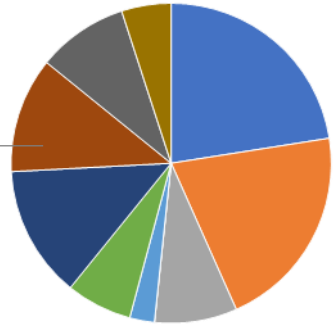
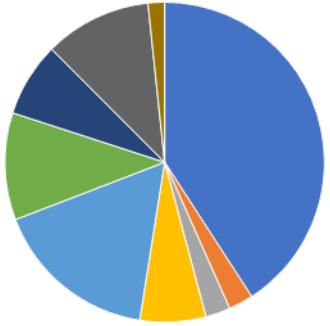
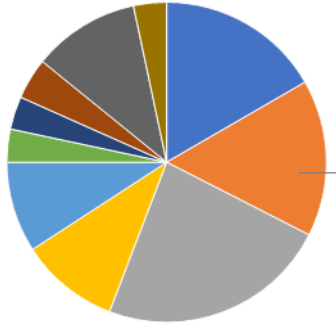


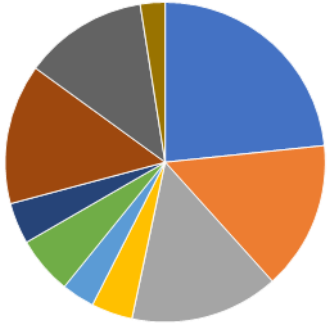




Early Alcoholic Fermentation (15-18 °Bx)







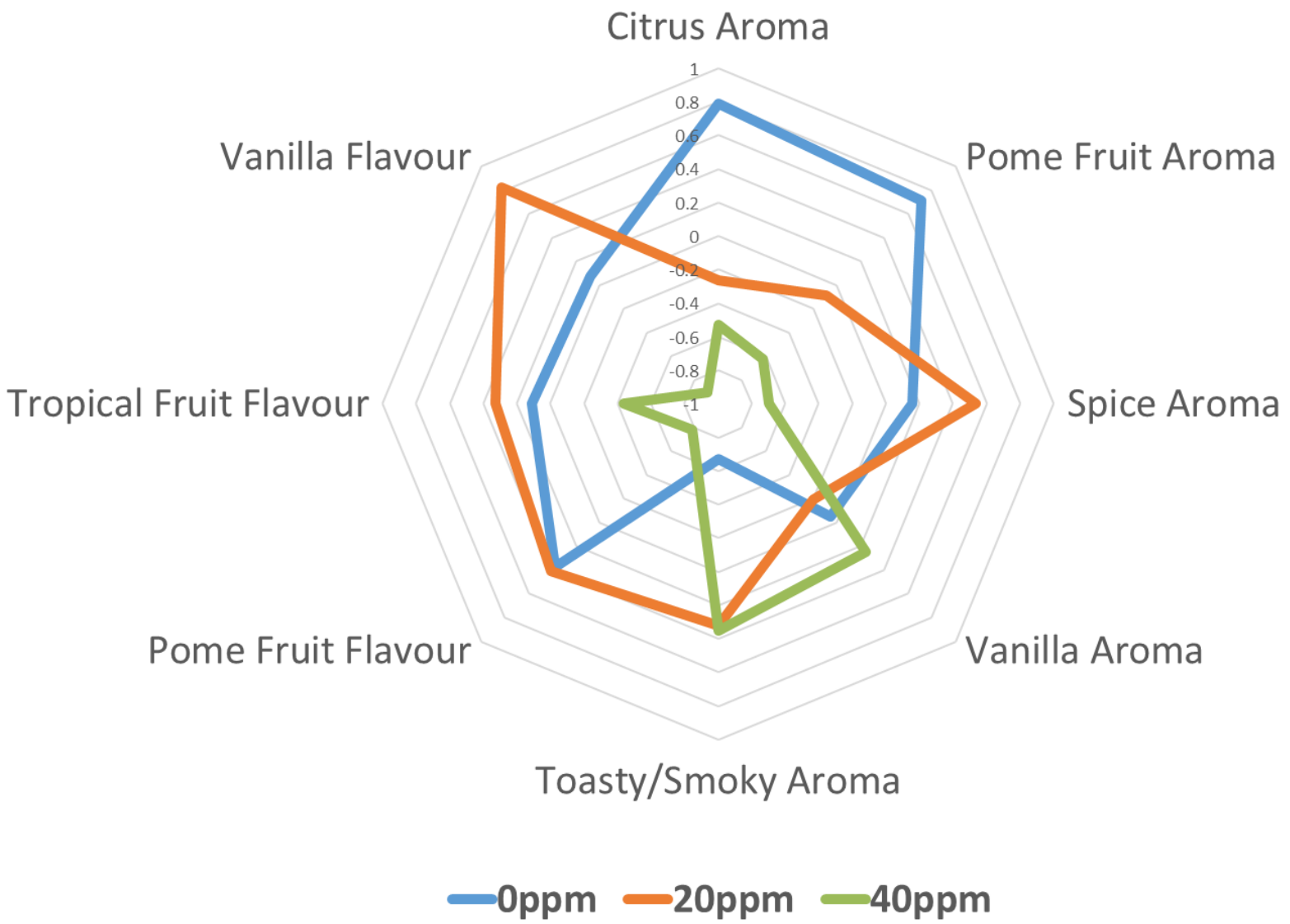
Late Alcoholic Fermentation (-1.5-0.3 °Bx)

Uninoculated 0ppm SO_2 Addition

Uninoculated 20ppm SO_2 Addition

Uninoculated 40ppm SO_2 Addition

Wine Sensory Profiles



CRUSH / LAG PHASE	0 PPM SO_2	20 PPM SO_2	40 PPM SO_2
Temperature (°C)	14.0	13.9	13.9
pH	3.3	3.3	3.3
Residual Sugar (°Bx)	22.5	22.6	22.6
YAN	242	235	216
Volatile Acidity (g/L)	0.1	0.1	0.1
Total Acidity (g/L)	7.3	7.3	7.2
Malic Acid (g/L)	2.7	2.7	2.6

END OF FERMENTATION	0 PPM SO_2	20 PPM SO_2	40 PPM SO_2
Temperature (°C)	18.4	18.7	18.9
pH	3.0	3.0	3.0
Residual Sugar (°Bx)	-1.0	-0.2	-0.2
Volatile Acidity (g/L)	0.2	0.3	0.2
Total Acidity (g/L)	7.7	8.1	8.0
Malic Acid (g/L)	1.6	1.8	1.8
Ethanol Content (%)	12.1	11.7	12.0

*YAN measured as alpha amino (mg/L) + ammonia (mg/L)

Mission Hill (2015) Experimental Design

Chardonnay
(Single Vineyard)

***Pied de cuve* inoculum**
(500mL per barrel)

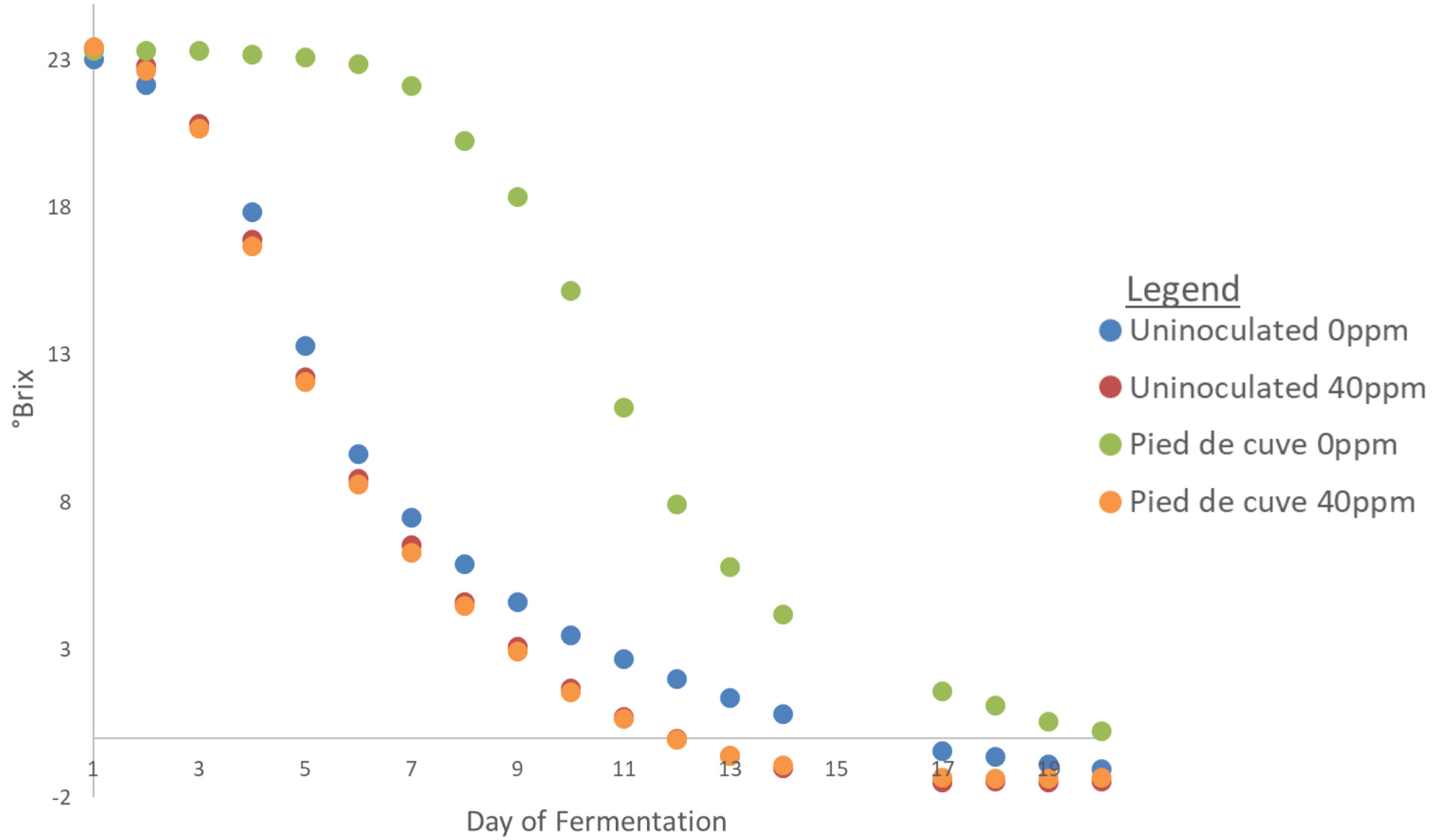
Uninoculated
0ppm SO_2 Addition
(at crush)

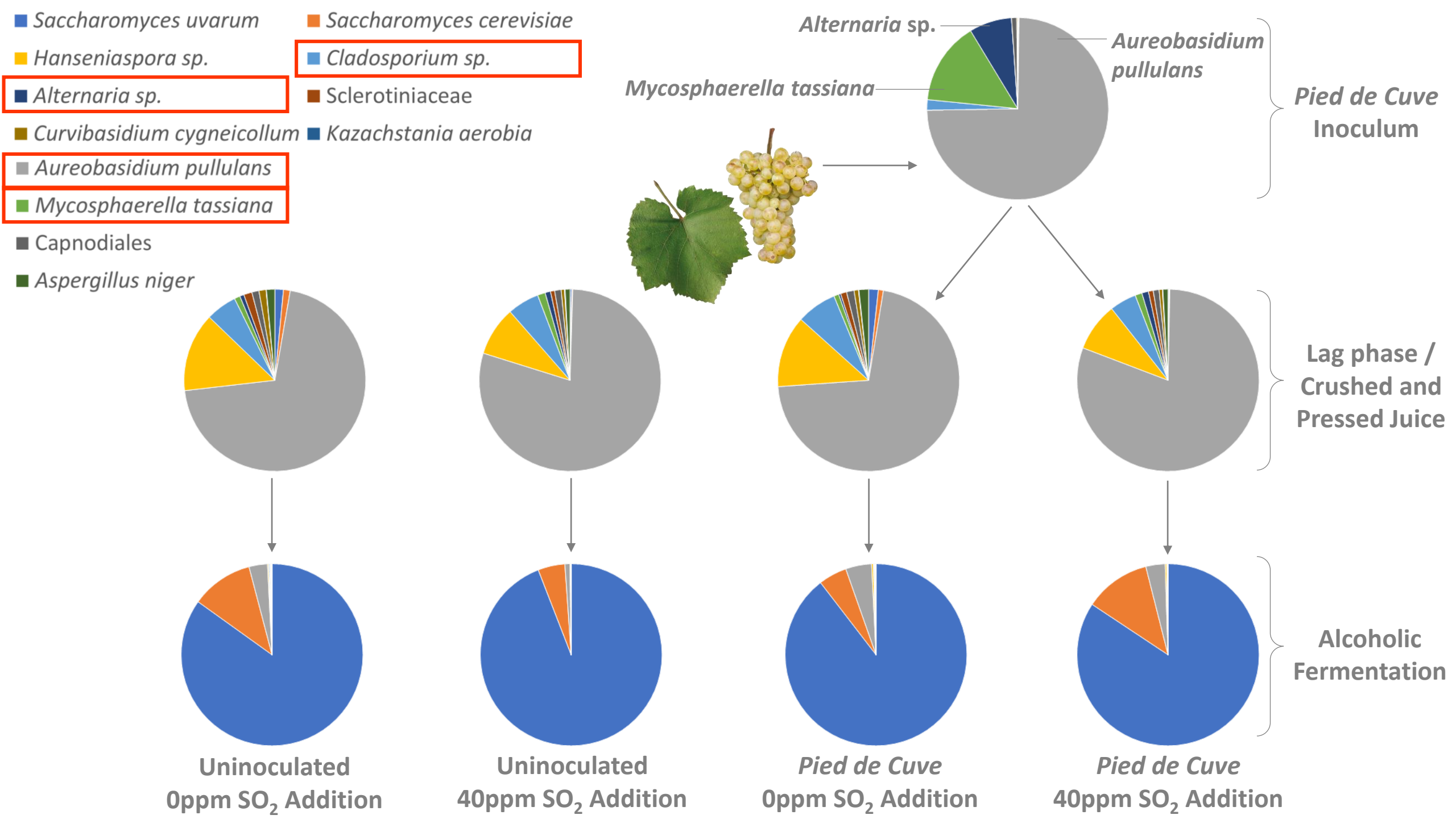
Uninoculated
40ppm SO_2 Addition
(at crush)

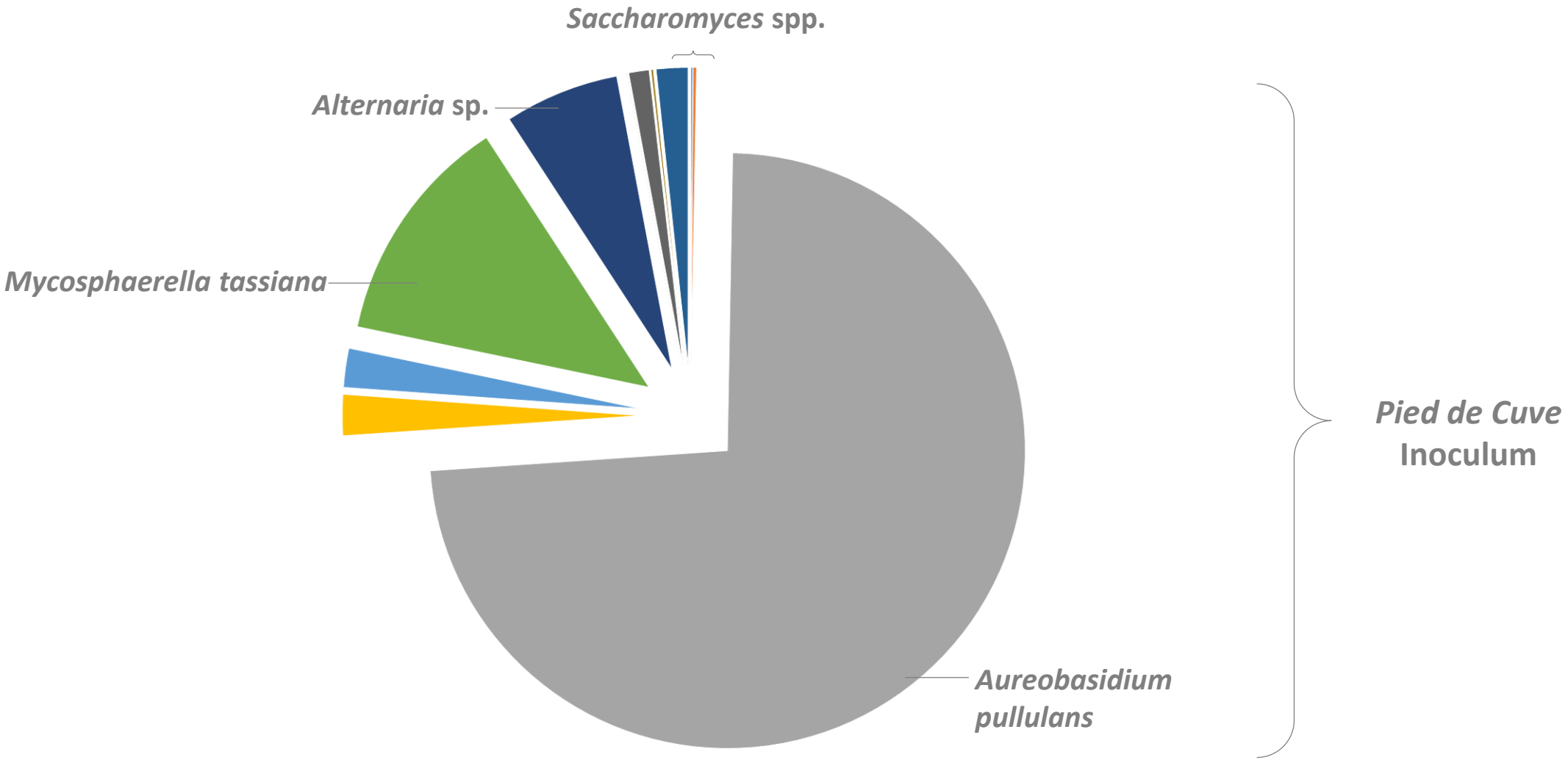
Pied de Cuve
0ppm SO_2 Addition
(at crush)

Pied de Cuve
40ppm SO_2 Addition
(at crush)

Fermentation Progression




Saccharomyces uvarum
Saccharomyces cerevisiae
Hanseniaspora sp.
Cladosporium sp.
Alternaria sp.
Sclerotiniaceae
Curvibasidium cygneicollum
Kazachstania aerobia
Aureobasidium pullulans
Mycosphaerella tassiana
Capnodiales
Aspergillus niger
Alternaria sp.
Aureobasidium pullulans
Mycosphaerella tassiana
Pied de Cuve Inoculum
Lag phase / Crushed and Pressed Juice
Alcoholic Fermentation
Uninoculated 0ppm SO2 Addition
Uninoculated 40ppm SO2 Addition
Pied de Cuve 0ppm SO2 Addition
Pied de Cuve 40ppm SO2 Addition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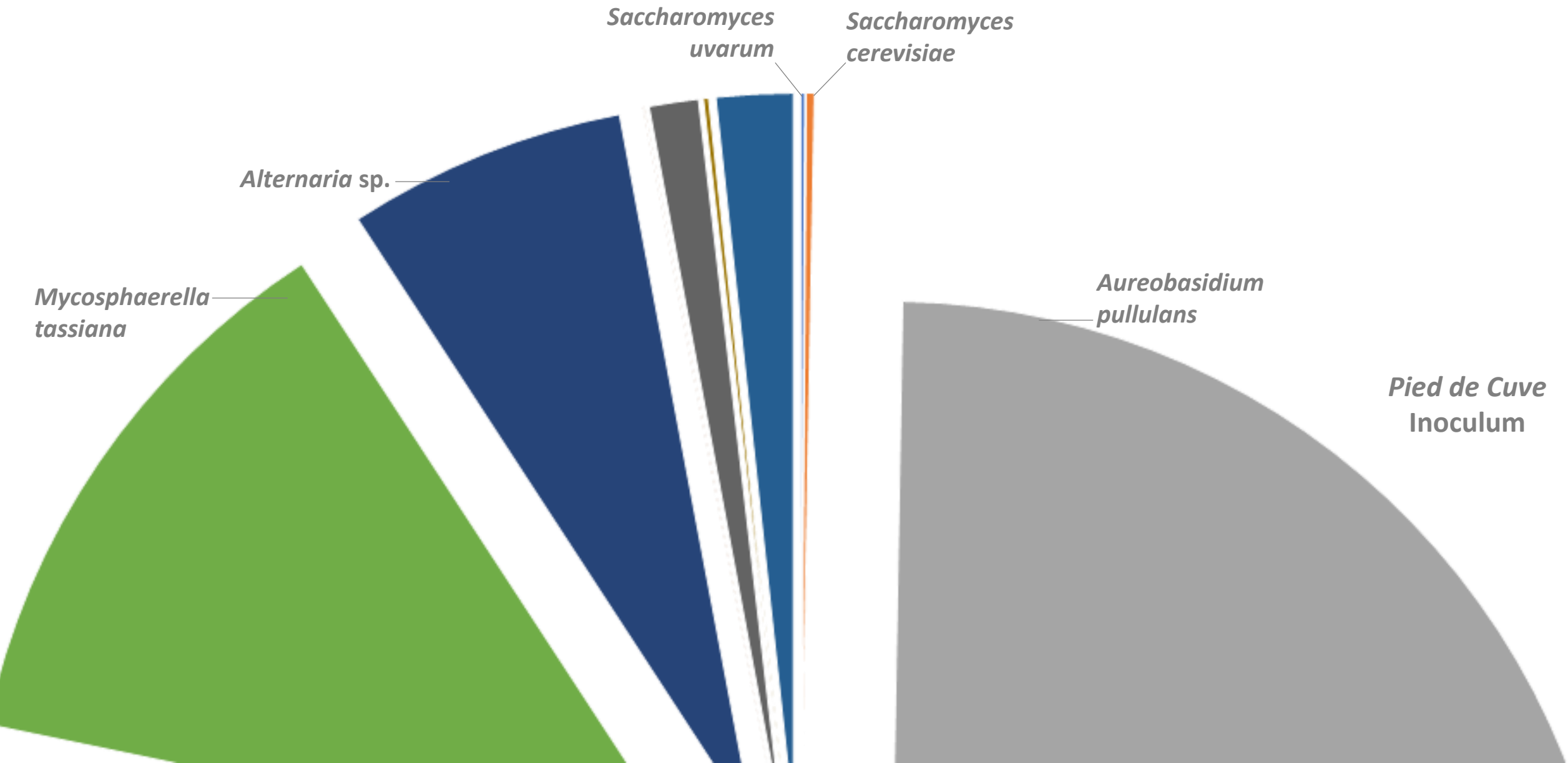
Alternaria sp.
Mycosphaerella tassiana
Aureobasidium pullulans
Pied de Cuve
Inoculum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Saccharomyces cerevisiae
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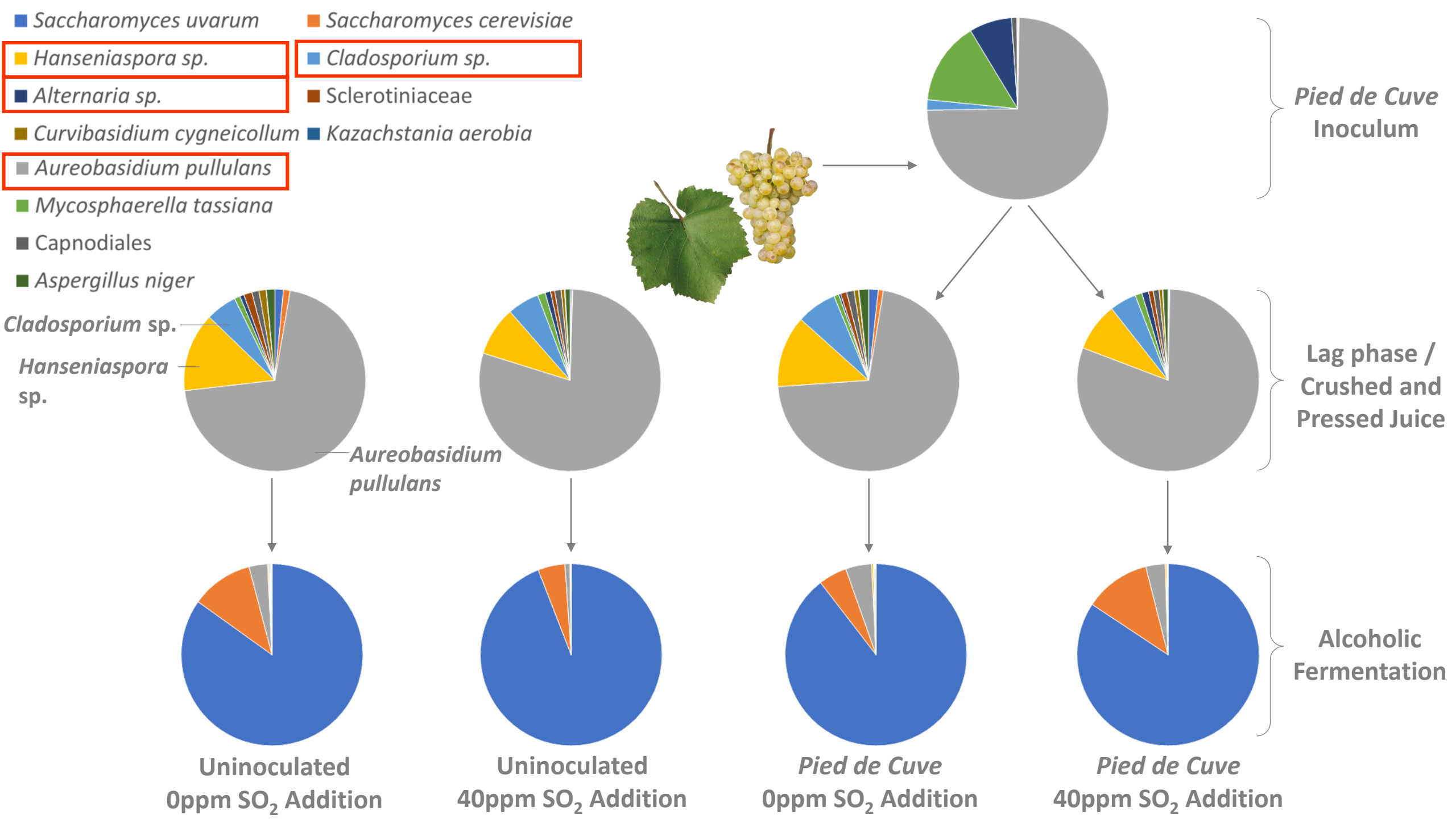
Aureobasidium pullulans
Pied de Cuve
Inoculum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Aspergillus niger
Cladosporium sp.
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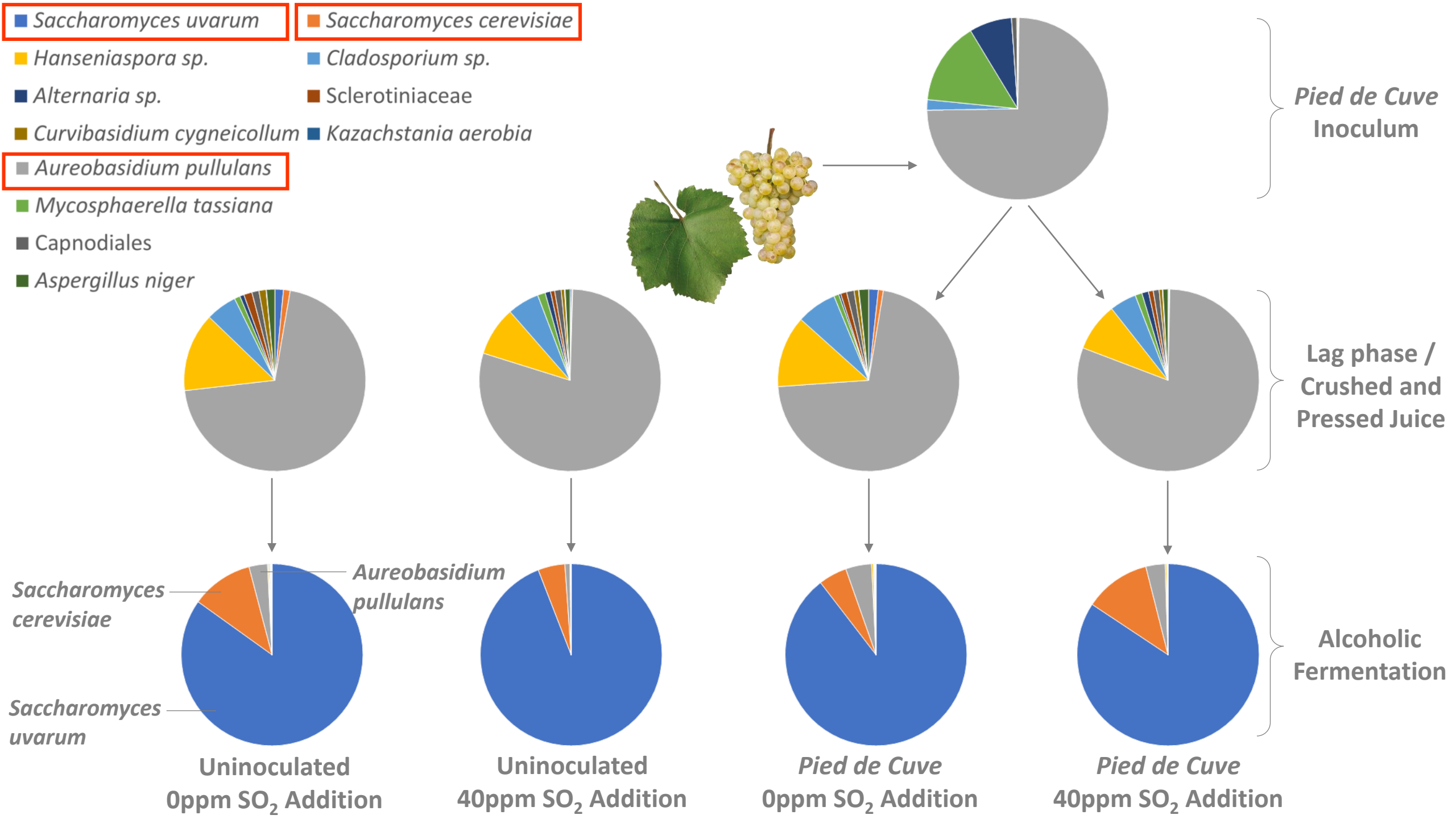
Aureobasidium pullulans
Pied de Cuve Inoculum
Lag phase / Crushed and Pressed Juice
Alcoholic Fermentation
Uninoculated 0ppm SO2 Addition
Uninoculated 40ppm SO2 Addition
Pied de Cuve 0ppm SO2 Addition
Pied de Cuve 40ppm SO2 Addition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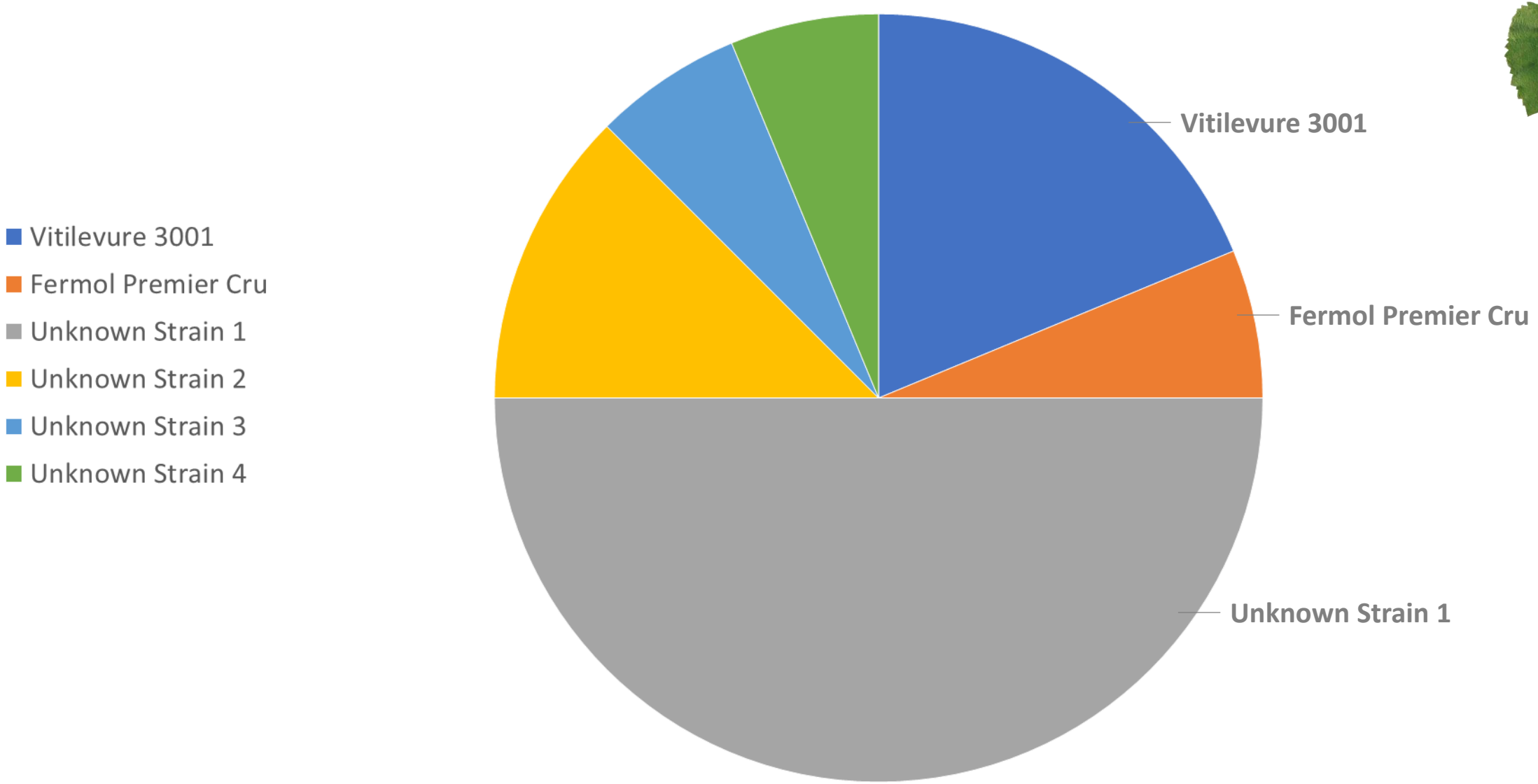
Saccharomyces cerevisiae
Aureobasidium pullulans
Saccharomyces uvarum
Uninoculated 0ppm SO2 Addition
Uninoculated 40ppm SO2 Addition
Pied de Cuve 0ppm SO2 Addition
Pied de Cuve 40ppm SO2 Addition

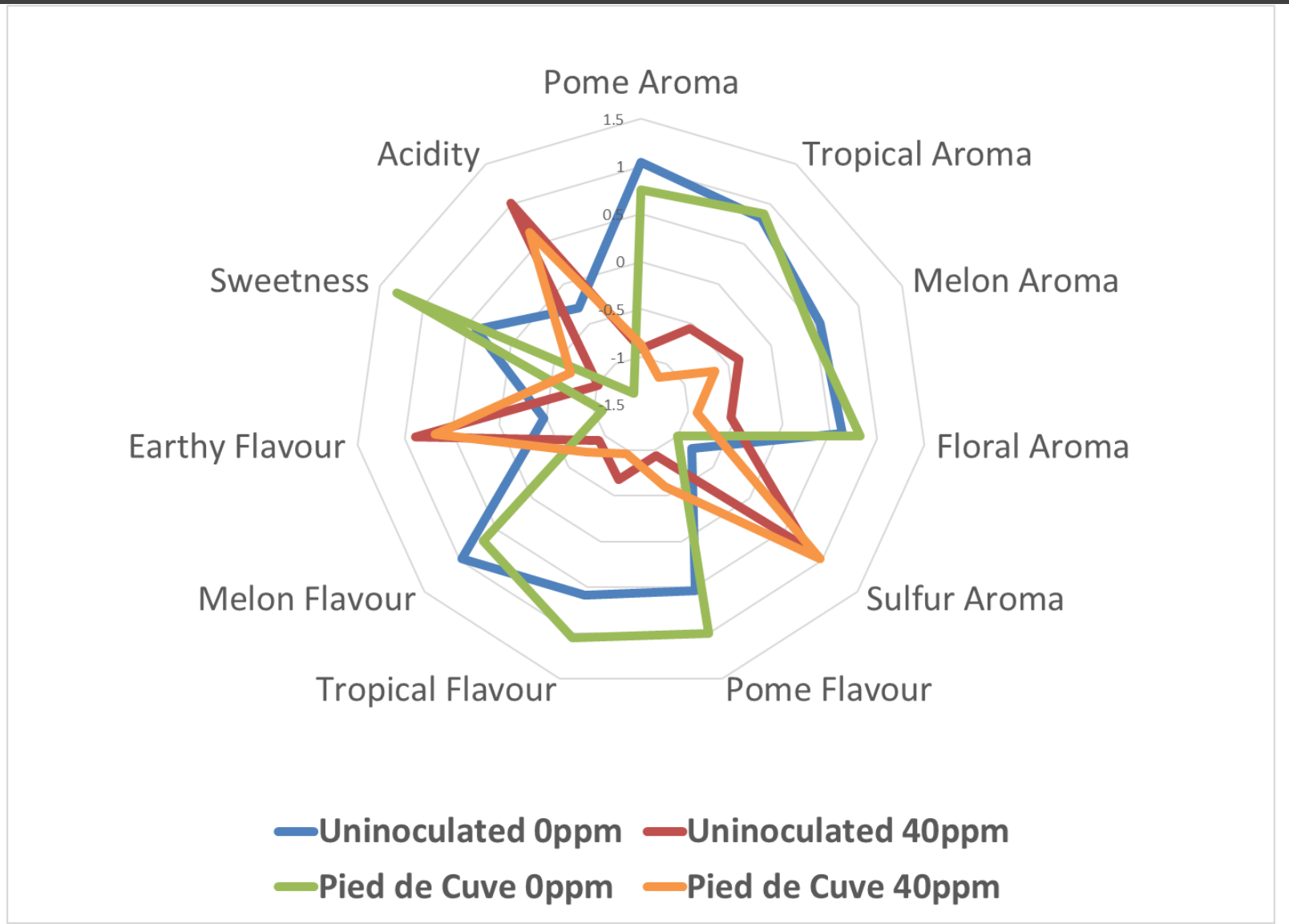
Indigenous *Saccharomyces uvarum* strains

Indigenous *Saccharomyces uvarum* strains

Saccharomyces cerevisiae strains



Wine Sensory Profiles



CRUSH / LAG PHASE	UNINOCULATED 0 PPM SO_2	UNINOCULATED 40 PPM SO_2	PIED DE CUVE 0 PPM SO_2	PIED DE CUVE 40 PPM SO_2
Temperature (°C)	12.9	12.9	12.9	12.9
pH	3.5	3.4	3.4	3.4
Residual Sugar (°Bx)	22.3	21.8	21.9	21.8
YAN	306	294	312	292
Total Acidity (g/L)	6.0	4.7	4.8	4.9
Malic Acid (g/L)	2.3	2.3	2.3	2.2

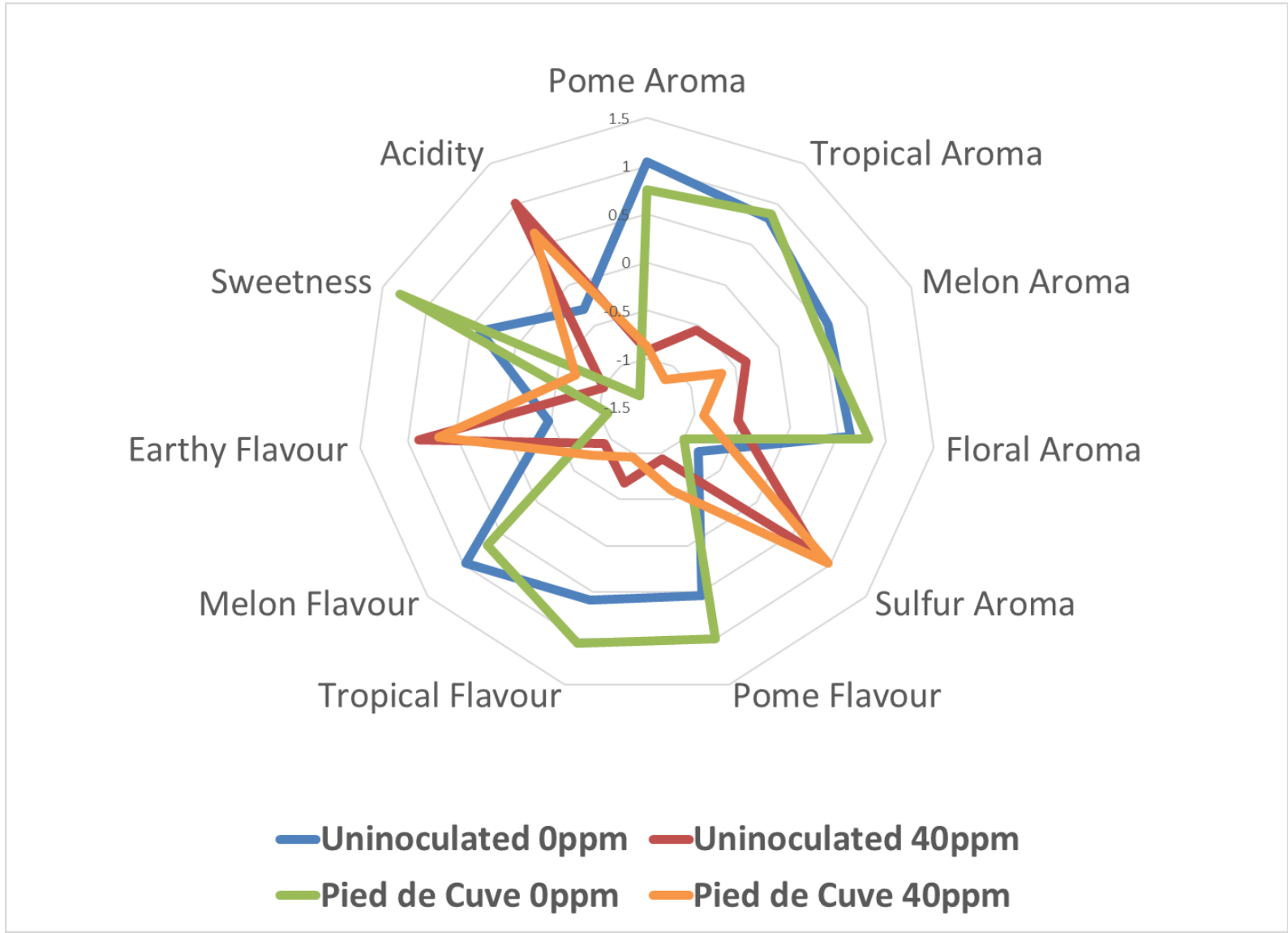
END OF FERMENTATION	UNINOCULATED 0 PPM SO_2	UNINOCULATED 40 PPM SO_2	PIED DE CUVE 0 PPM SO_2	PIED DE CUVE 40 PPM SO_2
Temperature (°C)	13.4	15.1	13.6	15.0
pH	3.5	3.6	3.6	3.6
Fructose (g/L)	2.7	0.6	9.4	1.7
Glucose (g/L)	-0.1	-0.1	0.1	0.1
Total Acidity (g/L)	6.1	7.2	6.3	7.2
Volatile Acidity (g/L)	0.2	0.2	0.2	0.2
Malic Acid (g/L)	0.6	2.3	0.4	2.4
Ethanol Content (%)	13.6	13.7	13.2	13.6

CRUSH / LAG PHASE	UNINOCULATED 0 PPM SO_2	UNINOCULATED 40 PPM SO_2	PIED DE CUVE 0 PPM SO_2	PIED DE CUVE 40 PPM SO_2
Temperature (°C)	12.9	12.9	12.9	12.9
pH	3.5	3.4	3.4	3.4
Residual Sugar (°Bx)	22.3	21.8	21.9	21.8
YAN	306	294	312	292
Total Acidity (g/L)	6.0	4.7	4.8	4.9
Malic Acid (g/L)	2.3	2.3	2.3	2.2

END OF FERMENTATION	UNINOCULATED 0 PPM SO_2	UNINOCULATED 40 PPM SO_2	PIED DE CUVE 0 PPM SO_2	PIED DE CUVE 40 PPM SO_2
Temperature (°C)	13.4	15.1	13.6	15.0
pH	3.5	3.6	3.6	3.6
Fructose (g/L)	2.7	0.6	9.4	1.7
Glucose (g/L)	-0.1	-0.1	0.1	0.1
Total Acidity (g/L)	6.1	7.2	6.3	7.2
Volatile Acidity (g/L)	0.2	0.2	0.2	0.2
Malic Acid (g/L)	0.6	2.3	0.4	2.4
Ethanol Content (%)	13.6	13.7	13.2	13.6

CRUSH / LAG PHASE	UNINOCULATED 0 PPM SO_2	UNINOCULATED 40 PPM SO_2	PIED DE CUVE 0 PPM SO_2	PIED DE CUVE 40 PPM SO_2
Temperature (°C)	12.9	12.9	12.9	12.9
pH	3.5	3.4	3.4	3.4
Residual Sugar (°Bx)	22.3	21.8	21.9	21.8
YAN	306	294	312	292
Total Acidity (g/L)	6.0	4.7	4.8	4.9
Malic Acid (g/L)	2.3	2.3	2.3	2.2

END OF FERMENTATION	UNINOCULATED 0 PPM SO_2	UNINOCULATED 40 PPM SO_2	PIED DE CUVE 0 PPM SO_2	PIED DE CUVE 40 PPM SO_2
Temperature (°C)	13.4	15.1	13.6	15.0
pH	3.5	3.6	3.6	3.6
Fructose (g/L)	2.7	0.6	9.4	1.7
Glucose (g/L)	-0.1	-0.1	0.1	0.1
Total Acidity (g/L)	6.1	7.2	6.3	7.2
Volatile Acidity (g/L)	0.2	0.2	0.2	0.2
Malic Acid (g/L)	0.6	2.3	0.4	2.4
Ethanol Content (%)	13.6	13.7	13.2	13.6


Pome Aroma
Tropical Aroma
Melon Aroma
Floral Aroma
Sulfur Aroma
Pome Flavour
Tropical Flavour
Melon Flavour
Earthy Flavour
Sweetness
Acidity
1.5
1
0.5
0
-0.5
-1
-1.5
Uninoculated 0ppm
Uninoculated 40ppm
Pied de Cuve 0ppm
Pied de Cuve 40ppm

Conclusions and Future Directions

Conclusions

- Uninoculated fermentations can increase *Saccharomyces* strain diversity
  - May include indigenous or commercial yeasts
- Low/no SO_2 added at crush can increase vineyard yeast presence
  - Wines have more tropical and pome fruit notes
- *Pied de cuve* inoculum should be closely monitored for desirable yeast presence
  - Likely need higher yeast count in inoculum

Future Directions

- Isolate and identify indigenous *Saccharomyces* yeasts from vineyards/natural environments around the Okanagan Valley
- Screen indigenous yeasts for fermentative potential

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Control Points in the Minimal Intervention Cellar

Oregon Wine Symposium

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