



# Driving Pinot Noir Style through Yeast Selection

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6/25/19



### Webinar Formalities

- This Webinar is being recorded and will be published on the Enartis website
- Please refrain from using the chat box during the presentation, there will be 15 minutes for questions at the end of the presentation
- If you are having technical difficulties please use chat box 2, Jasha will be there to help



## Overview

- Pinot noir Characteristics And Clonal Variation
- Styles
- Pinot noir Phenolic And Aromatic Profile
- Pinot noir Processing
- Enartis Yeast Characteristics in Pinot Noir:
  - Enartis Yeast Range for Pinot noir
  - Main Chemical Parameters
  - Main Aromatic Compounds
  - Conclusion
  - 2019 Harvest Trials: Yeast Selection For Pinot Noir
- Citations



### Defintions

- **Grape variety:** A group of morphologically distinct clones originating from a single initial seed which was sexually produced (Boursiquot and This 1999).
- **Clone:** A select cutting from a parent plant that is vegetatively propagated.
- **Genome:** An organism complete set of DNA, including all of it genes.
- **Genotype:** The genetic makeup of an organism. It describes an organism's complete set of genes.
- **Phenotype:** The collective expression of the genotype in conjunction with the environment on a plant's observable characteristics.

## Pinot Noir Genome

- Sequenced Dec 2007 (Velasco et al, 2007)
  - 19 Chromosomes
  - Relatively small genome, with high degree of heterozygosity
  - >2 Million single nucleotide polymorphism 87%
- What's the difference?
  - Pinot Noir, Pinot Gris and Pinot Blanc
  - Somatic mutations leading to phenotypic divergence

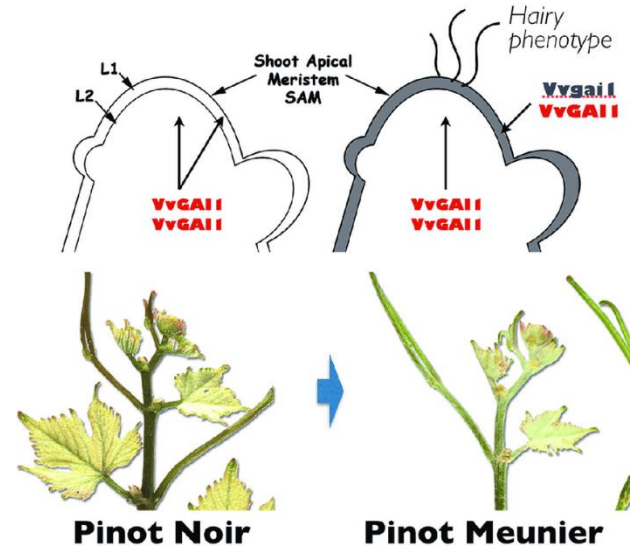


Image from: *The Microvine: A Versatile Plant Model to Boost Grapevine Studies in Physiology and Genetics* (Pellogrino et al, 2019)

Why so many clones of Pinot Noir?

- The older a variety is, the more mutations it is likely to have
- Mutations may be selected for propagation, with the more mutations a vine has undergone, the more clones it is likely to have.
- Pinot noir is perhaps the oldest cultivated variety of the genus Vitis. It is thought to be the cultivated vine described by Roman authors in the first century



## Common Pinot noir clones

### Four main groups of Pinot noir clones:

- Standard quality (pinot fin)
- Highly fruitful (pinot fructifier)
- Upright shoots (pinot droit)
- Loose clustered (mariafeld)

### North American Examples:

- Pommard Clones (1950s)
  - UCD 4
  - Suit case clones
- Dijon Clones (~50 registered) (1980's)
  - 115, 165, 236, 375, 459, 667, 743, 777, and 943
- Heritage clones:
  - Swan, Martini, Chalone, Mt. Eden

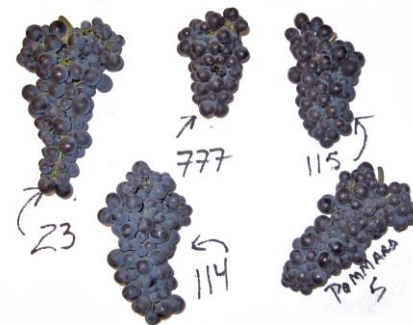


**Foundation Plant Services**

<https://fps.ucdavis.edu/fgrmain.cfm>



<http://www.entav-inra.fr/en/home-2/>



## Traditional/Old world

- *Tradition, history, culture*
- Characteristics: Lower alcohol, less extracted, higher acidity
- Higher portion of stems, whole cluster inclusion
- 18-36 months ageing in barrel
- Yeast isolated from Burgundy (microbial “terroir”)
- Challenges: Too thin, reduction, herbal, green, tight







## “Old World”



## New World

- *Innovation, technology, marketing*
- Characteristics: Higher alcohol, extracted, lower acidity, fruit forward, higher oak
- Increase color and phenolic extraction
- Longer cold soak
- Typically uses new, heavier toast barrels ~12-18 months
- More technological yeast strains (fast fermenters, high aromatic potential)
- Challenges: Too alcoholic, reduction, loss of coloring material



## “New World”



- Cryo-maceration
- Thermovinification
- Flash détente
- Microwave treatment
- Pulse Electronic Field
- Ultrasound



(Ana Carew, 2014; Leong et al, 2016)



Poll Question:

What style of  
Pinot noir are you  
making?



## Pinot noir regional aromatic profile

### Typical aromas of Burgundy Pinot noir:

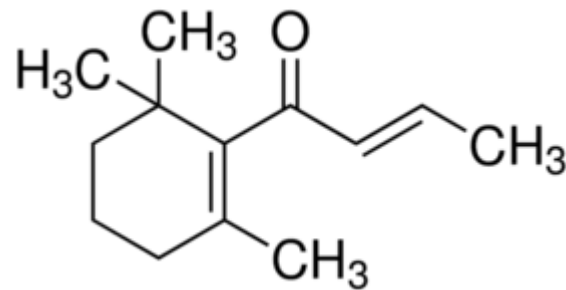
- Ethyl-anthranilate (fruity)
- ethyl-cinnamate (cherry, plum, cinnamon)
- methyl-anthranilate (fruity, grape)
- $\beta$ -damascenone (floral)

### Typical aromas of West Coast Pinot noir

- Total of 42 compounds identified
- 2-phenylethanol (rose petal)
- 3-methyl-1-butanol (nail-polish)
- linalool (floral)
- $\beta$ -damascenone (floral)

### Typical aromas of New Zealand Pinot noir:

- Ethyl-isobutyrate (strawberry)
- $\beta$ -damascenone (floral)
- Isovaleric acid (cheese)
- Ethyl-isovalerate (fruit, cherry)
- Ethyl-cinnamate (honey, cinnamon)
- Guaiacol (medicinal, smokey)

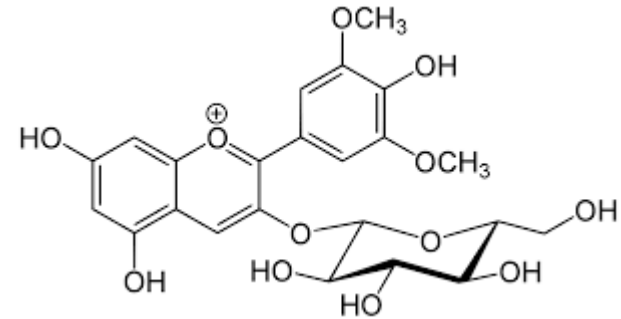


$\beta$ -damascenone (floral)

Impact odorant and aroma enhancer

## Pinot noir phenolic profile

- Lacks acylated anthocyanins
- Dominant anthocyanin:
  - Malvidin-3-glucoside
  - Poor correlations with co-pigmentation
  - ~100 mg/L in Pinot noir
- High concentration of seed tannins
  - Monomeric flavan-3-ols and low molecular weight tannins
  - Low extractability → skin-to-seed ratio



Malvidin-3-glucoside



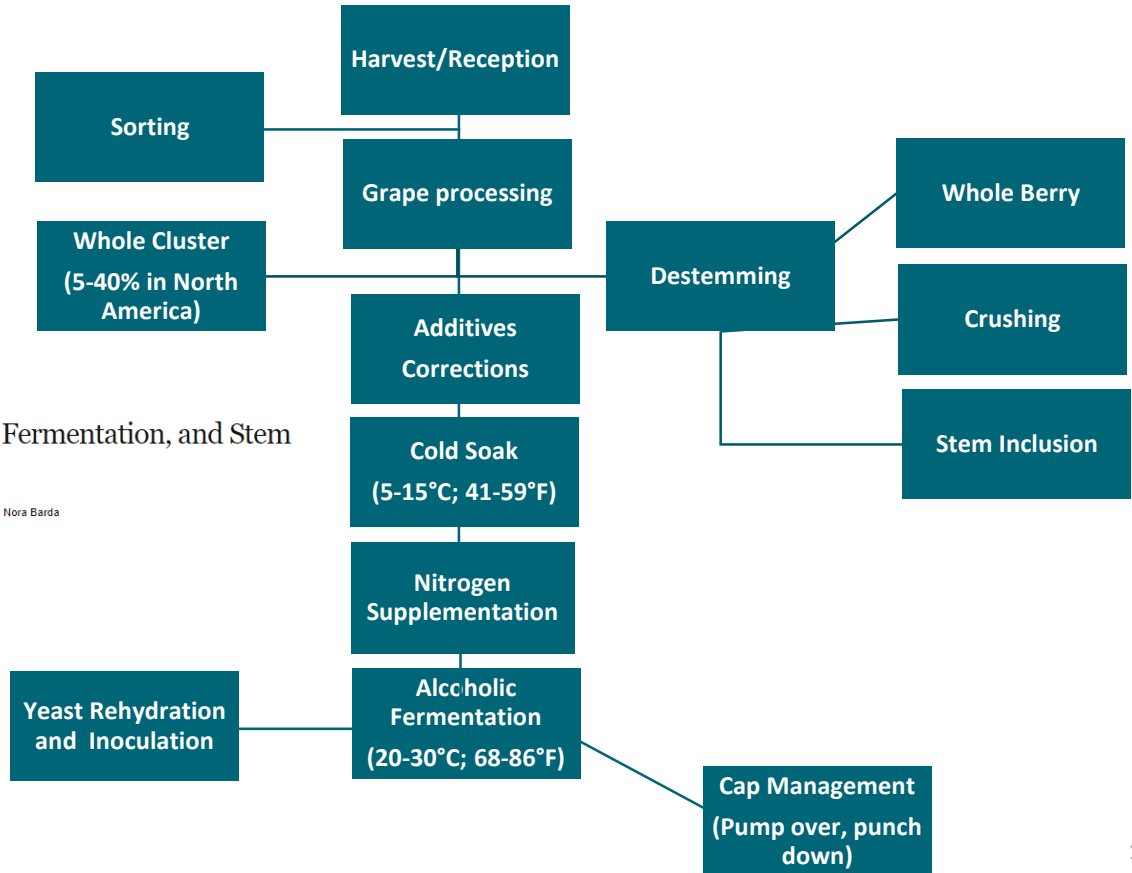
Image from Wine Folly.com





## Chemical and Sensory Effects of Cold Soak, Whole Cluster Fermentation, and Stem Additions in Pinot noir Wines

L. Federico Casassa, Santiago E. Sar, Esteban A. Bolcato, Mariela A. Diaz-Sambueza, Anibal A. Catania, Martin L. Fanzone, Fernando Raco, Nora Barda  
Am J Enol Vitic. September 2018 : ajev.2018.18014; published ahead of print September 26, 2018 ; DOI: 10.5344/aje.2018.18014





### Logistics and yeast selection considerations

- **Early in the season:** Fast, finishing fermenter, low nutrient requirements
  - Turning tanks
- **Regional consideration:**
  - Cool Climate
    - Increase mouthfeel → High glycerol producing yeast
    - Reduce acidity → malic consuming yeast
  - Warm climate
    - Retaining acidity → low malic consumption, acidulating yeast
    - Reducing alcohol → Low conversion and high glycerol strains
- **Fruit health**
  - Botrytis or powdery mildew → Robust, low nutrient requiring strains





## Enartis Yeast Characteristics in Pinot Noir



Comparison of commonly used for Pinot noir yeast strains

- ES454
- ES488
- WS
- MB15
- ASSMANSHAUSEN
- VINTAGE RED
- U42 (*Saccharomyces uvarum*)



### Pinot noir Fermentation

- **Grape**

- Alto Adige (North of Italy)
- Harvest 2017
- Sugar content: 239 g/L
- Potential alcohol: 14.3 %
- pH: 3.74

- **Vinification process**

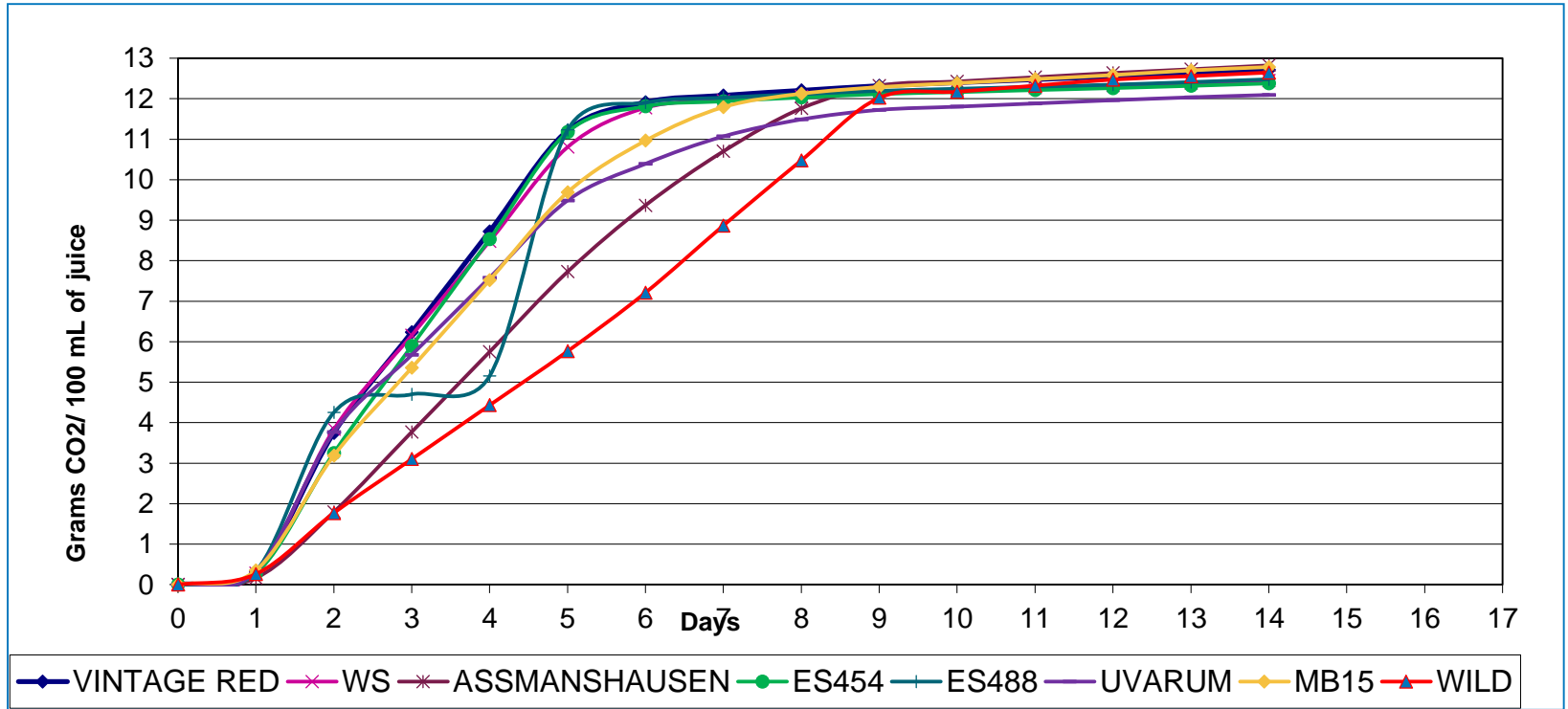
- Manual destemming and crusher
- Homogenization of the juice
- No SO<sub>2</sub> addition
- No nutrient addition
- Fermentation in flask (170 g of juice)
- Fermentation temperature: 20°C
- Inoculation rate: 2.5x10E6 cells/mL



# Main chemical parameters

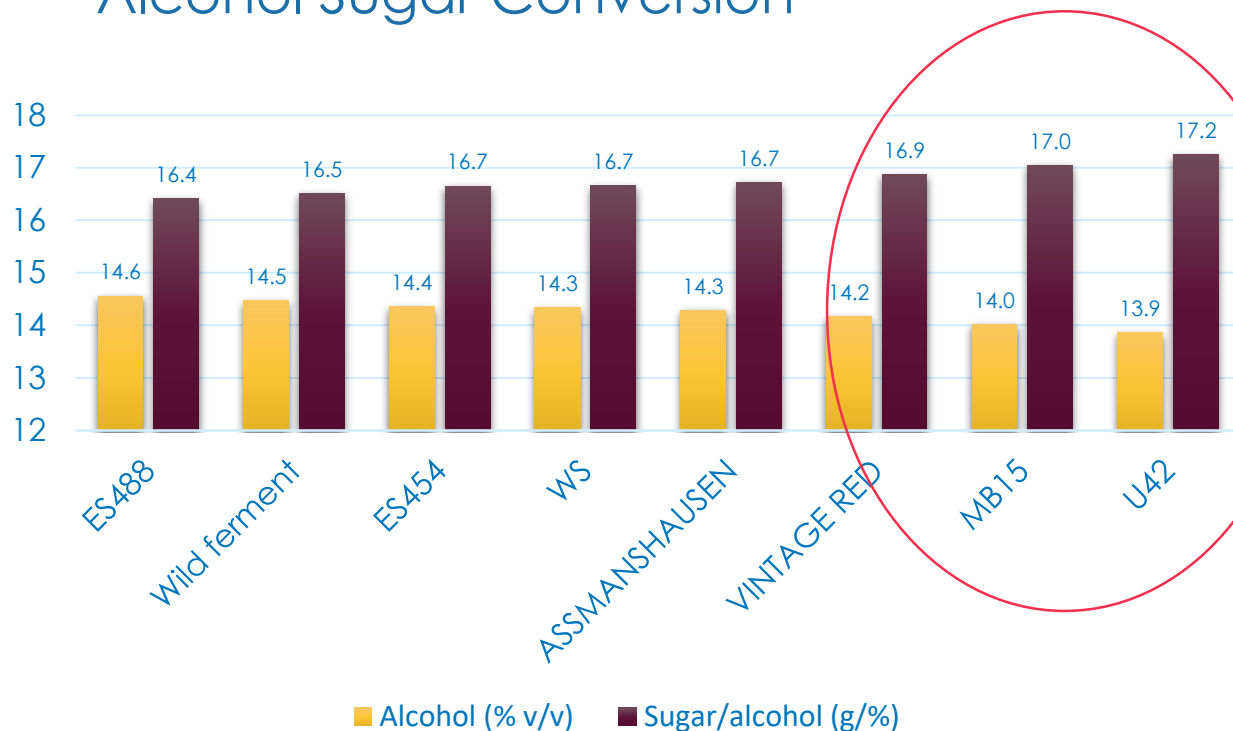
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## Fermentation Kinetics





### Alcohol Sugar Conversion

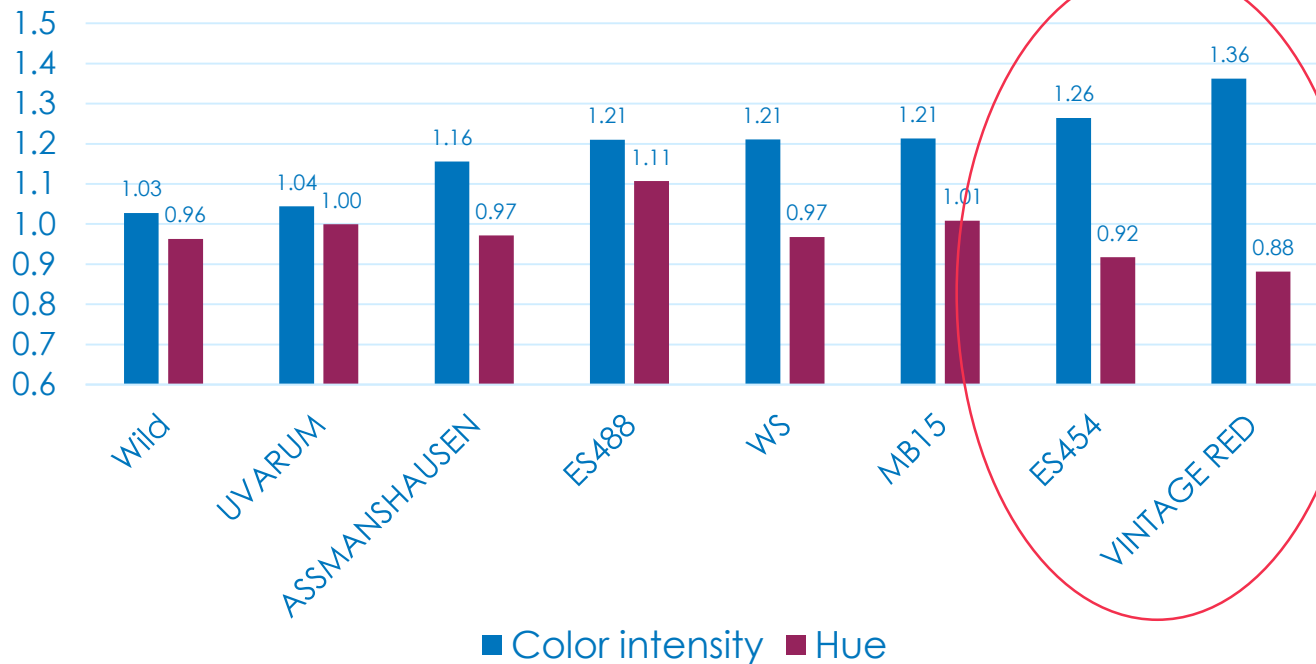


- All fermentation went dry
- Potential alcohol: 14.3%
- **Vintage Red & MB15** have a low yield sugar/alcohol (observed in other trials)
- **U42** has the lowest yield sugar/alcohol ratio
- 0.7% Difference in ABV between lowest and highest producing strains

Warm Climate/High potential alcohol: VINTAGE RED, MB15 and U42 application in reducing alcohol concentrations



## Color Characteristics



Vintage Red & ES454 produce wines with the most intense color and hue

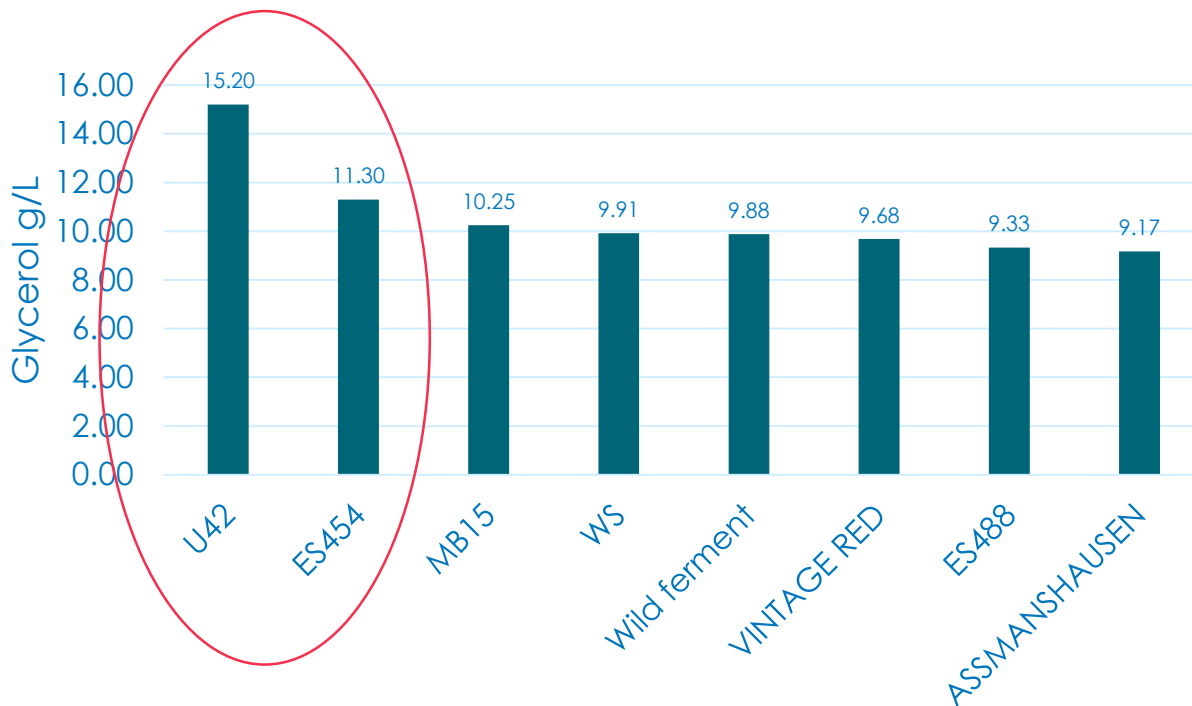
30% more intensity and hue than the spontaneous/wild ferment

Increasing Color intensity and Hue: VINTAGE RED, and ES 454

(Somers and Evans, 1977)



### Glycerol Production



Increasing mouthfeel, smoothness and overall flavor of wine

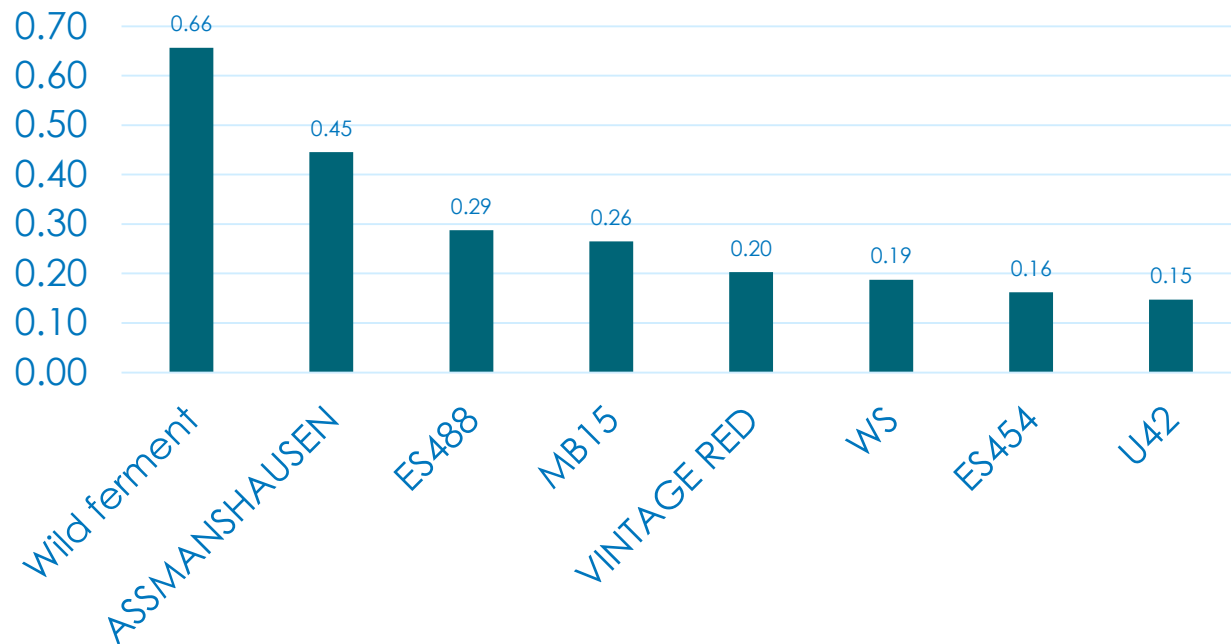
- **U42** *S. uvarum* produced 40% more glycerol than lowest producer
- **ES454** high *S. cerevisiae* producer of glycerol
- Positive flavor influenced by glycerol concentrations >10 g/L, especially with low volatile composition





### Acetic Acid Production

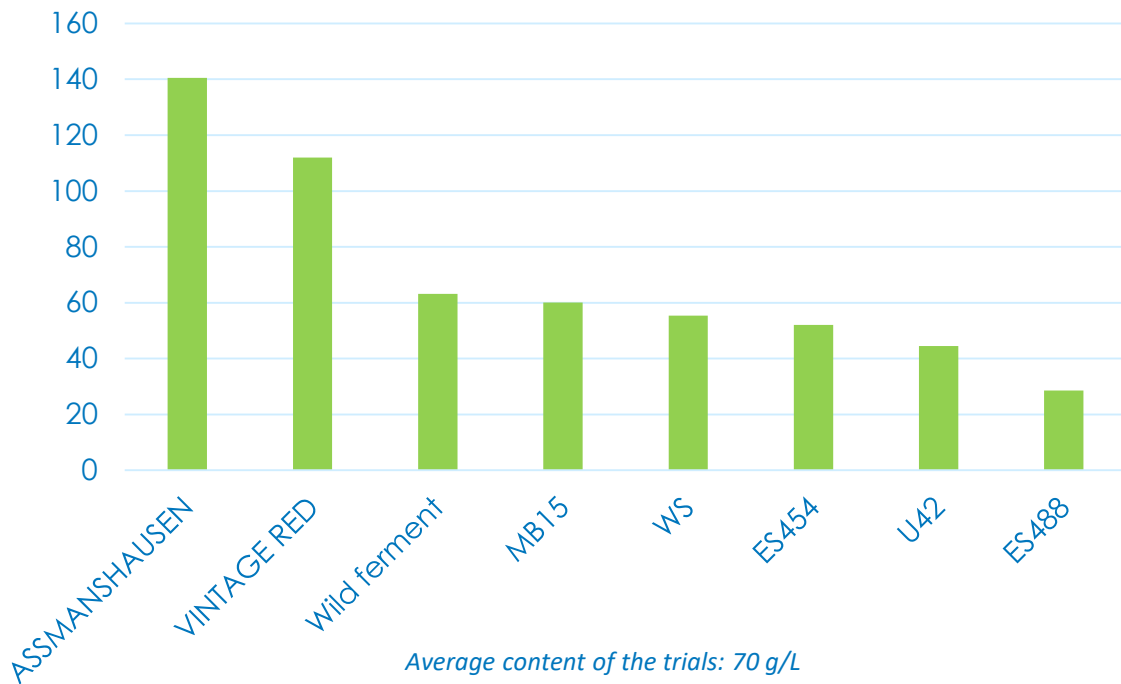
- **U42** produces the lowest acetic acid compared to the spontaneous/wild ferment
- Average content in trials 0.29 g/L





### Acetaldehyde

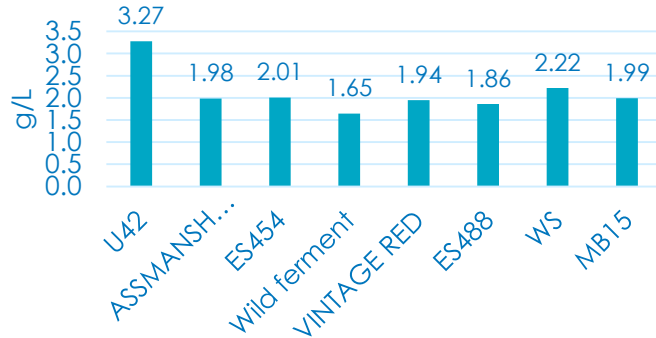
- Acetaldehyde helps color stability (see Vintage Red and ES454 color data)
- Vintage Red & MB15** are medium-high producer
- Assmanshausen** longer fermentation kinetics and potential oxidation can contribute to high level of acetaldehyde.



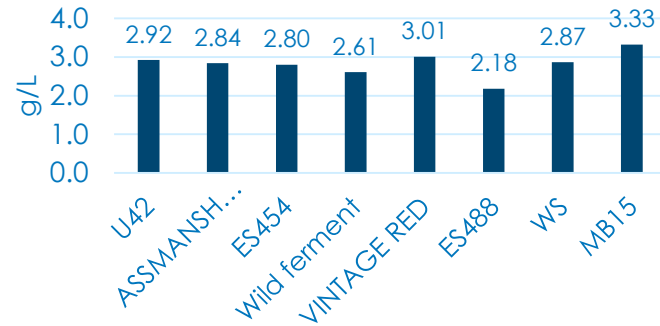
## Yeast Effect On Wine Acidity

- **U42** produced highest level of succinic acid
- **ES488** consumed the highest level of malic acid

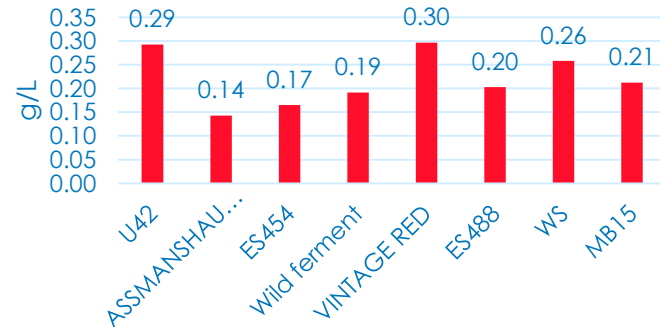
SUCCINIC ACID



MALIC ACID

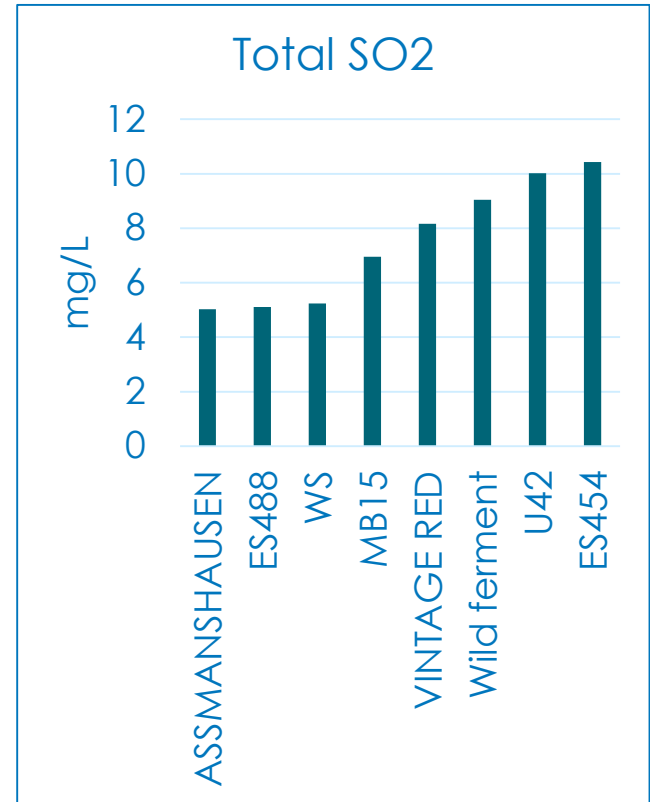
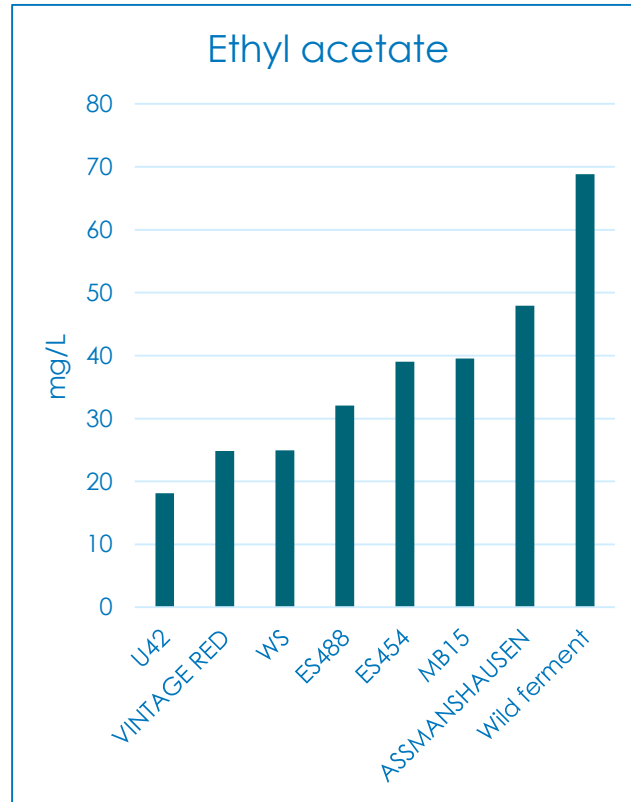


LACTIC ACID



### SO<sub>2</sub> and Ethyl Acetate

- 30-60 mg/L of **Ethyl acetate** is normal and positive for wine aroma
- Ethyl acetate > 150 mg/L is a defect
- All strains produced low SO<sub>2</sub> level





# Main aromatic compounds

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## Pinot Noir Main Aromatic Compounds

### Floral aroma

- Benzaldehyde
- Linalool
- 2,3-butanediol
- 2-phenylethanol acetate
- 2-phenylethanol
- Ethyl hexanoate
- Hexanoic acid
- Octanoic acid

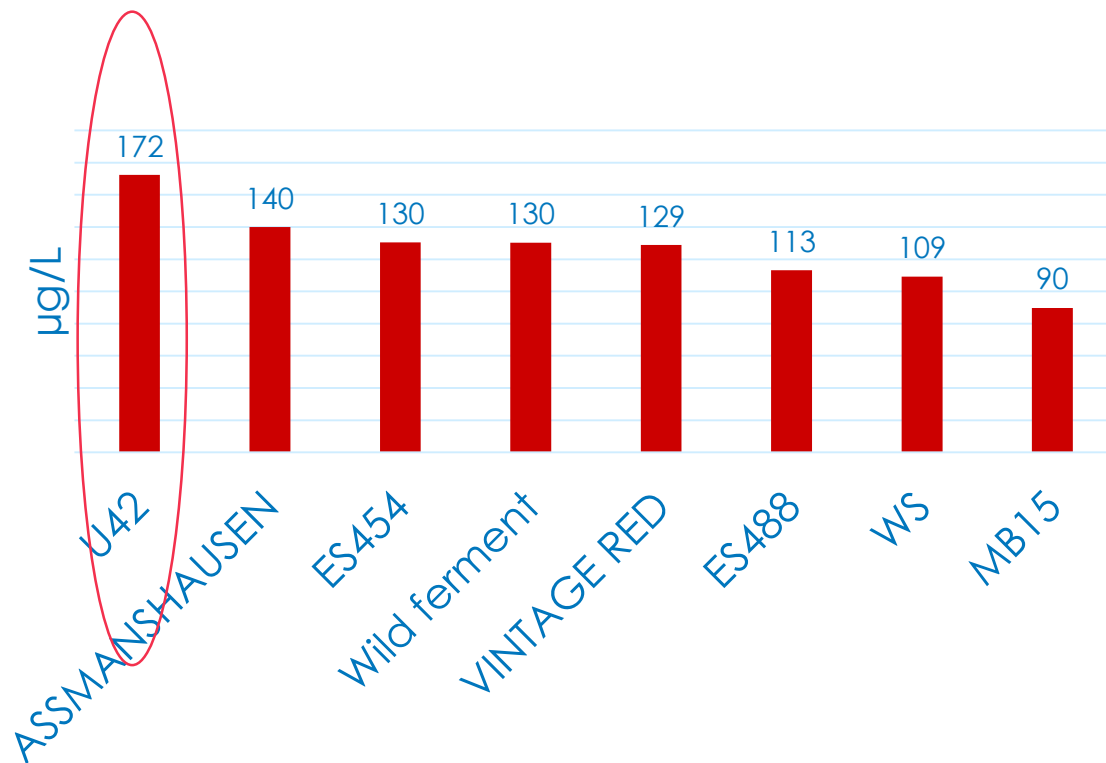


### Fruit aroma

- Benzaldehyde
- Benzaldehyde cyanohydrin
- Ethyl acetate
- Ethyl butyrate
- Ethyl formate
- Mercaptohexan-1-ol
- Methyl butanoate
- Methyl cinnamate
- Hexanediol
- Ethyl hexanoate
- Ethyl octanoate
- Methyl vanilate
- 3-methyl butanol
- 2,3-butanediol



## Benzaldehyde-cyanohydrin



- Benzaldehyde-cyanohydrin
- **Cherry aroma**
- Perception threshold ~2,000 µg/L (Rutan et al, 2014)
- Aroma typical of cool-climate Pinot Noir
- **U42** produced the highest level, 48% more than MB15

## Esters

- Responsible of fruity aroma in young wines  
(Sumby et al, 2010)
- Ethyl esters of fatty acids are more stable over time than the ester acetates
- Among ester acetates, only **isoamyl acetate** is above the odor threshold



| YEAST STRAINS | ETHYL ESTERS (OAV) | ISOAMYL ACETATE (OAV) | TOTAL ESTERS (OAV) |
|---------------|--------------------|-----------------------|--------------------|
| Wild ferment  | 14,11              | 2,33                  | 16,45              |
| ASSMANSHAUSEN | 22,48              | 2,04                  | 24,53              |
| MB15          | 24,90              | 1,07                  | 25,97              |
| U42           | 26,62              | 0,95                  | 27,57              |
| VINTAGE RED   | 30,23              | 0,82                  | 31,05              |
| WS            | 31,84              | 1,08                  | 32,92              |
| ES454         | 34,25              | 0,82                  | 35,07              |
| ES488         | 44,82              | 1,07                  | 45,89              |

\*Odor Active Value (OAV) = aromatic molecule content / threshold

\* Ethyl acetate is not part of the sum

**ES 454**, and **ES 488** are good candidates for elaborating young Pinot noirs





### Primary Varietal Aromas: Terpens and Nor-isoprenoids Analysis

| YEAST STRAINS | $\beta$ -Citronelol<br>(OAV) | $\beta$ -Damascenone<br>(OAV) | TOTAL<br>(OAV) |
|---------------|------------------------------|-------------------------------|----------------|
| ASSMANSHAUSEN | 1,07                         | 16                            | 17,07          |
| WS            | 0,80                         | 17,6                          | 18,40          |
| Wild ferment  | 0,98                         | 17,6                          | 18,58          |
| ES488         | 1,00                         | 19,2                          | 20,20          |
| U42           | 0,87                         | 20,8                          | 21,67          |
| ES454         | 0,77                         | <b>22,4</b>                   | <b>23,17</b>   |
| VINTAGE RED   | 1,03                         | <b>22,4</b>                   | <b>23,43</b>   |
| MB15          | 1,08                         | <b>22,4</b>                   | <b>23,48</b>   |



\*Odor Active Value (OAV) = aromatic molecule content / threshold

*ES 454, Vintage Red, and MB15 showed the highest concentration of varietal derived aroma*



Conclusion



### Aromatic and Stylistic Objective

| FRUITY AROMA    | FLORAL AROMA | FRUITY + VARIETAL AROMA | VARIETAL AROMA        | COLOR INTENSITY & STABILITY | LESS YIELD IN ALCOHOL |
|-----------------|--------------|-------------------------|-----------------------|-----------------------------|-----------------------|
| ES454,<br>ES488 | U42,<br>WS   | VINTAGE RED             | MB15,<br>ASSMANHAUSEN | ES454,<br>VINTAGE RED       | U42,<br>MB15          |

### Oxygen management

**ES454 & Vintage Red** produce adequate quantities of acetaldehyde, encouraging color condensation without the application of micro-oxygenation.

## Enartis Yeast Enological and Stylistic Features

| Enological Characteristic | ES454  | ES488  | VINTAGE RED       | ASSMANS-HAUSEN | WS     | MB15     | U42      |
|---------------------------|--------|--------|-------------------|----------------|--------|----------|----------|
| Aroma profile             | FRUITY | FRUITY | FRUITY + VARIETAL | CHERRY         | FLORAL | VARIETAL | FLORAL   |
| Fermentation kinetic      | Fast   | Fast   | Fast              | Long           | Fast   | Moderate | Moderate |
| Glycerol                  | High   | Medium | Medium            | Medium         | Medium | High     | High     |
| Acetic acid               | Low    | Medium | Low               | High           | Low    | Low      | Low      |
| Acetaldehyde              | High   | Low    | High              | High           | Medium | Medium   | Low      |
| Total SO <sub>2</sub>     | Low    | Low    | Low               | Low            | Low    | Low      | Low      |
| H <sub>2</sub> S          | 1      | 1      | 2                 | 1              | 2      | 2        | 0        |


**Glycerol:** low < 7; medium 7-10; high > 10

**Acetic acid:** low < 0.3; medium 0.3-0.5; high > 0.5

**Acetaldehyde:** low < 40; medium 40-70; high > 70

**Total SO<sub>2</sub>:** low < 20; medium 20-40; high > 40

**H<sub>2</sub>S:** 0=none; 1=low; 2=medium; 3=high



Poll Question:  
Based on this data,  
which yeast strain  
best fits your needs?

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Thanks  
Everyone for  
Joining!  
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# Inquire about 2019 Harvest trials: Yeast Selection for Pinot noir

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## Citations

- Harbertson JF, Hodgins RE, Thurston LN, Schaffer LJ, Reid MS, Landon JL, Ross CF, Adams 701 DO. 2008. Variability of tannin concentration in red wines. *Am J Enol Vitic* 59:210-214.
- Casassa, L. F., Sari, S. E., Bolcato, E. A., Diaz-Sambueza, M. A., Catania, A. A., Fanzone, M. L., ... & Barda, N. (2019). Chemical and Sensory Effects of Cold Soak, Whole Cluster Fermentation, and Stem Additions in Pinot noir Wines. *American Journal of Enology and Viticulture*, 70(1), 19-33.
- Carew, A. L., Sparrow, A. M., Curtin, C. D., Close, D. C., & Dambergs, R. G. (2014). Microwave maceration of Pinot Noir grape must: Sanitation and extraction effects and wine phenolics outcomes. *Food and bioprocess technology*, 7(4), 954-963.
- Fang Y, Qian M. 2005. Aroma compounds in Oregon Pinot noir wine determined by aroma extract 684 dilution analysis (AEDA). *Flavour Fragr J* 20:22-29.
- Harbertson JF, Hodgins RE, Thurston LN, Schaffer LJ, Reid MS, Landon JL, Ross CF, Adams 701 DO. 2008. Variability of tannin concentration in red wines. *Am J Enol Vitic* 59:210-214.
- Leong, S. Y., Burritt, D. J., & Oey, I. (2016). Evaluation of the anthocyanin release and health-promoting properties of Pinot Noir grape juices after pulsed electric fields. *Food Chemistry*, 196, 833-841.
- Pellegrino, A., Romieu, C., Rienth, M., & Torregrosa, L. (2019). The Microvine: A Versatile Plant Model to Boost Grapevine Studies in Physiology and Genetics. In *Advances in grape and wine biotechnology*. IntechOpen.
- Rutan T, Herbst-Johnstone M, Pineau B, Kilmartin PA. (2014). Characterization of the aroma of 744 Central Otago Pinot noir wines using sensory reconstitution studies. *Am J Enol Vitic* 65:424-434.
- Sumby, K.M.; Grbin, P.R.; Jiranek, V. Microbial modulation of aromatic esters in wine: Current knowledge and future prospects. *Food Chem.* 2010, 121, 1–16.