[O2W]

oxygen in wines

[O2W]

Wine Aroma development : Impact of Oxygen

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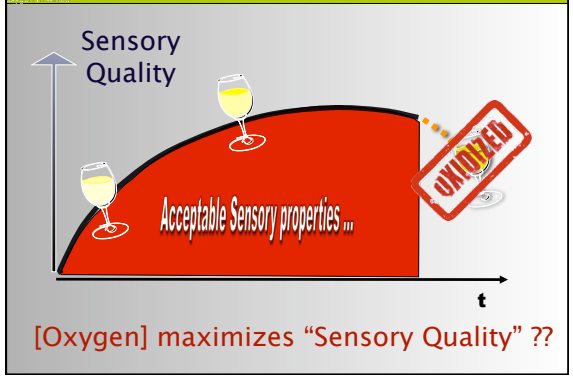
[O2W]

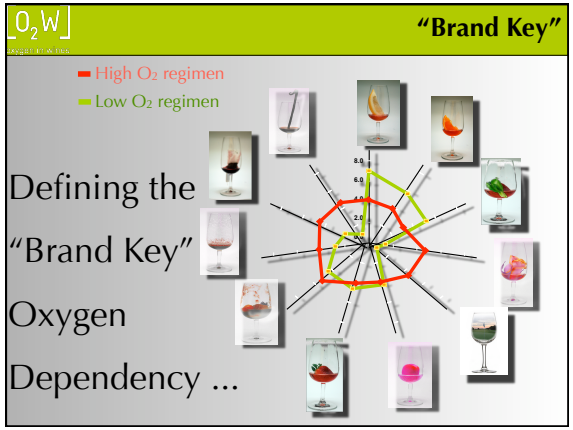
Objectives

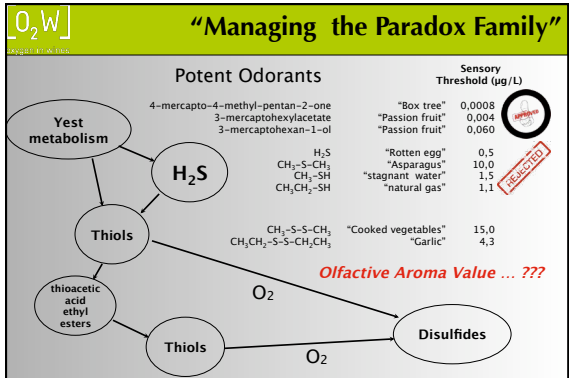
Impact of Oxygen on the volatile wine fraction
- Risks & Opportunities

Oxygen : A management tool for "Sensory Quality"



[Oxygen] maximizes "Sensory Quality" ??





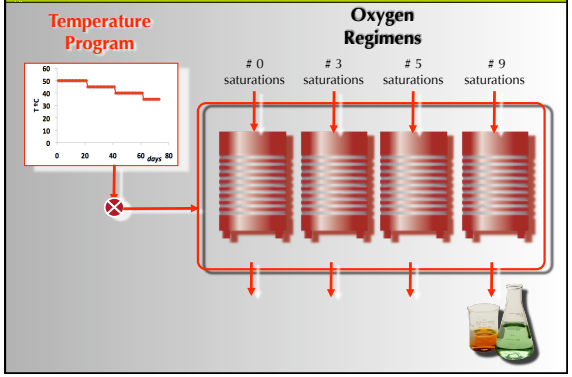
1. Sensory Information

2. Key-Molecules Identification

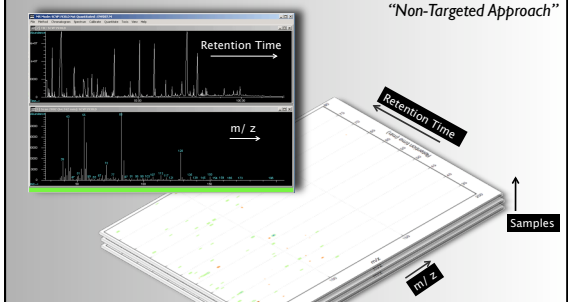
3. Mechanisms of Formation

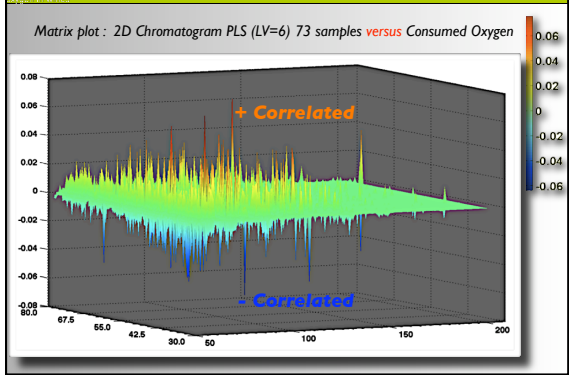
4. Kinetic Measurements

Experimental design



"Data Mining": O2 & Volatile Fraction





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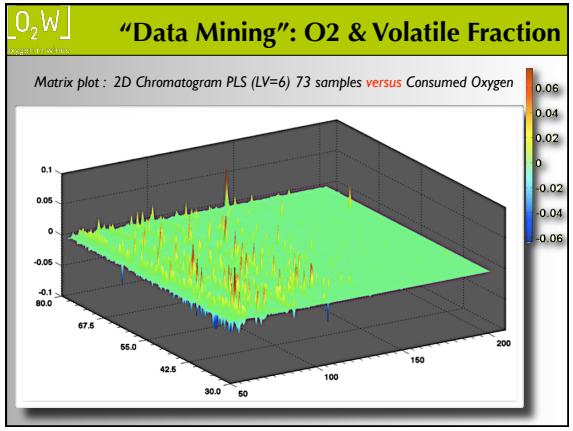

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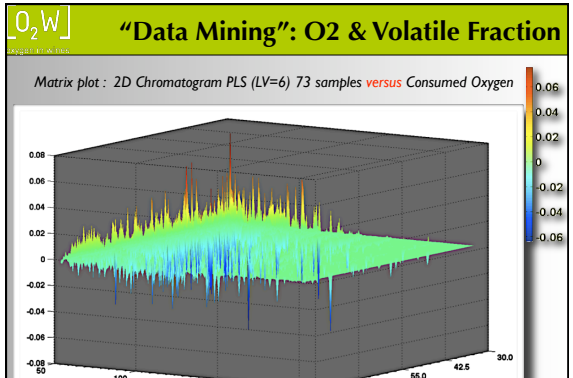
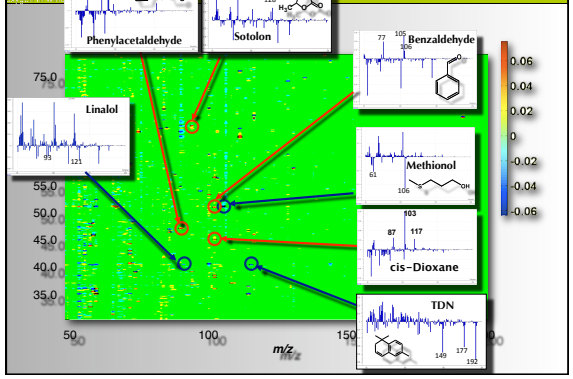
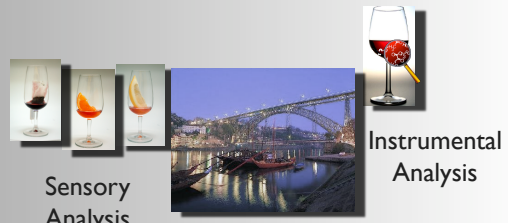
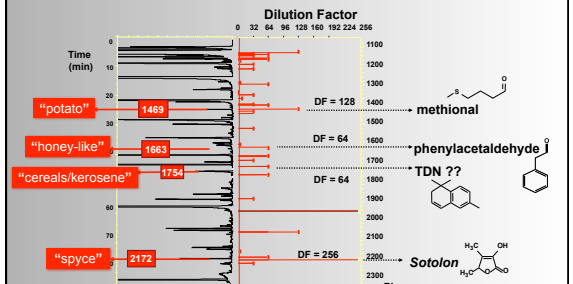


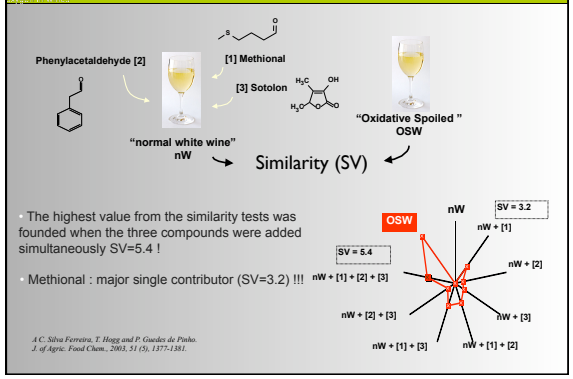


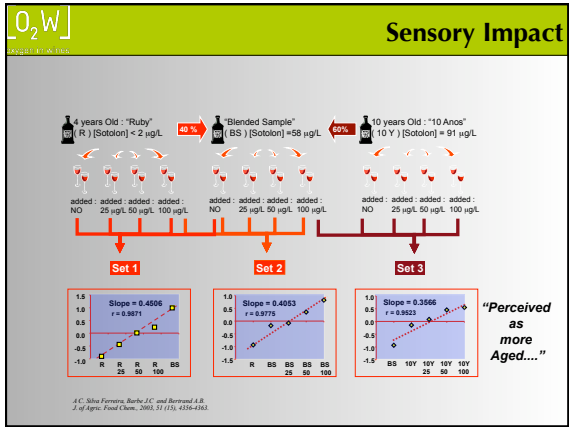
"Correlate Sensory & Chemical Data"

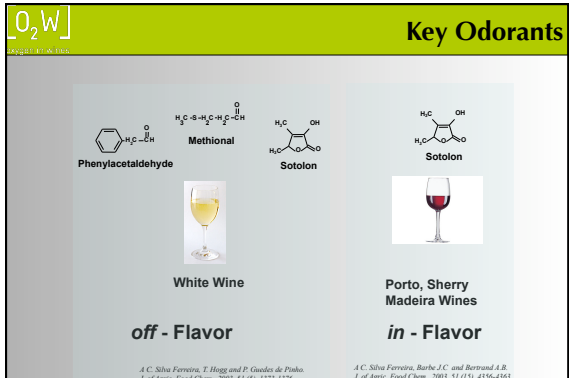


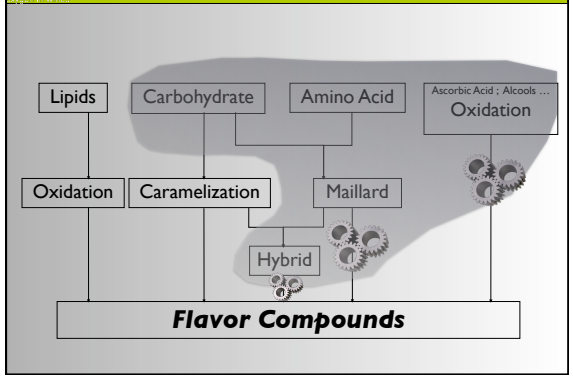
Ranking "OZ's" : AEDA




Phenylacetaldehyde [2]
[1] Methional
[3] Sotolon
"normal white wine"
nW
"Oxidative Spoiled"
OSW
Similarity (SV)
• The highest value from the similarity tests was founded when the three compounds were added simultaneously SV=5.4 !
• Methional : major single contributor (SV=3.2) !!!
OSW
nW
SV = 3.2
SV = 5.4
nW + [1]
nW + [2]
nW + [1] + [2] + [3]
nW + [2] + [3]
nW + [3]
nW + [1] + [3]
nW + [1] + [2]
A C. Silva Ferreira, T. Hogg and P. Guedes de Pinho. J. of Agric. Food Chem., 2003, 51 (5), 1377-1381.

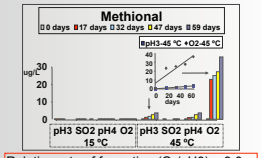

Sensory Impact
4 years Old : "Ruby"
(R) [Sotolon] < 2 µg/L
40 %
"Blended Sample"
(BS) [Sotolon] =58 µg/L
60%
10 years Old : "10 Anos"
(10 Y) [Sotolon] = 91 µg/L
added : NO
added : 25 µg/L
added : 50 µg/L
added : 100 µg/L
Set 1
Set 2
Set 3
Slope = 0.4506
r = 0.9871
Slope = 0.4053
r = 0.9775
Slope = 0.3566
r = 0.9523
"Perceived as more Aged...."
A C. Silva Ferreira, Barbe J.C and Bertrand A.B. J. of Agric. Food Chem., 2003, 51 (15), 4356-4363.


Key Odorants
Phenylacetaldehyde
Methional
Sotolon
White Wine
off - Flavor
Sotolon
Porto, Sherry
Madeira Wines
in - Flavor
A C. Silva Ferreira, T. Hogg and P. Guedes de Pinho.
A C. Silva Ferreira, Barbe J.C and Bertrand A.B.



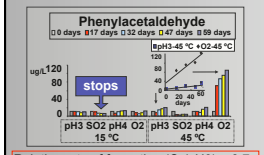
Key Odorants : Formation

- "Potato-Like"
- At pH = 3 and pH = 4 (T = 45ºC), the amounts of methional formed > threshold value (OAV = 7).
- In the samples treated with oxygen, the amount of methional formed was much higher (OAV = 37).



Relative rate of formation (O_2/pH3) = 9.0

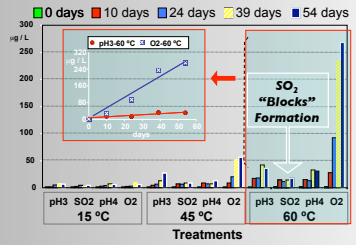
- "Honey-Like"
- The same behavior is observed for "phenylacetaldehyde", another "Strecker aldehyde"
- **Methional and Phenylacetaldehyde: SO_2 blocks its formation.**



Relative rate of formation (O_2/pH3) = 8.7

A C. Silva Ferreira, P. Guedes de Pinho P. Rodrigues T. Hogg J. of Agric. Food Chem., 2002, 50 (5), 5919-5929.

Key Odorants : Formation



Sotolon

RRF (O_2 / pH3) = 9.9

Major flavor impact compounds …

Sotolon | Methional | Phenylacetaldehyde

Rate of Formation Highly Dependent

Oxygen Regimen !!!

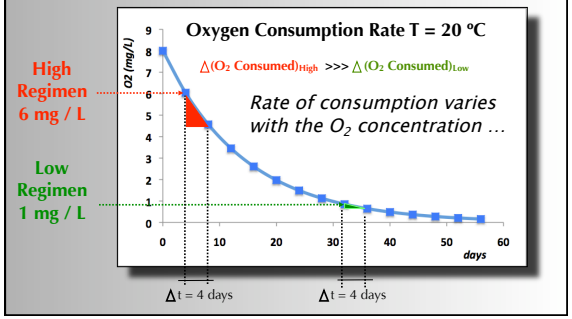
A.C. Silva Ferreira, Barbe J.C. and Bertrand A.B.
J. of Agric. Food Chem., 2003, 51 (15), 4356-4363.

A.C. Silva Ferreira, T. Hogg and P. Guedes de Pinho.
J. of Agric. Food Chem., 2003, 51 (5), 1377-1381.

O_2W Kinetics Studies : Oxygen Consumption

$$C_{O2}(t) = C_{O2}^{t(0)} \cdot exp(-K_{app} \cdot t)$$

$E_{a\,O2}$ = 2.6 kJ/mol
$K_{ref\,O2}$ = 0.134 days $^{-1}$

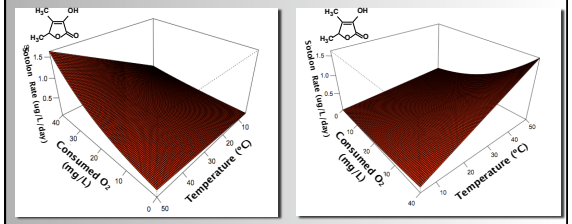


O_2W Kinetics Studies : Sotolon Formation

$$C_{Sot}^{t=i} = C_{Sot}^{t=0} + r_{Sot} \cdot t$$

$$r_{Sot} = C_{O_2}^{Cons} \cdot k_{ref}^{Sot} \cdot \exp\left[\frac{E_a^{Sot}}{R} \cdot \left(\frac{1}{T} - \frac{1}{T_{ref}}\right)\right]$$

$E_{a\,sot}$ = 38 kJ/mol
$K_{ref\,sot}$ = 0.012 days $^{-1}$

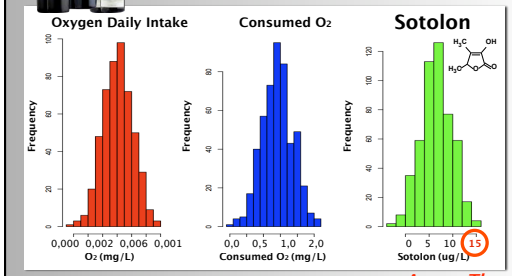


Sotolon formation :

"Monte Carlo" simulations : bottle

t = 3 years

T = 12 ºC
Permeability : 1,5 (mg/L)/ 365 (days)
"Monte Carlo" : 50 % dispersion



Aroma Threshold

Conclusion

In order to optimize "Sensory Quality" three conditions must be addressed :

1. "Brand Key" Oxygen dependence;
2. Kinetic parameters must be collected (Ea; K);
3. Oxygen regimes of the container need to be provided.