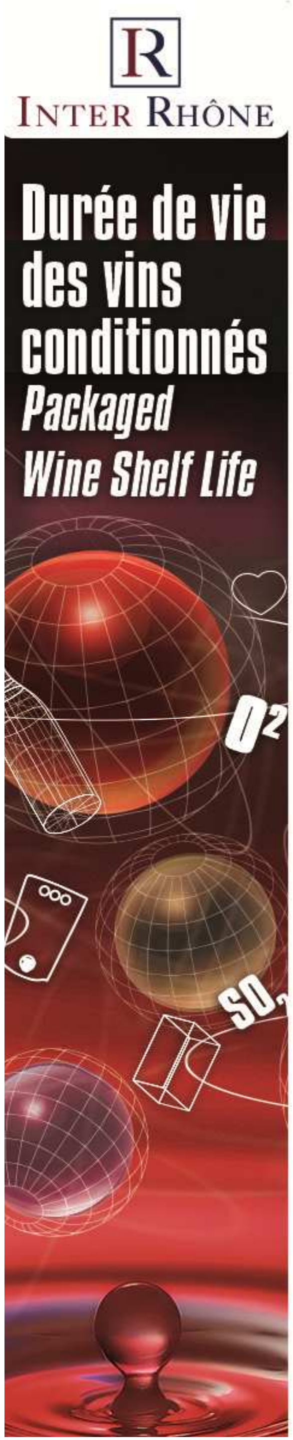

INTER RHÔNE
SO_2
O^2
Conférence Internationale
International Conference
Durée de vie des vins conditionnés
on Packaged Wine Shelf Life
Nouvelles Recherches, Méthodes et Perspectives
New Research, Methods and Perspectives
22 & 23 juin 2015
Palais des Papes, Avignon

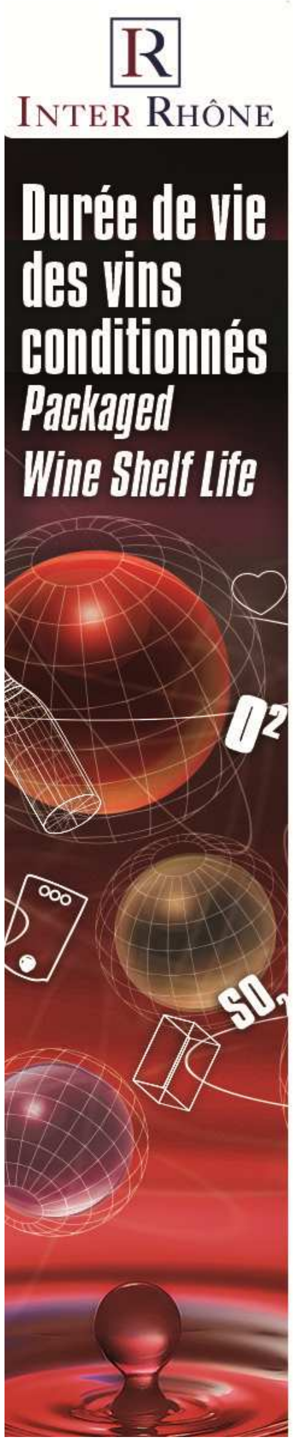


INRA SCIENCE & IMPACT
Unité expérimentale de
PECH ROUGE - UE 0999

COMPARISON OF GASEOUS EXCHANGES OF ROSÉ WINE BOTTLED IN PET AND GLASS AND IMPACT ON SULFITES

Comparaison des échanges gazeux d'un vin rosé en bouteille PET et verre et impact sur les sulfites

Jean-Claude VIDAL



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Novinpak®

FUI 2011-2014

R&D collaborative project
Monolayer PET like an alternative to glass

GAS ASSESSMENT
- HS and dissolved O_2, CO_2 & N_2 monitoring
- Analytical parametres monitoring

INRA Pech Rouge, Gruissan, France

UE Pech-Rouge

COLOR EVOLUTION & POLYPHENOL
INRA SPO, Montpellier, France
INRA Pech Rouge, Gruissan, France

AROMAS EVOLUTION
INRA IATE, Montpellier, France

SENSORY ASSESSMENT
Wine ageing
INRA SPO, Montpellier, France
INRA Pech Rouge, Gruissan, France

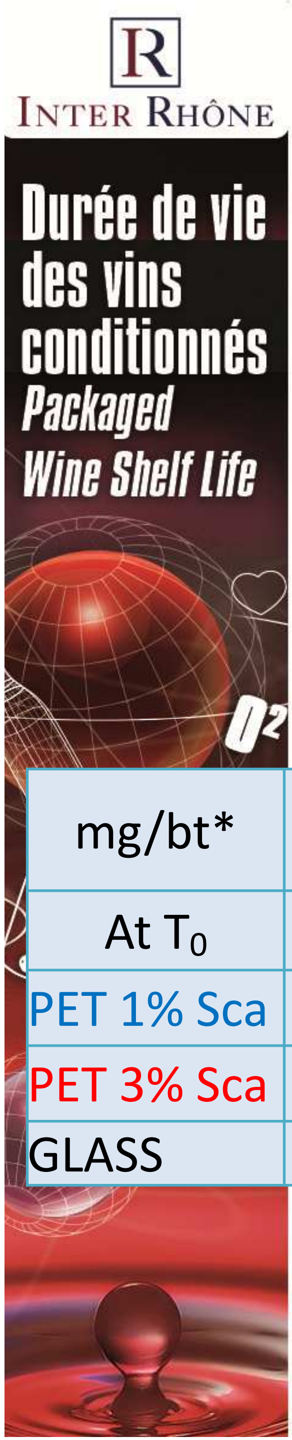
ENVIRONMENTAL PERFORMANCES
Life cycle analysis
INRA IRSTEA, Montpellier

INERTNESS OF PET & FOOD CONTACT SUITABILITY
PURE ENVIRONNEMENT, Perpignan

BARRIER PROPERTIES OF PET
Université Rouen

PET BOTTLE CONCEPTION
SIDEL, Le Havre

PRODUCTION CONSTRAINTS
UCCOAR, Carcassonne



Exchanges of gases in a bottle of wine

1st part: Toussaint M, Vidal J.C., Salmon J.M. **Comparative evolution of oxygen, carbon dioxide, nitrogen and sulfites during storage of a rosé wine bottled in PET and glass.** *J. Agric. Food Chem.* 2014, 62, 2946-2955.

2sd part :

- Dry Cinsault rosé wine 11.9%vol.
- Flint bottles 75 cL
- **Glass vs PET monolayer 38 g + 1% scavanger / 3% scavanger**
- Novatwist screwcaps with Saranex seals

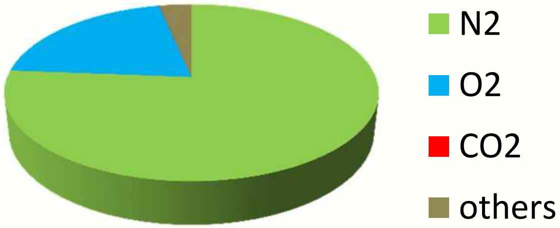
mg/bt*	D O_2 n = 5	HS O_2 n = 5	T O_2 n = 5	D CO_2 n = 5	HS CO_2 n = 5	f SO_2 n = 3
At T_0	PreSens	PreSens		Carbodoseur	µGC	Iodometry
PET 1% Sca	0.85 ± 0.12	3.60 ± 0.50	4.45 ± 0.62	718 ± 58	1.44 ± 0.48	31 ± 1
PET 3% Sca	1.05 ± 0.02	3.97 ± 0.22	5.02 ± 0.24	762 ± 17	2.04 (n = 1)	33 ± 1
GLASS	0.81 ± 0.14	4.20 ± 0.08	5.01 ± 0.22	771 ± 35	1.21 ± 0.15	32 ± 1

* Except for fSO_2 mg/L

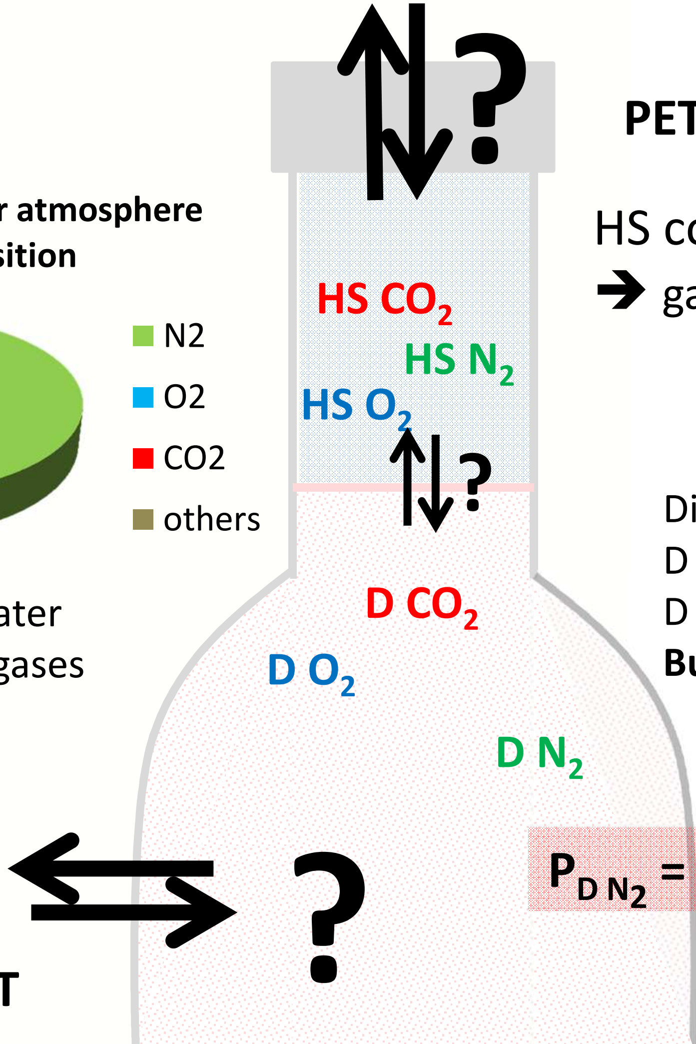
- Good homogeneity intra and inter procedures at bottling
- Storage 460 days at 20°C and 67%RH, upright in continous light

Exchanges of gases in a bottle of wine

Saturated water atmosphere composition



3% others: water vapor, noble gases



PET

PET & GLASS

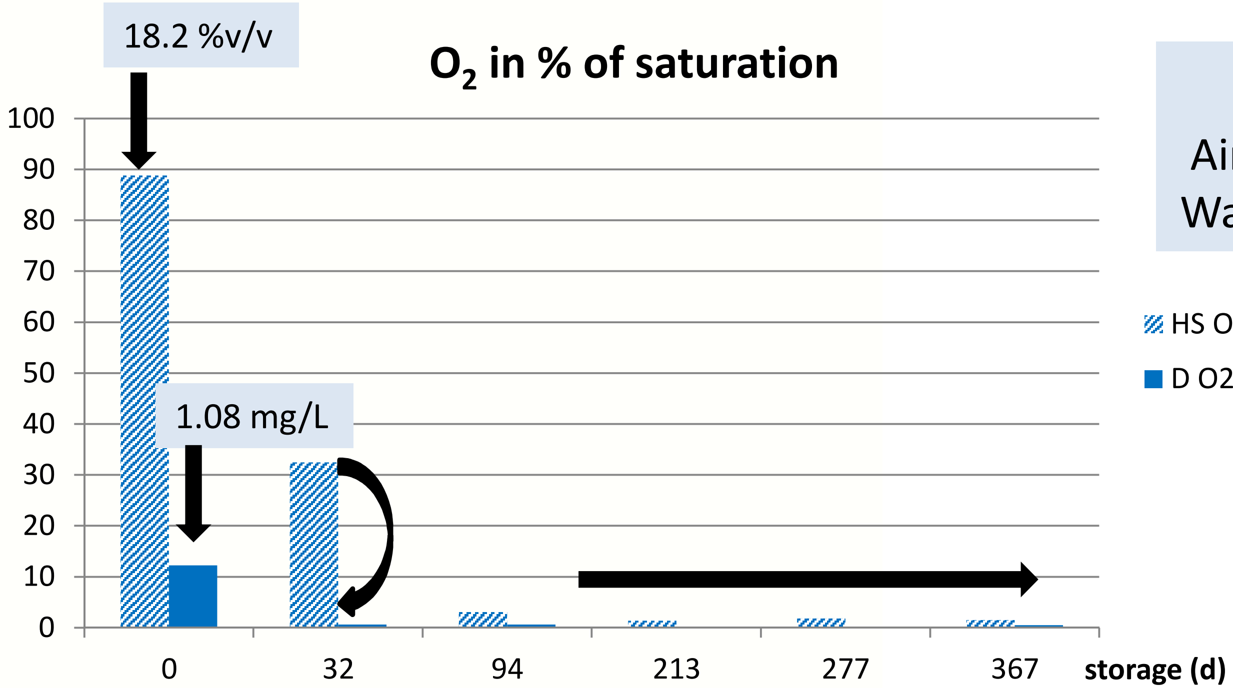
HS composition, P_{aphro}?
➔ gas chromatography

Dissolved gases in wine?
D O_2 ➔ Polarography (Orbisphère)
D CO_2 ➔ Volumetry (Carbodoseur)
But D N_2 not mesured, calculated

$$P_{D\,N_2} = 0.97 \times P_{tot} - P_{D\,O_2} - P_{D\,CO_2}$$

$$P_{tot} = P_{atmos} + P_{aphro}$$

O_2 exchange in a glass bottle



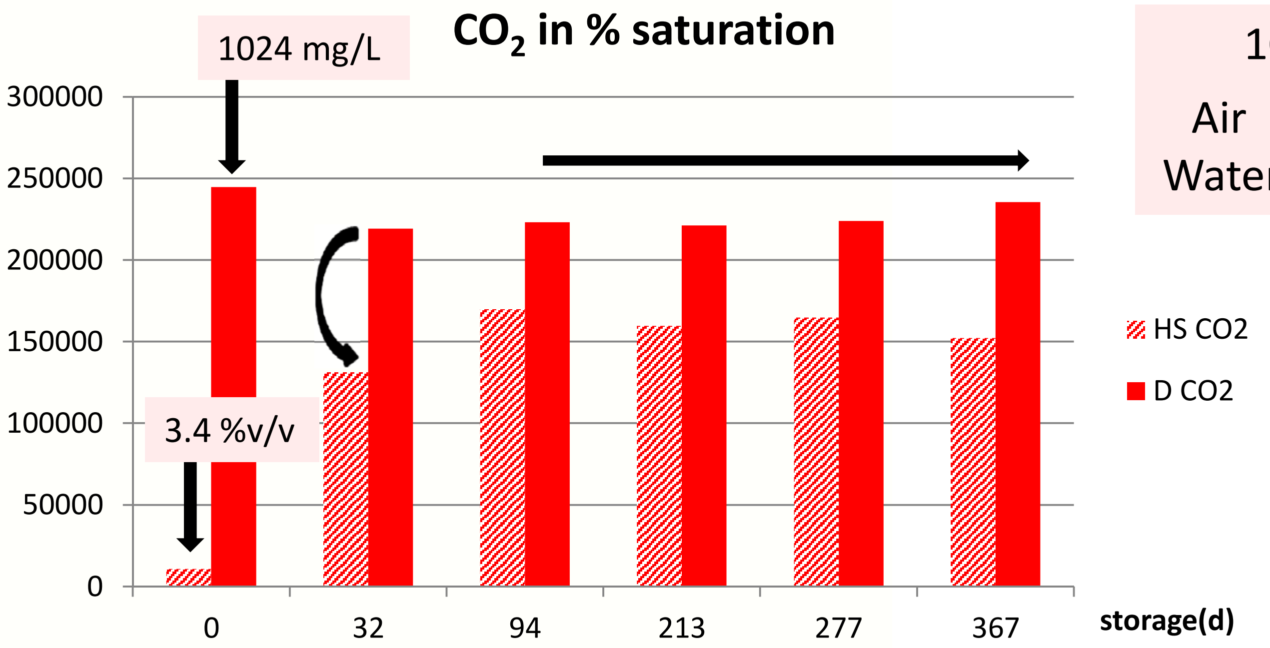
100% sat

Air 20.45% v/v

Water 9.1 mg/L

- % of saturation < 100%
  - ➔ O_2 tends to enter in bottle through screwcap to reach equilibrium
- % sat. D O_2 < %sat. HS O_2
  - ➔ O_2 tends to dissolve in wine
- After 3 months, both HS O_2 and D O_2 remain stable (≈ 0.05 mg/bt)
  - O_2 ingress through screwcap < O_2 consumption

CO_2 exchange in a glass bottle

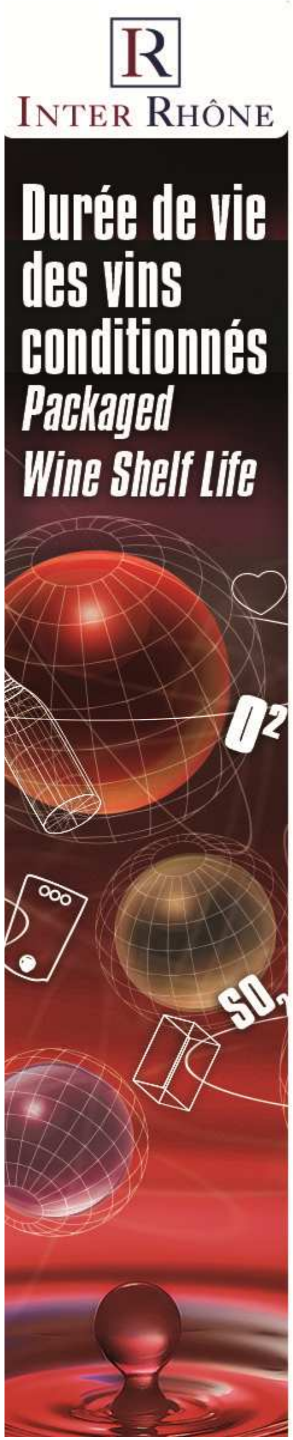


100% sat

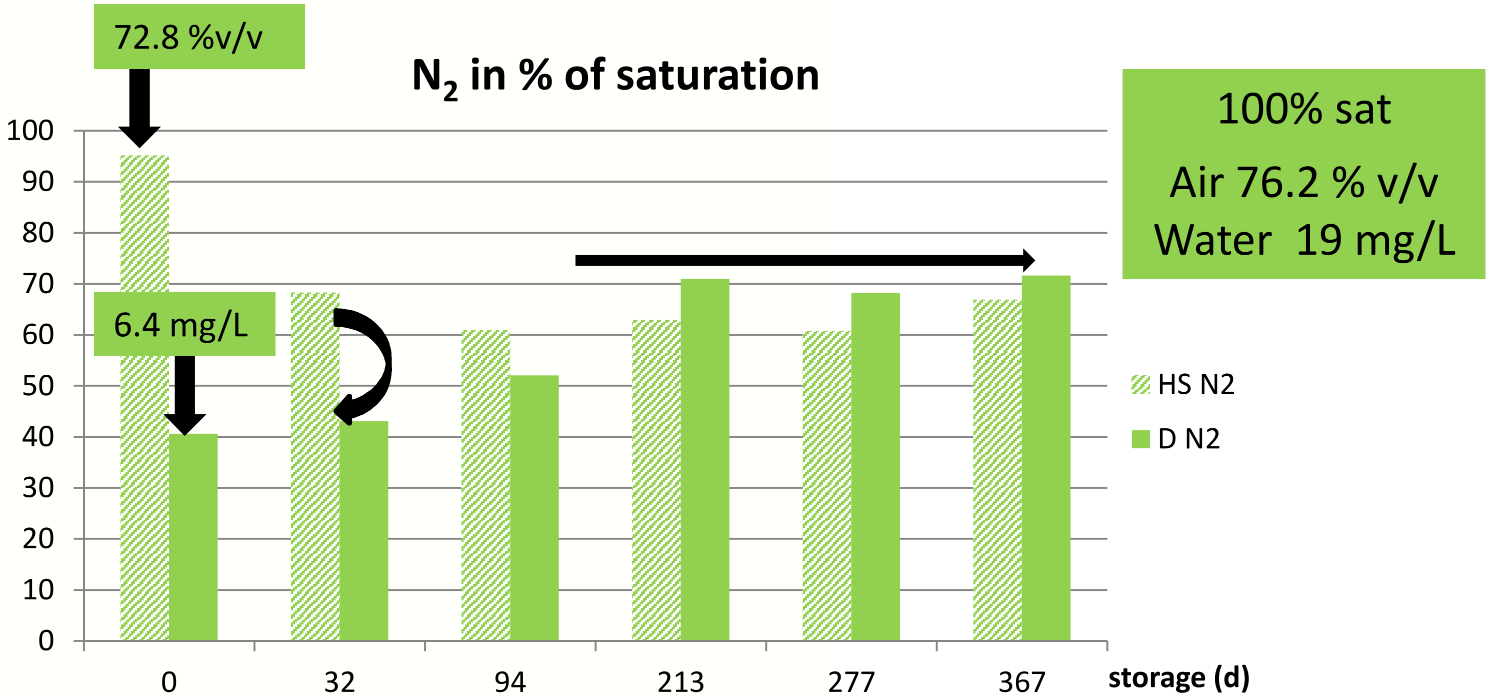
Air 0.03 % v/v

Water 0.64 mg/L

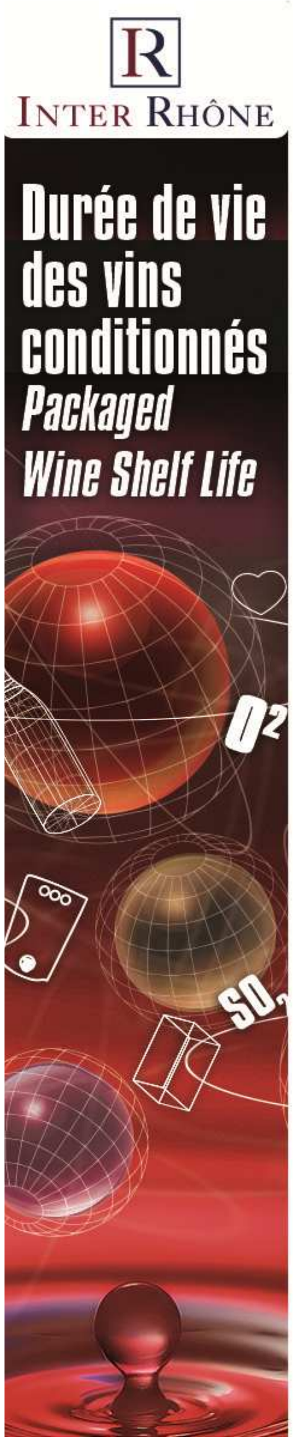
- % of saturation >>>>> 100%
  ➔ To reach equilibrium CO_2 tends to escape from bottle
- % sat. HS CO_2 < %sat. D CO_2 ➔ D CO_2 ===> HS
- After 1 month, both HS CO_2 and D CO_2 remain stable
  ➔ Losses of CO_2 by screwcap very low



N_2 exchange in a glass bottle



- % of saturation < 100%
  - ➔ N_2 tends to enter in bottle through screwcap to reach equilibrium
- % sat. D N_2 < % sat. HS N_2
  - ➔ N_2 tends to dissolve in wine
- After 1 month, both HS N_2 and D N_2 remain stable
  - ➔ N_2 ingress through screwcap very low



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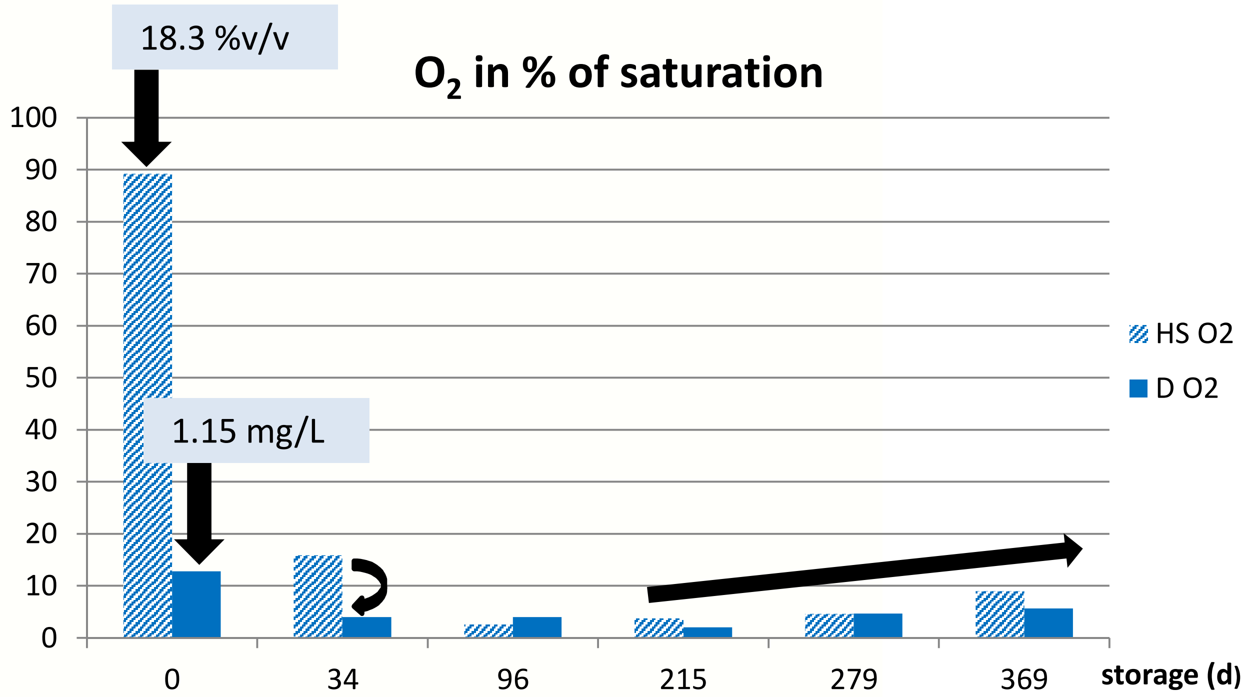
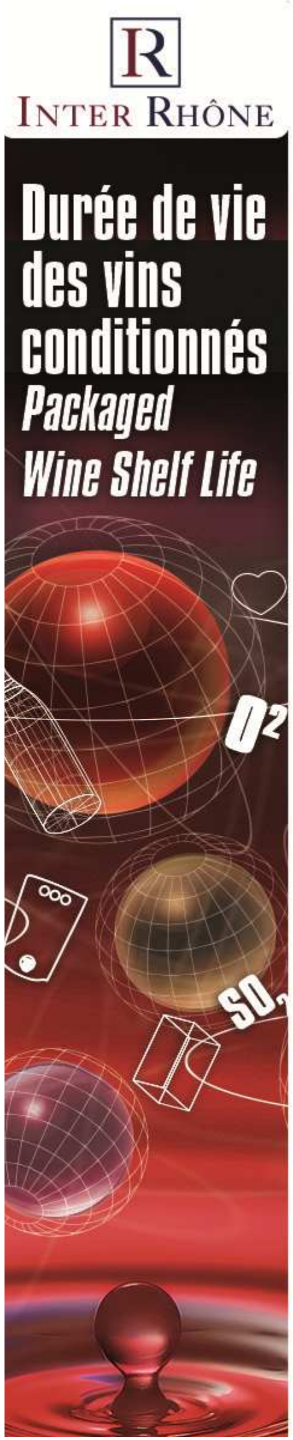
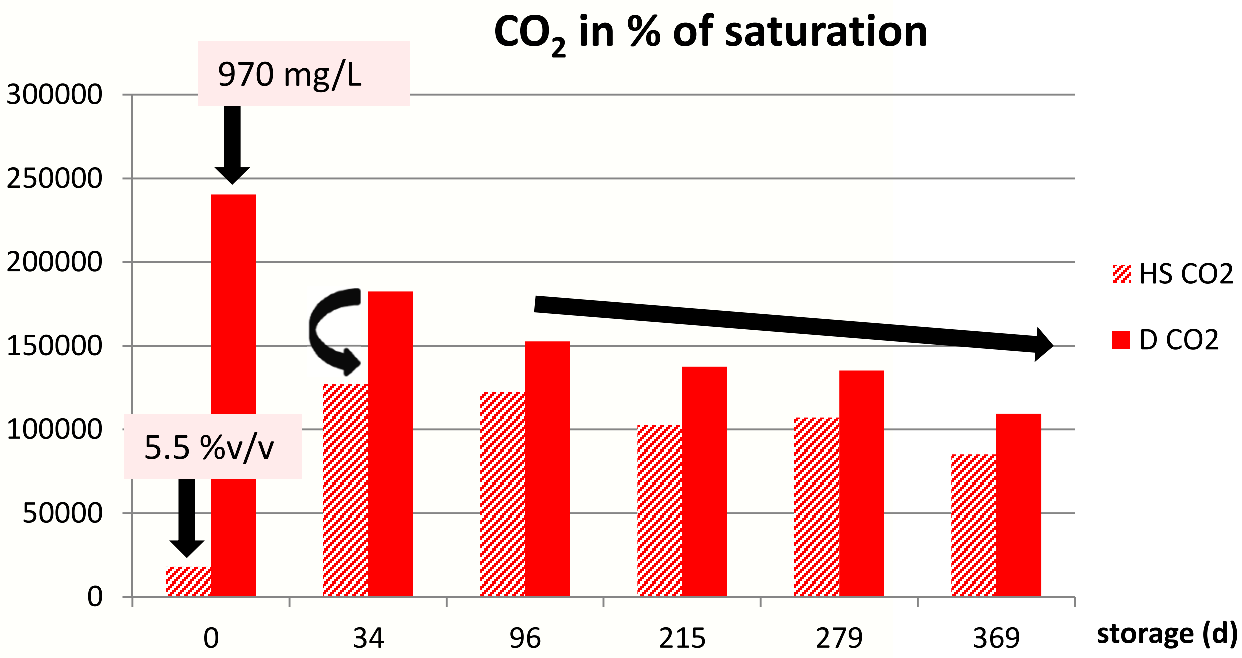
O_2 exchange in a PET 1% Sca bottle



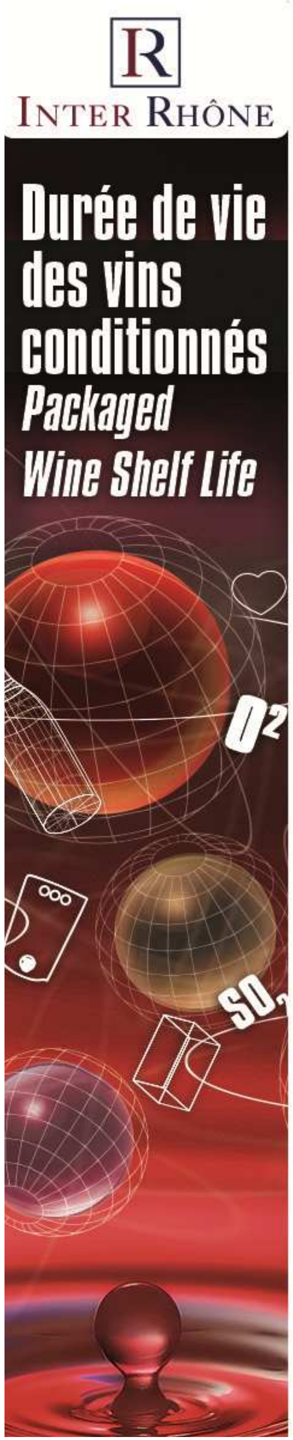
- % of saturation < 100% & % sat. D O_2 < %sat. HS O_2
  ➔ same thing than glass bottles
- After 3 months, HS O_2 and D O_2 increase
  O_2 consumption by wine becomes slowler than O_2 ingress
  but event less intense than with the virgen PET



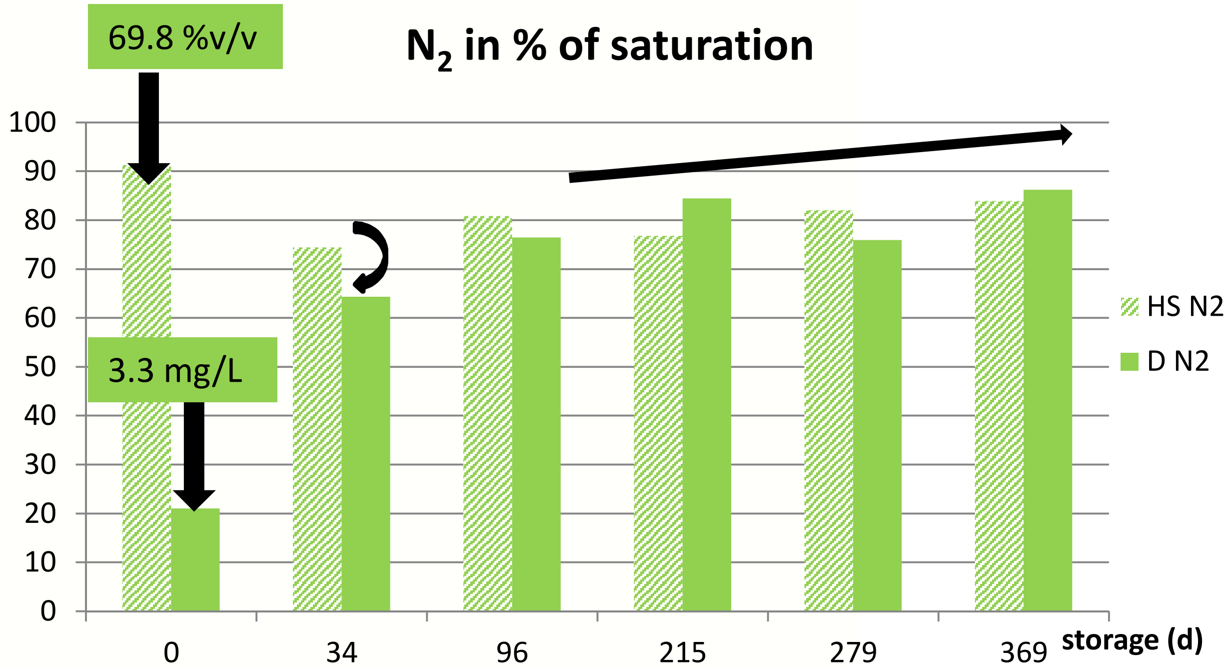
CO_2 exchange in a PET 1% Sca bottle



- % of saturation >>>>> 100% & % sat. HS CO_2 < %sat. D CO_2
  ➔ same thing than glass bottles
- After 3 months, both HS CO_2 and D CO_2 decrease
  ➔ favorable to O_2 and N_2 ingresses



N_2 exchange in a PET 1% Sca bottle



- % of saturation < 100% & % sat. D N_2 < %sat. HS N_2
  ➔ Same thing than glass bottle
- After 1 month, both HS N_2 and D N_2 increase
  ➔ No consumption by wine + CO_2 losses compensation

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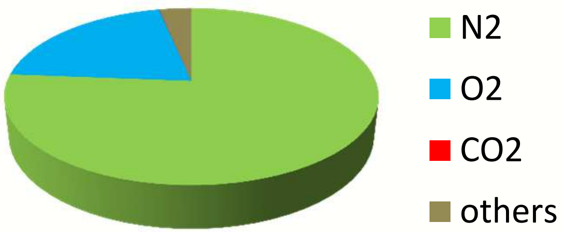
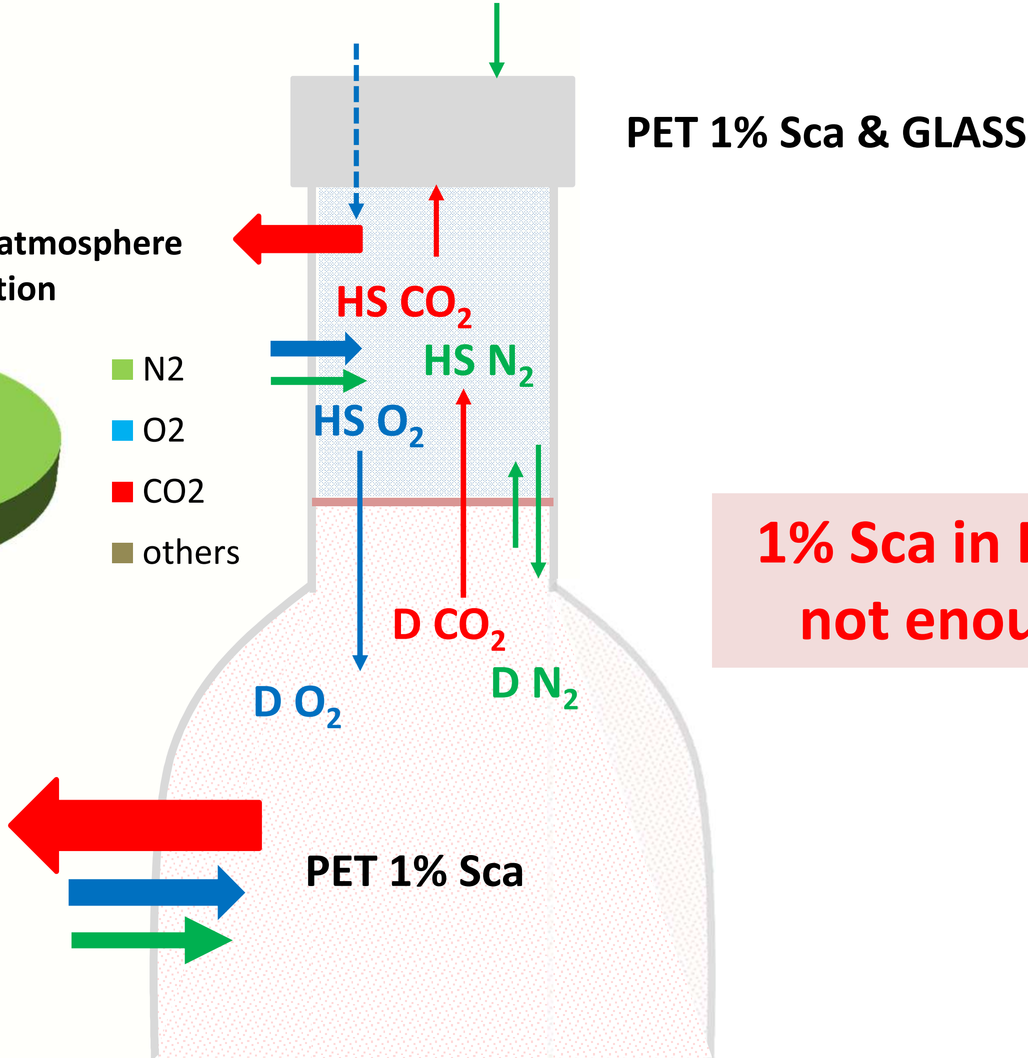
Exchanges of gases in a bottle of wine

Saturated water atmosphere composition



Others: water vapor, noble gases



1% Sca in PET is not enough!

Why manage O_2 at bottling?

Management of **headspace** and **dissolved gases**
+ Choice of **packaging**
= Key factors for **quality control** and **wine shelf-life**

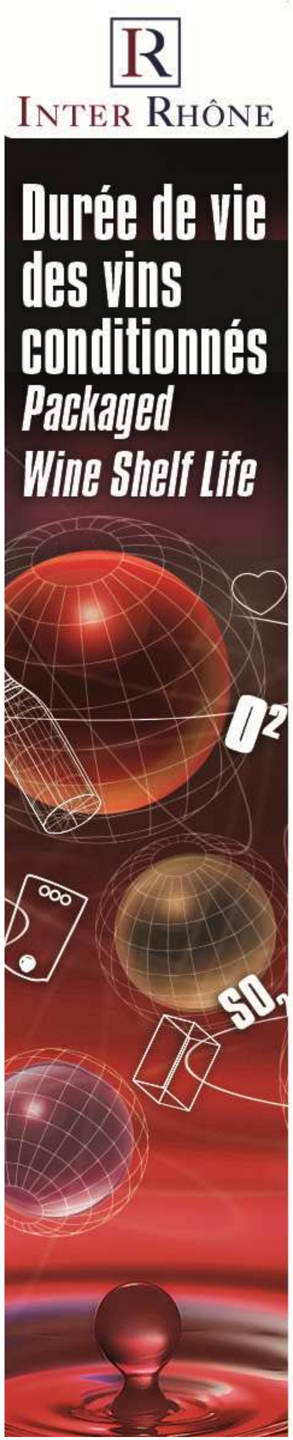
- O_2 ingresses during and after bottling → decrease of fSO_2

- Polyphenols oxidation

→ Sulfites react with products of wine oxidation and in particular with H_2O_2 produced when polyphenols are oxidized

→ wine becomes more sensitive to oxidation and ages faster

- **Below 10 mg/L of fSO_2 wine is not protected anymore**



Objective of study

- Reminder: storage during 460 days at 20°C
- Evolution of fSO_2 and total O_2 (TO) of a rosé wine
- OTR determined by luminescence thanks to bottles of acidified water
- Oxygen Ingresses (OI) & Consumed Oxygen (CO)

→ Date where fSO_2 content falls < 10 mg/L (linked with wine's shelf-life)

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Calculation of O_2 quantities

In wine's bottles

1. $Total\ O_2\ \boldsymbol{TO}_i = HSO_{2i} + DO_{2i}$
2. $O_2\ Ingresses\ \boldsymbol{OI}_i = TO_0 + (OTR\ \times i\ days)$
3. $Consumed\ O_2\ \boldsymbol{CO}_i = OI_i - TO_i$

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Determination of OTR (bottle + cap)

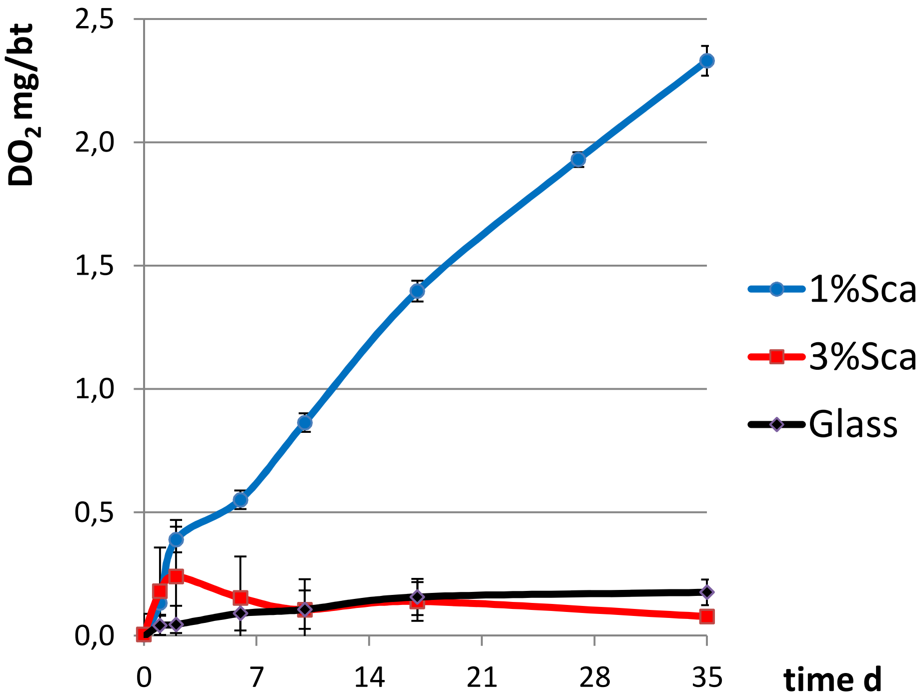
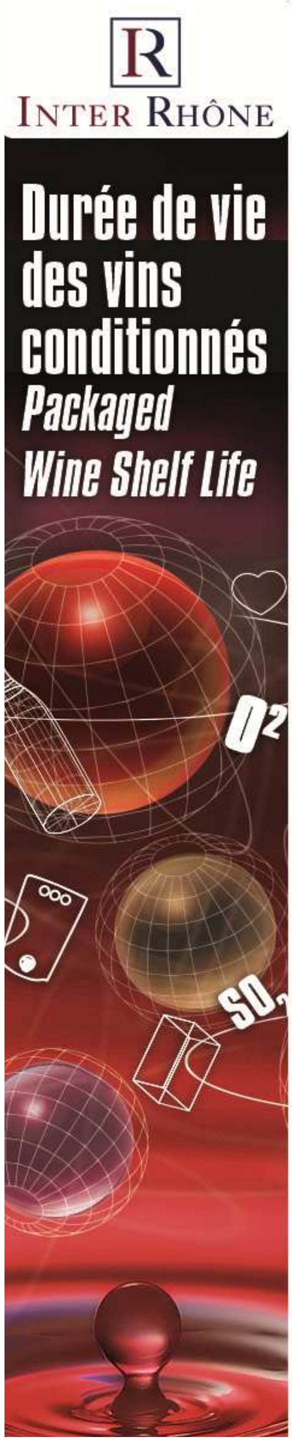


Figure: $DO_2 = f(t)$ for each acidified water procedure at 20°C. Averages and standard deviations are based on 3 bottles per procedure.

Procedure	OTR mg/d/bt	
	Luminescence	Mocon
PET1%Sca	0.0652	0.0411
PET3%Sca	≈ 0	0.0025
Glass	0.0046	0.0016



Evolution of TO in bottle

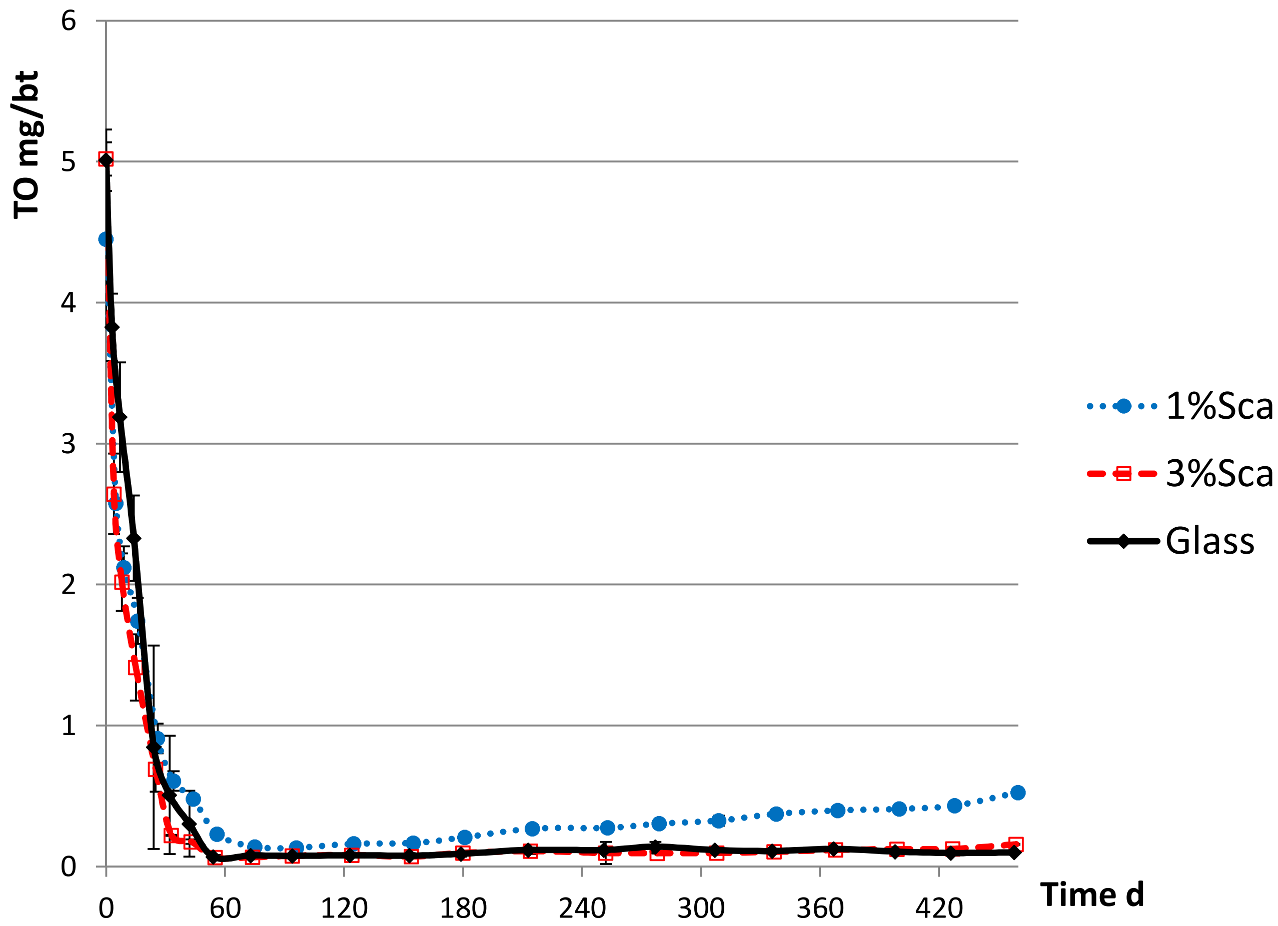
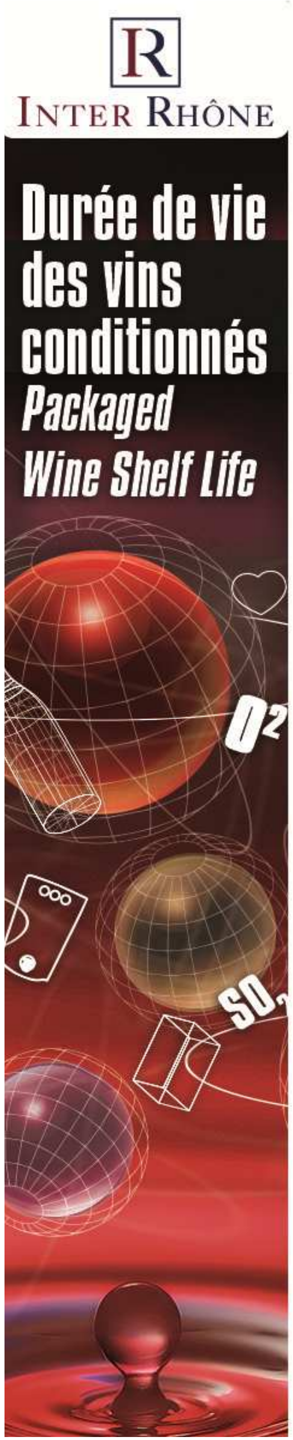


Figure: TO = f(t) for each wine procedure. Averages and standard deviations are based on 3 bottles per procedure.



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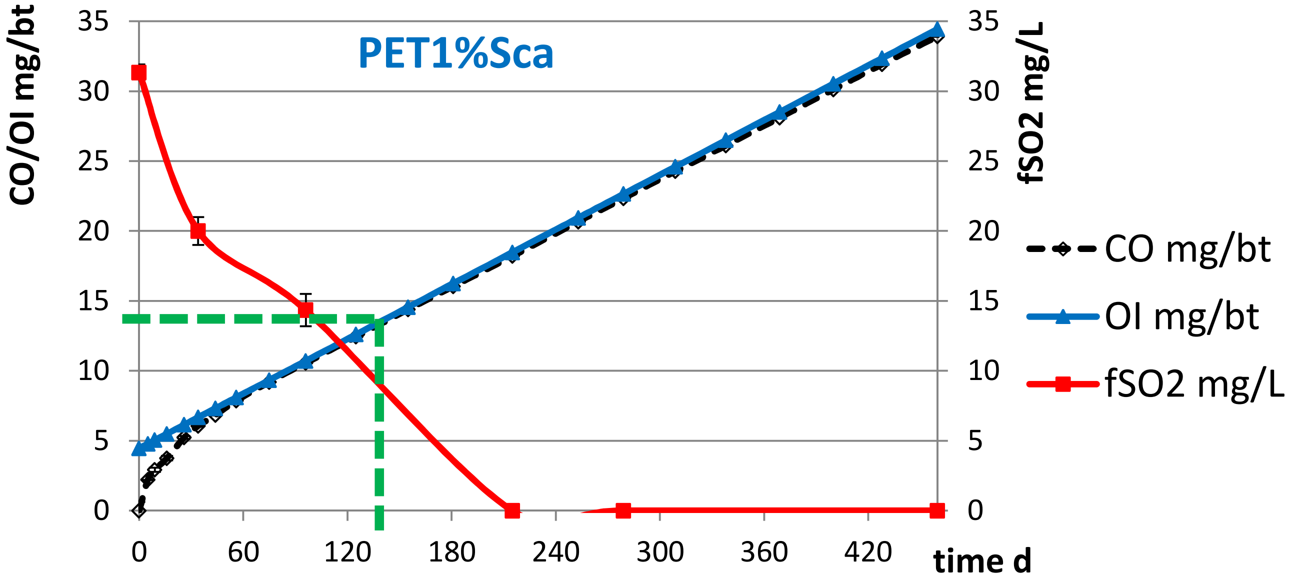
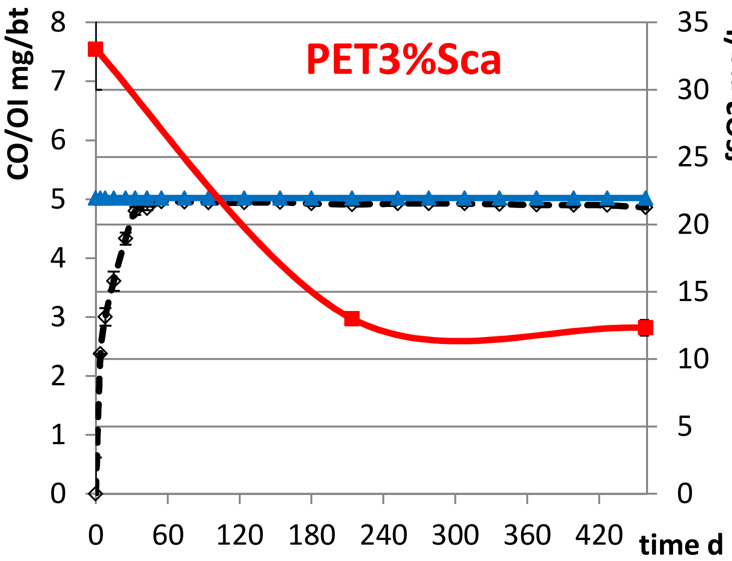
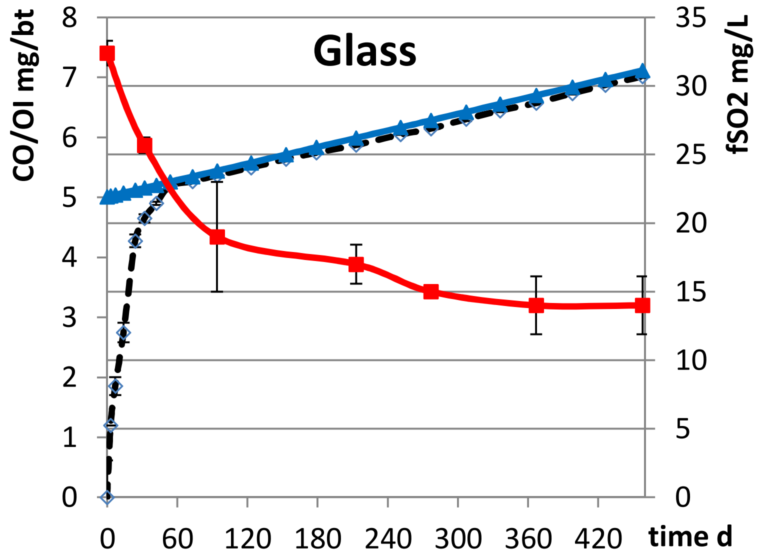
Evolution of CO, OI and fSO_2 in PET1%Sca, in PET3%Sca and in Glass







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Conclusion

- The approach consisting in using **OI instead of CO** to estimate wine's shelf-life is reasonable and easier, because the measurement of TO_i is not necessary to calculate OI (see equation 3)
- The determination of **TO and OTR** by luminescent method with optical spots sensors, coupled with values of **fSO_2**, represent a good and easy method to **estimate wine's shelf life**
- Novinpak showed that the **management of oxygen** at bottling and **the choice of packaging and its OTR** allow to reach the desired shelf life in agreement with **the mode of consumption**

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Thank you for your attention

Merci pour votre attention

Gracias por su atención

Grazie per la vostra attenzione

Obrigado por sua atenção

www.novinpak.org

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