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Nouvelles Recherches, Méthodes et Perspectives  New Research, Methods and Perspectives
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Palais des Papes, Avignon
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

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Novinpak®
FUI 2011-2014

GAS ASSESSMENT
- HS and dissolved O₂, CO₂ & N₂ monitoring
- Analytical parameters monitoring
INRA Pech Rouge, Gruissan, France

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

R&D collaborative project
Monolayer PET like an alternative to glass
Exchanges of gases in a bottle of wine


2nd 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 O₂  
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>n = 5</td>
<td></td>
<td>n = 5</td>
<td></td>
<td>n = 5</td>
<td></td>
<td>n = 3</td>
</tr>
<tr>
<td>At T₀</td>
<td>PreSens</td>
<td>PreSens</td>
<td>Carbodoseur</td>
<td>μGC</td>
<td>Iodometry</td>
<td></td>
</tr>
<tr>
<td>PET 1% Sca</td>
<td>0.85 ± 0.12</td>
<td>3.60 ± 0.50</td>
<td>4.45 ± 0.62</td>
<td>718 ± 58</td>
<td>1.44 ± 0.48</td>
<td>31 ± 1</td>
</tr>
<tr>
<td>PET 3% Sca</td>
<td>1.05 ± 0.02</td>
<td>3.97 ± 0.22</td>
<td>5.02 ± 0.24</td>
<td>762 ± 17</td>
<td>2.04 (n = 1)</td>
<td>33 ± 1</td>
</tr>
<tr>
<td>GLASS</td>
<td>0.81 ± 0.14</td>
<td>4.20 ± 0.08</td>
<td>5.01 ± 0.22</td>
<td>771 ± 35</td>
<td>1.21 ± 0.15</td>
<td>32 ± 1</td>
</tr>
</tbody>
</table>

* Except for fSO₂ mg/L

- Good homogeneity intra and inter procedures at bottling
- Storage 460 days at 20°C and 67%RH, upright in continuous light
Exchanges of gases in a bottle of wine

Saturated water atmosphere composition

- N2
- O2
- CO2
- others

3% others: water vapor, noble gases

Dissolved gases in wine?
- D O2 → Polarography (Orbisphère)
- D CO2 → Volumetry (Carbodoreuse)

But D N2 not measured, calculated

**PET & GLASS**

HS composition, P_{aphro}?

→ gas chromatography

\[ P_{DN2} = 0.97 \times P_{tot} - P_{DO2} - P_{DCO2} \]

\[ P_{tot} = P_{atmos} + P_{aphro} \]
$O_2$ exchange in a glass bottle

- $O_2$ 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 ($\approx 0.05$ mg/bottle)
- $O_2$ ingress through screwcap $< O_2$ consumption
**CO₂ exchange in a glass bottle**

- % of saturation >>> 100%
  - To reach equilibrium CO₂ tends to escape from bottle

- % sat. HS CO₂ < %sat. D CO₂ ➔ D CO₂ ===> HS

- After 1 month, both HS CO₂ and D CO₂ remain stable
  - Losses of CO₂ by screwcap very low

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**Table:**

- **Air:** 0.03 % v/v
- **Water:** 0.64 mg/L

**Graph:**

- CO₂ in % saturation
- Storage (d)

- 1024 mg/L
- 3.4 %v/v
• % 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
O₂ exchange in a PET 1% Sca bottle

- % of saturation < 100% & % sat. D O₂ < %sat. HS O₂
  - same thing than glass bottles
- After 3 months, HS O₂ and D O₂ increase
  - O₂ consumption by wine becomes slower than O₂ ingress but event less intense than with the virgen PET
CO₂ exchange in a PET 1% Sca bottle

- % of saturation >>>>> 100% & % sat. HS CO₂ < %sat. D CO₂
  - same thing than glass bottles
- After 3 months, both HS CO₂ and D CO₂ decrease
  - favorable to O₂ and N₂ 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
Exchanges of gases in a bottle of wine

Saturated water atmosphere composition

Others: water vapor, noble gases

PET 1% Sca & GLASS

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 $\Rightarrow$ decrease of fSO$_2$
- Polyphenols oxidation
  $\Rightarrow$ Sulfites react with products of wine oxidation and in particular with H$_2$O$_2$ produced when polyphenols are oxidized
  $\Rightarrow$ 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 fSO₂ and total O₂ (TO) of a rosé wine
- OTR determined by luminescence thanks to bottles of acidified water
- Oxygen Ingresses (OI) & Consumed Oxygen (CO)

➔ Date where fSO₂ content falls < 10 mg/L (linked with wine’s shelf-life)
Calculation of O$_2$ quantities

In wine’s bottles

1. Total $O_2$ $TO_i = HSO_{2i} + DO_{2i}$

2. O$_2$ Ingresses $OI_i = TO_0 + (OTR \times i \text{ days})$

3. Consumed $O_2$ $CO_i = OI_i - TO_i$
Determination of OTR (bottle + cap)

Figure: DO₂ = f(t) for each acidified water procedure at 20°C. Averages and standard deviations are based on 3 bottles per procedure.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>OTR mg/d/bt</th>
<th>Luminescence</th>
<th>Mocon</th>
</tr>
</thead>
<tbody>
<tr>
<td>PET1%Sca</td>
<td>0.0652</td>
<td>0.0411</td>
<td></td>
</tr>
<tr>
<td>PET3%Sca</td>
<td>≈ 0</td>
<td>0.0025</td>
<td></td>
</tr>
<tr>
<td>Glass</td>
<td>0.0046</td>
<td>0.0016</td>
<td></td>
</tr>
</tbody>
</table>
Figure: $TO = f(t)$ for each wine procedure. Averages and standard deviations are based on 3 bottles per procedure.
Evolution of CO, OI and fSO$_2$ in PET1%Sca, in PET3%Sca and in Glass
Conclusion

• The approach consisting in using OI instead of CO to estimate wine’s shelf-life is reasonable and easier, because the measurement of TOᵢ 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 fSO₂, 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
Thank you for your attention

Merci pour votre attention

Gracias por su atención

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www.novinpak.org

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