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Oxygen management in wine

WEA, Barossa, June 2009

Mai Nygaard

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Overview of presentation

Integrated Oxygen management

PreSens technology

Post bottling chemistry

- Impact of OTR on sensory

Bottling line application

- Total Package Oxygen (TPO)

Future Perspectives

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Context: Need for O_2 Management in Wines

Wine faults , International Wine Challenge, London 2006 to 2008

Main Category	Category	2006	2007	2008
Taint	Musty cork taint	27.8%	29.7%	31.1%
Oxidation	Oxidation	24.3%	22.9%	19.1%
Reduction	Sulfides	29.3%	26.5%	28.9%
Micro		16.8%	19.1%	17.2%
Miscellaneous		1.8%	1.8%	3.7%
Total % of faults		7.1%	6.9%	5.9%

Oxygen management related issues account for almost 50% of all faults with roughly **3% of all wines affected** (based on 2008 figures).(Data from Sam Harrop)

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Adelaide Wine Show, 2008

Adelaide Wine Show entries: 2598 wines

97% of white table wines and 77 % of red table wines under non-cork closures

According to wine judges:
302 wines displayed faults – 12%

Fault breakdown (some wines displayed multiple faults):

3 % Oxidized
2 % Reduced
3 % Brett
2 % VA
1 % Cork (TCA)
4 % Other

Reduction + oxidation corresponds to **5 %** or 130 wine entries!

Source: AWRI, Oct 2008

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Oxygen Management throughout the Value Chain

FOCUS ON BOTTLING & POST-BOTTLING

[O2W] oxygen in wines

www.o2inwines.org

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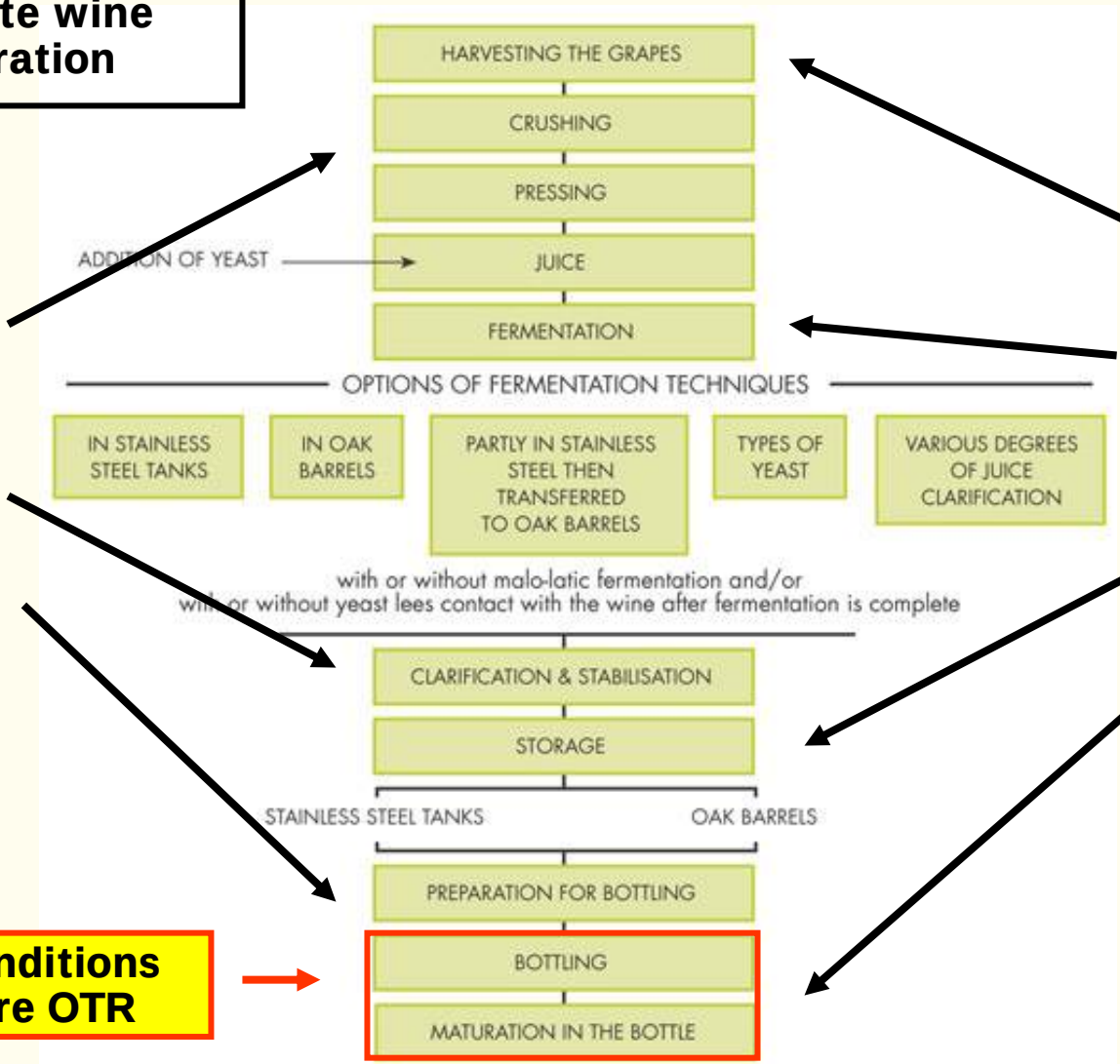
O2 control points

e.g. white wine preparation



No O2

Control O2

Bottling conditions and Closure OTR

Nomacorc's collaborative Research Program Details

University California, Davis, U.S.; Dr. Andrew Waterhouse
Mechanisms governing oxidation; Chardonnay, Cabernet Sauvignon

INRA, Montpellier, France; Dr. Véronique Cheynier
Oxygen influence on evolution of polyphenolics ; Grenache Rosé, Grenache Rouge

Geisenheim Institute, Geisenheim Germany; Dr. Rainer Jung
Influence of bottling conditions; Riesling

University Catolica, Santiago, Chile; Dr. Eduardo Agosin
Influence of oxygen on aroma development; Carmènere

AWRI, Adelaide, Australia; Dr. Elizabeth Waters
Influence of oxygen ingress on reduction and oxidation
Sauvignon Blanc, Shiraz

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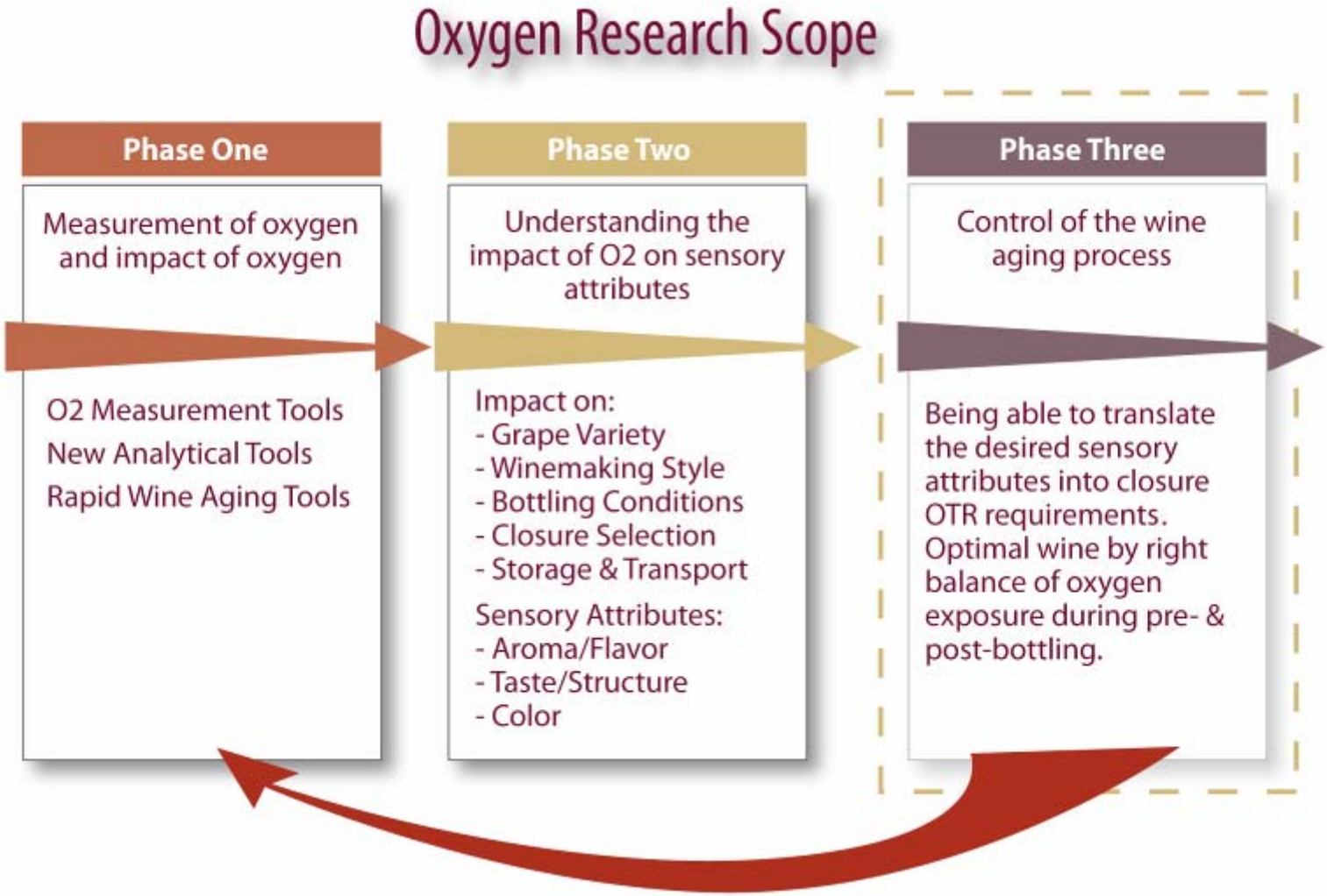
Nomacorc research scope



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Measuring Oxygen

Nomacorc/Presens Solution

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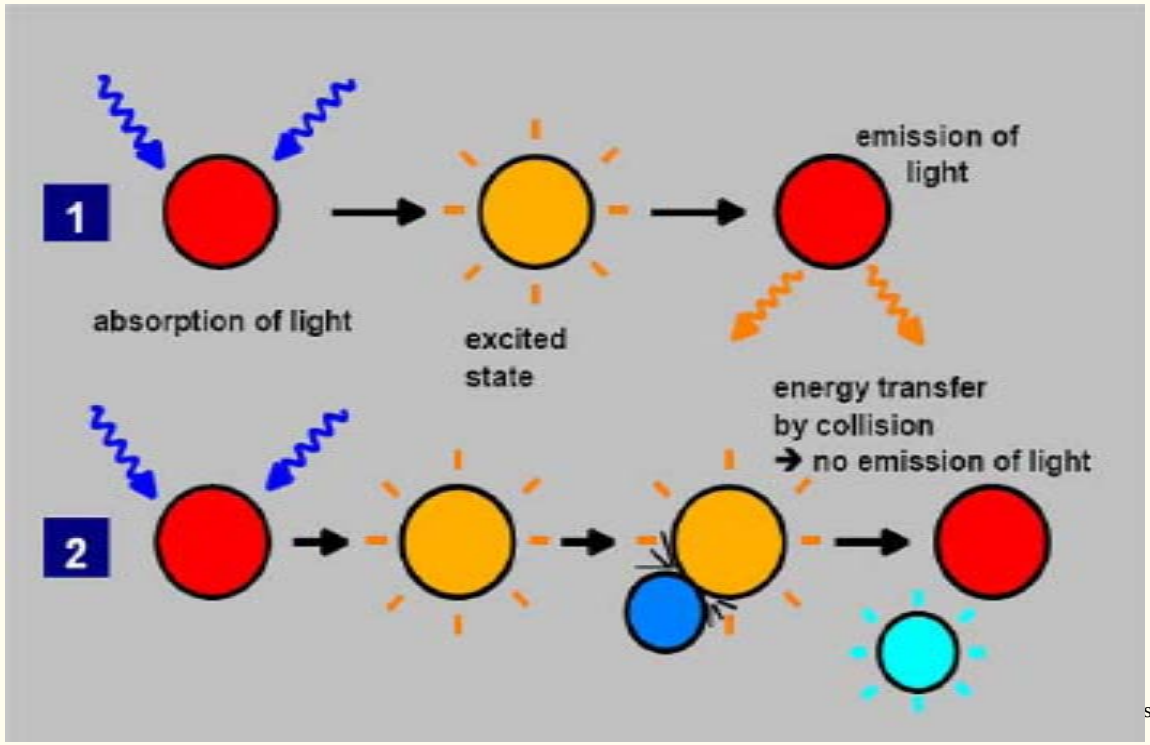
New tool to monitor and control oxygen in wine

Nomacorc is distributing to the global wine industry a new analytical tool from PreSens for measuring oxygen

- Non destructive oxygen measurement based on oxo-luminescense principle
- Light emission depending on oxygen concentration in gas or solution
- Accurate, reliable and easy to use



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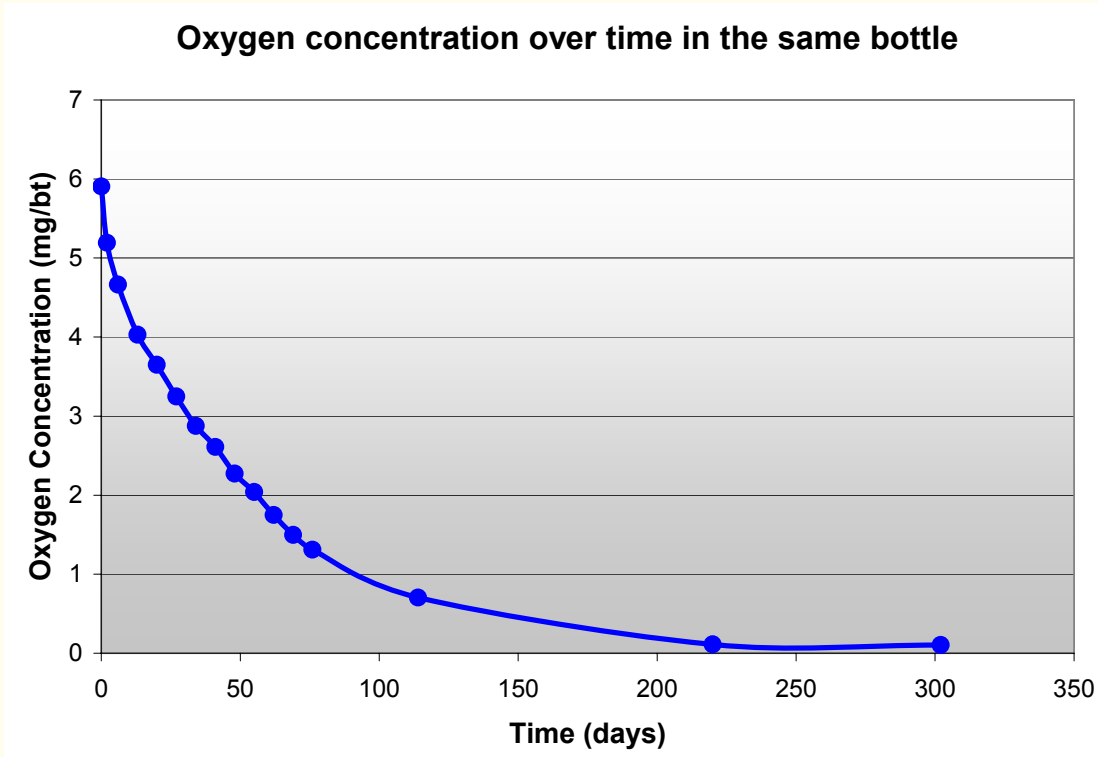
Non-invasive & Non-destructive



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Understanding Oxygen

OTR impact on aroma, flavour and colour development

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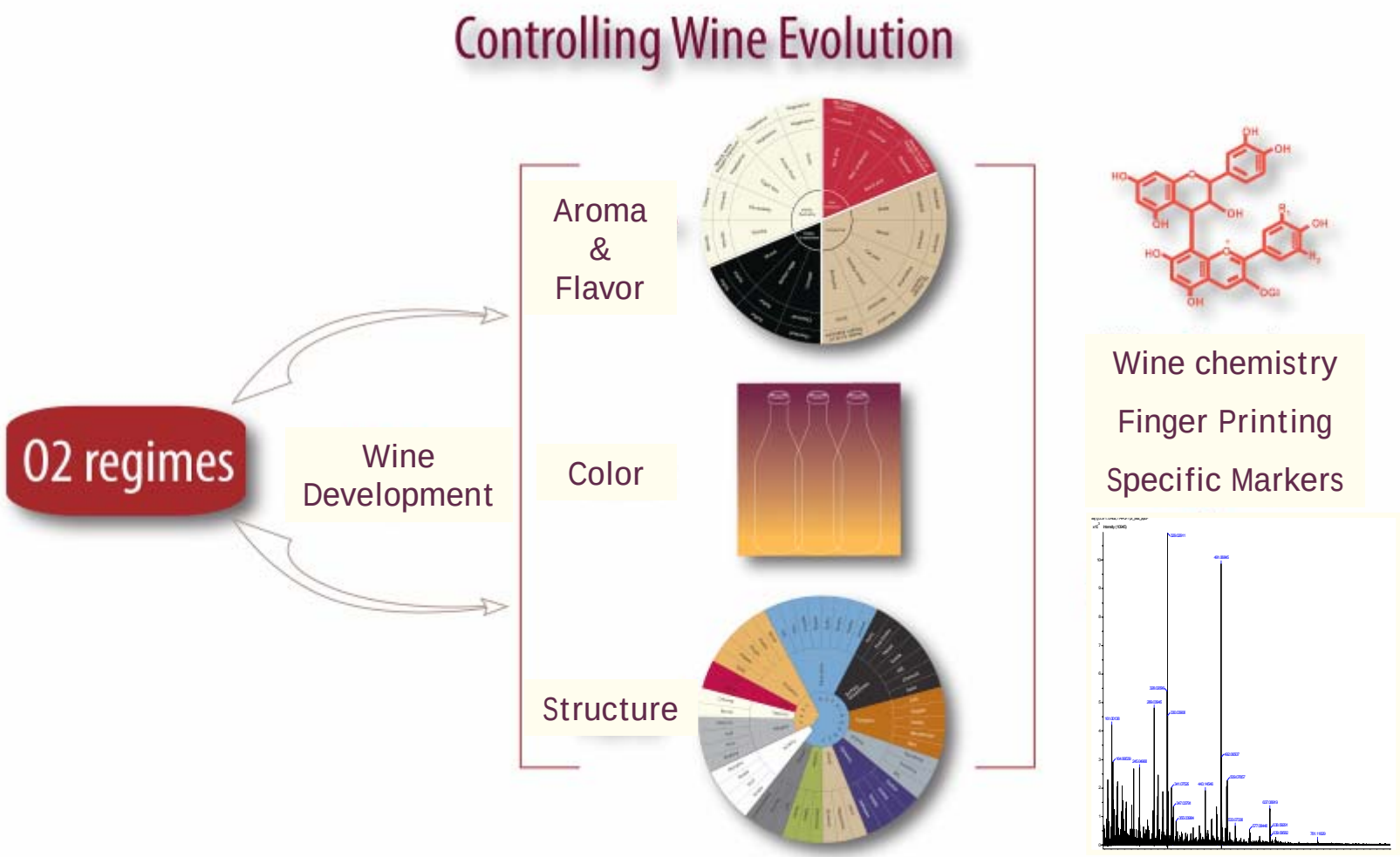
Controlling Wine Evolution



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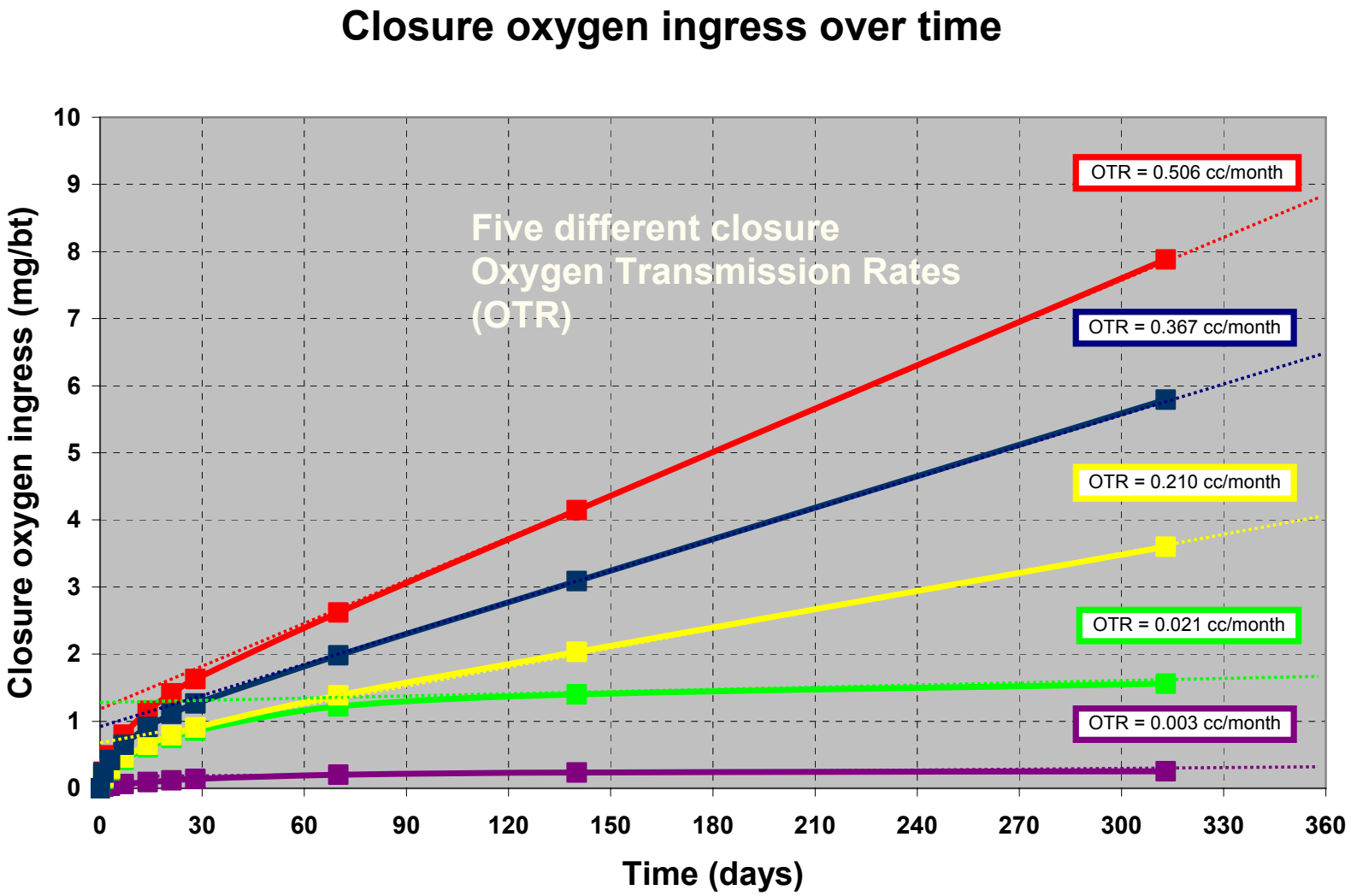
Closure oxygen ingress measurement



AWRI commercial closure trial, 18 months results

Bottling in 2007

Semillon Wine

Reference Natural Cork
Screw Cap, Saran Tin liner
Reference synthetic

Classic, Classic+, Premium,
Next Generation Premium

DO at bottling between 0.5 and 0.8 ppm
No measurement of oxygen from Head Space

Chemical and sensory analysis at AWRI

Monitoring planned for 24 months

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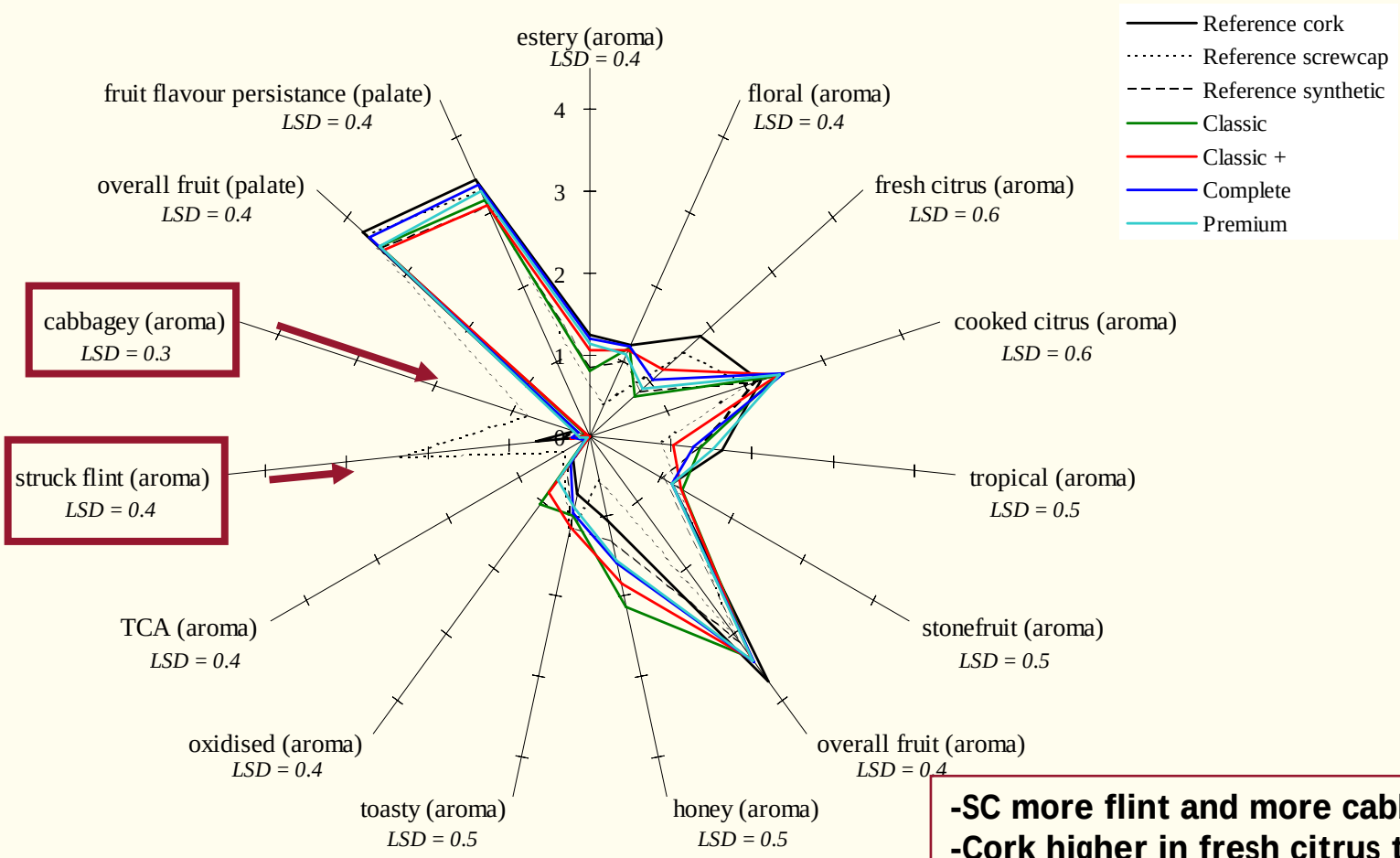
Reduced notes can develop under low OTR conditions



-SC more flint and more cabbagey
-Cork higher in fresh citrus than SC
-SC less honey

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The 'bad' thiols

LMWS compound	Reference 2 natural cork (µg/L)	Reference Screwcap (µg/L)	Reference synthetic cork (µg/L)	Classic (µg/L)	Classic+ (µg/L)	Complete (µg/L)	Premium (µg/L)	LMWS compound aroma threshold (µg/L)
Carbon disulfide	5.7 (0.33)	5.7 (0.33)	3.7 (0.33)	4.3 (0.33)	4.0 (0.00)	4.0 (0.00)	5.7 (0.33)	5
Diethyl disulfide	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	4
Diethyl sulfide	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	1
Dimethyl disulfide	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	10
Dimethyl sulfide	16 (1.5)	18 (1.0)	16 (0.0)	17 (0.58)	17 (0.58)	17 (0.33)	16 (1.3)	25
Ethanethiol	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	1.5
Ethyl thioacetate	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	70
Hydrogen sulfide	1.2 (0.44)	2.0 (0.0)	Trace	Trace	1.2 (0.44)	Trace	1.8 (0.73)	1
Methyl thioacetate	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	40
Methanethiol	n.d.	3.7 (0.33)	n.d.	n.d.	n.d.	n.d.	n.d.	1.5

Methanethiol significantly higher in reduced wines

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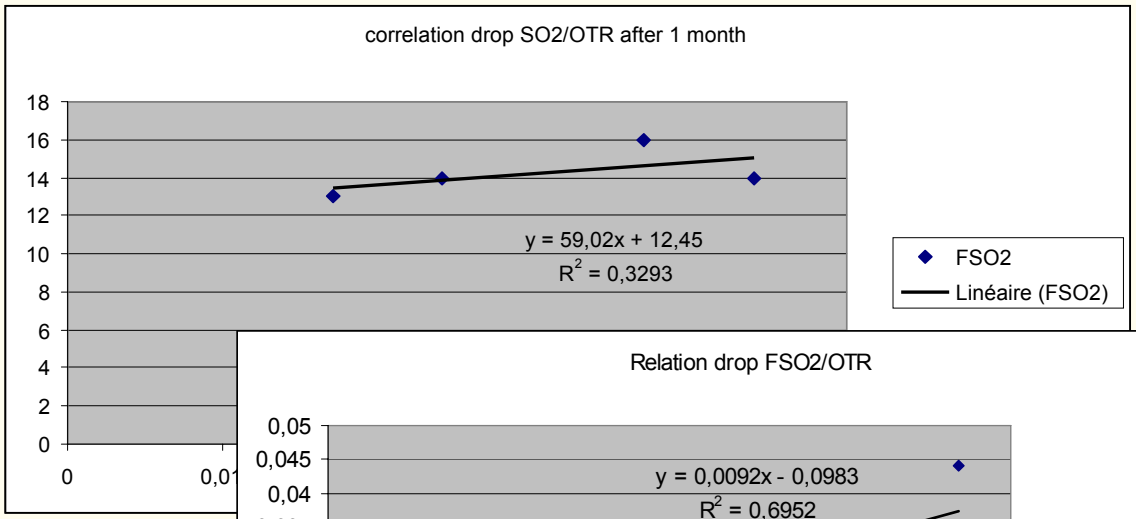
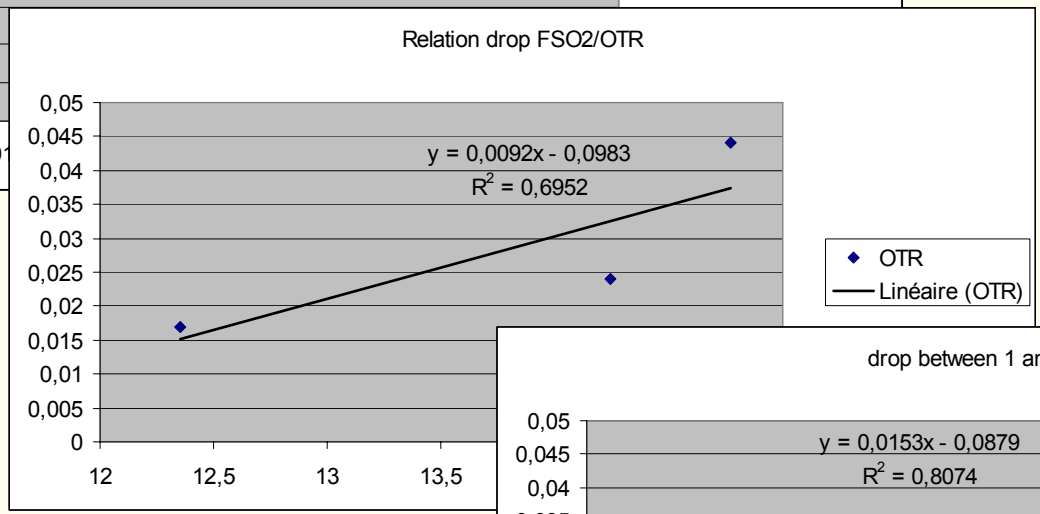
Correlation drop FSO2/OTR

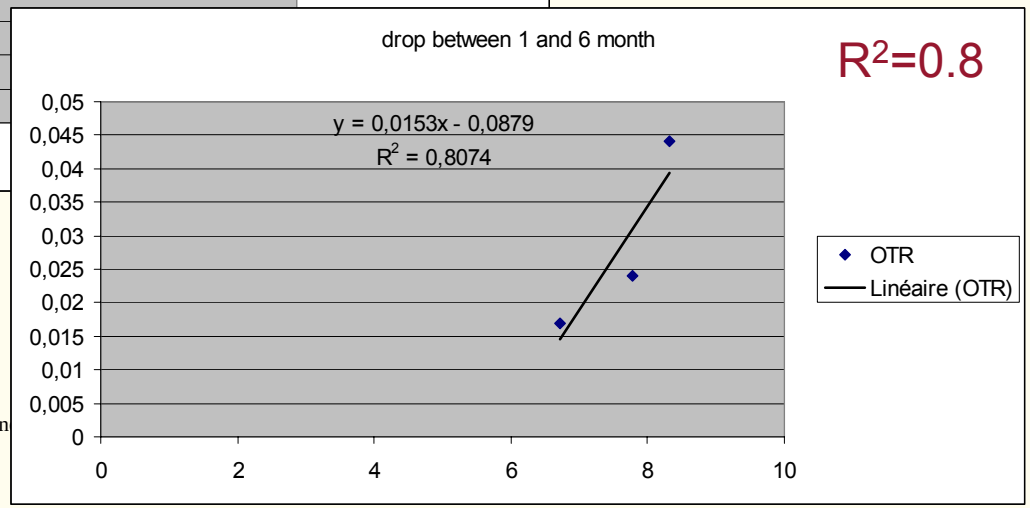


R^2=0.4



R^2=0.7

OTR effect takes place after a certain lag time



R^2=0.8

Often closure effect doesn't show until 6 month post bottling!

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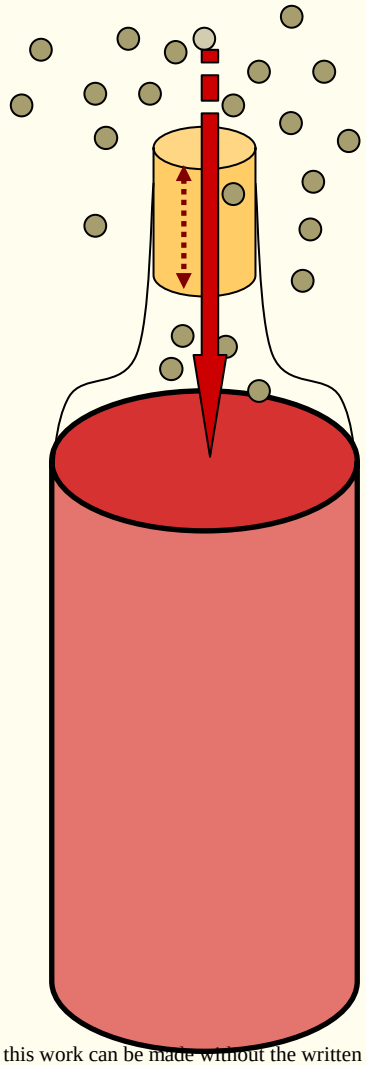
Understanding oxygen uptake



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So how about Bottling & Post-bottling Aging

Measurement of DO in wine and gaseous oxygen in the headspace

→ Total Package Oxygen

Monitoring Bottling performance
Post-Bottling Kinetics
DO consumption
HS-DO transfers

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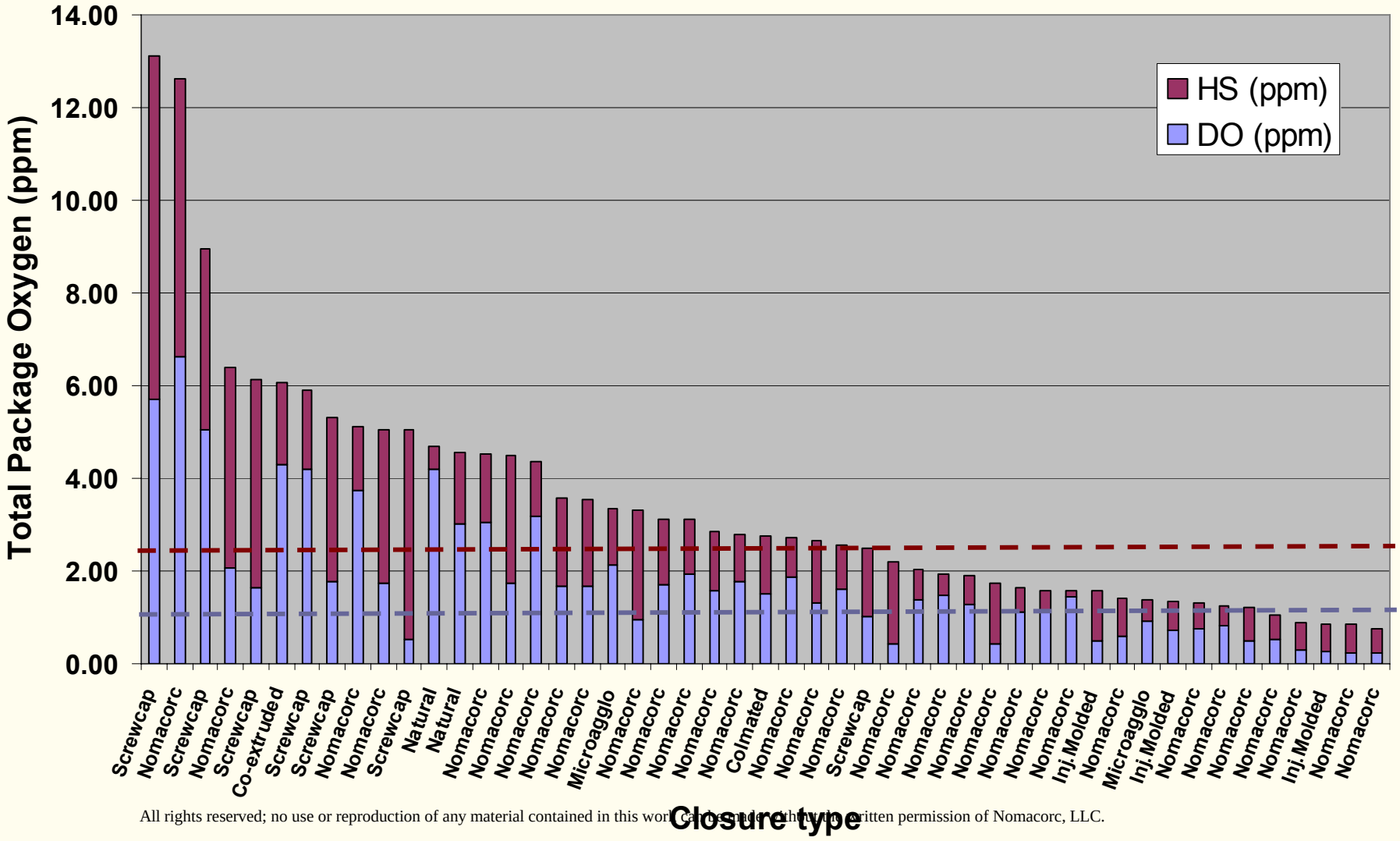
Total oxygen pickup at bottling



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Bottling influence Geisenheim Study

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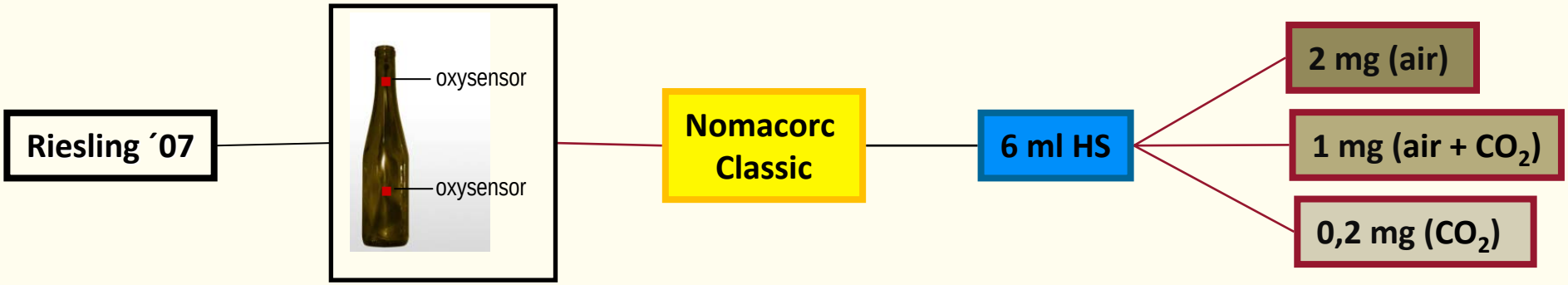
Effect of headspace treatment



Wine | Bottle | Closure | HS volume | O_2 in HS

375 ml bottles
3 different headspace treatments at bottling

Dissolved oxygen in the tank 0.3 ppm
after bottling 0.9 to 1.3 ppm= 0.3 to 0.5 mg/bt

Headspace oxygen
after bottling 0.4 to 14.5 ppm = 0.15 to 5.4 mg/bt

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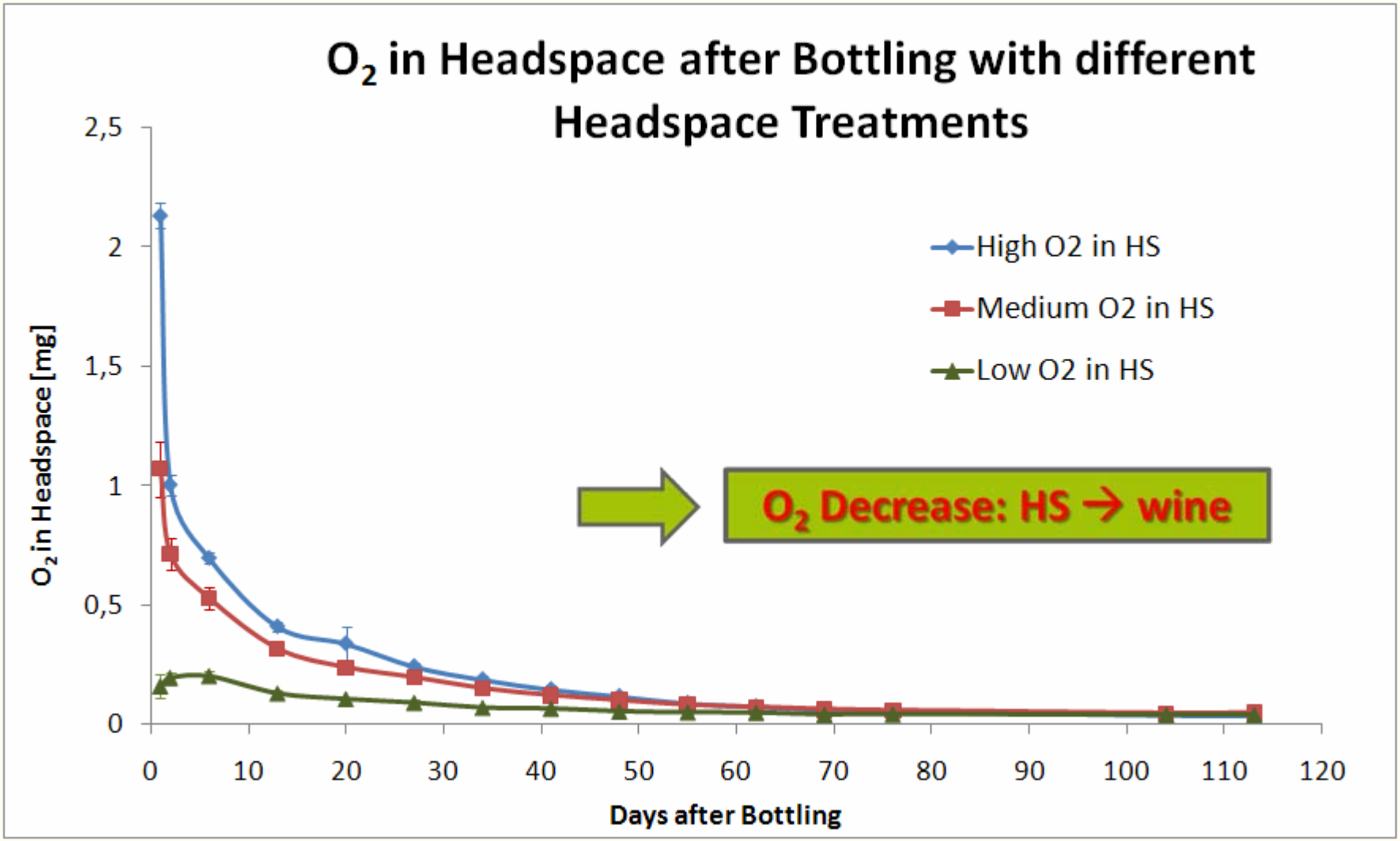
Effect of headspace treatment



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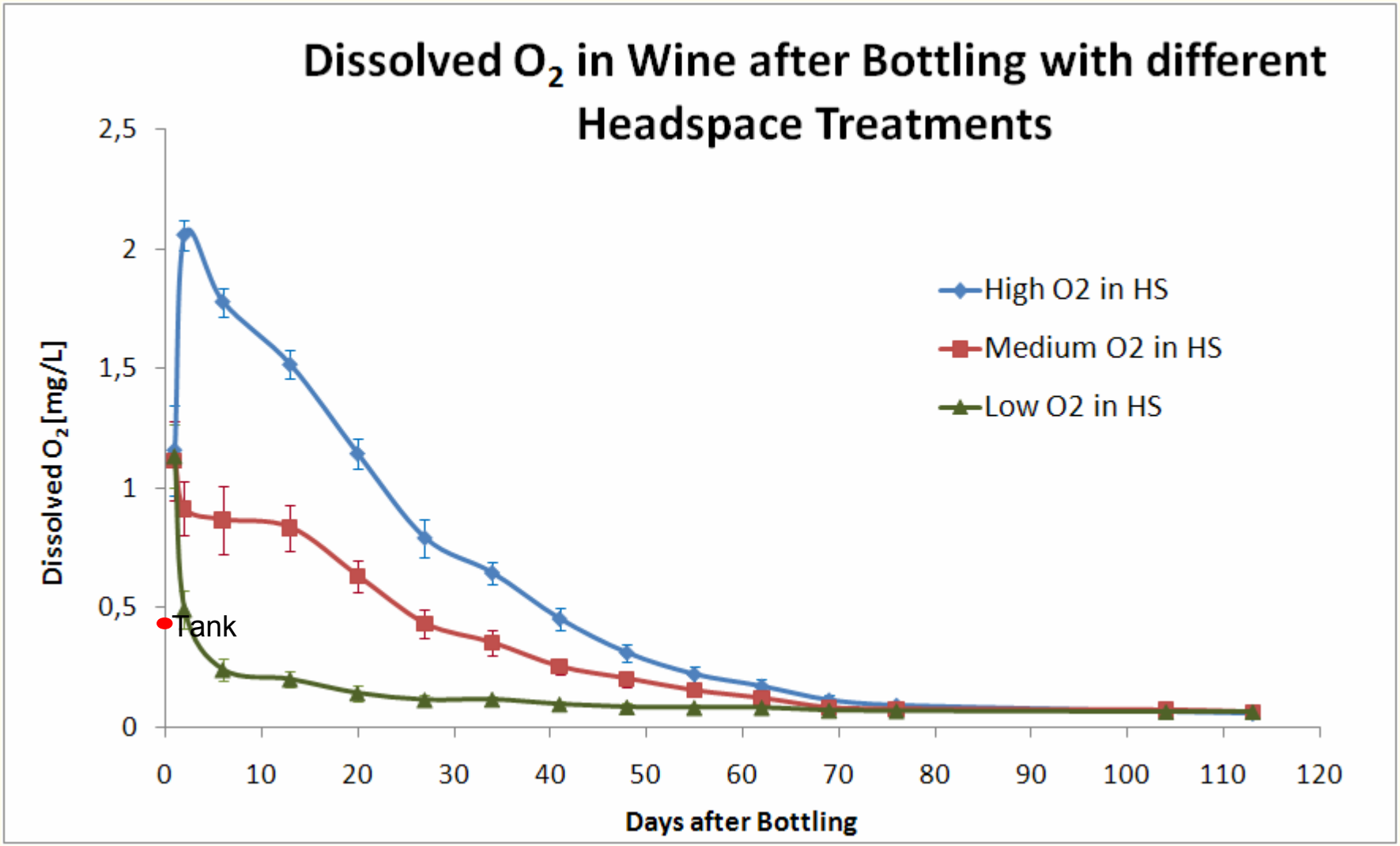

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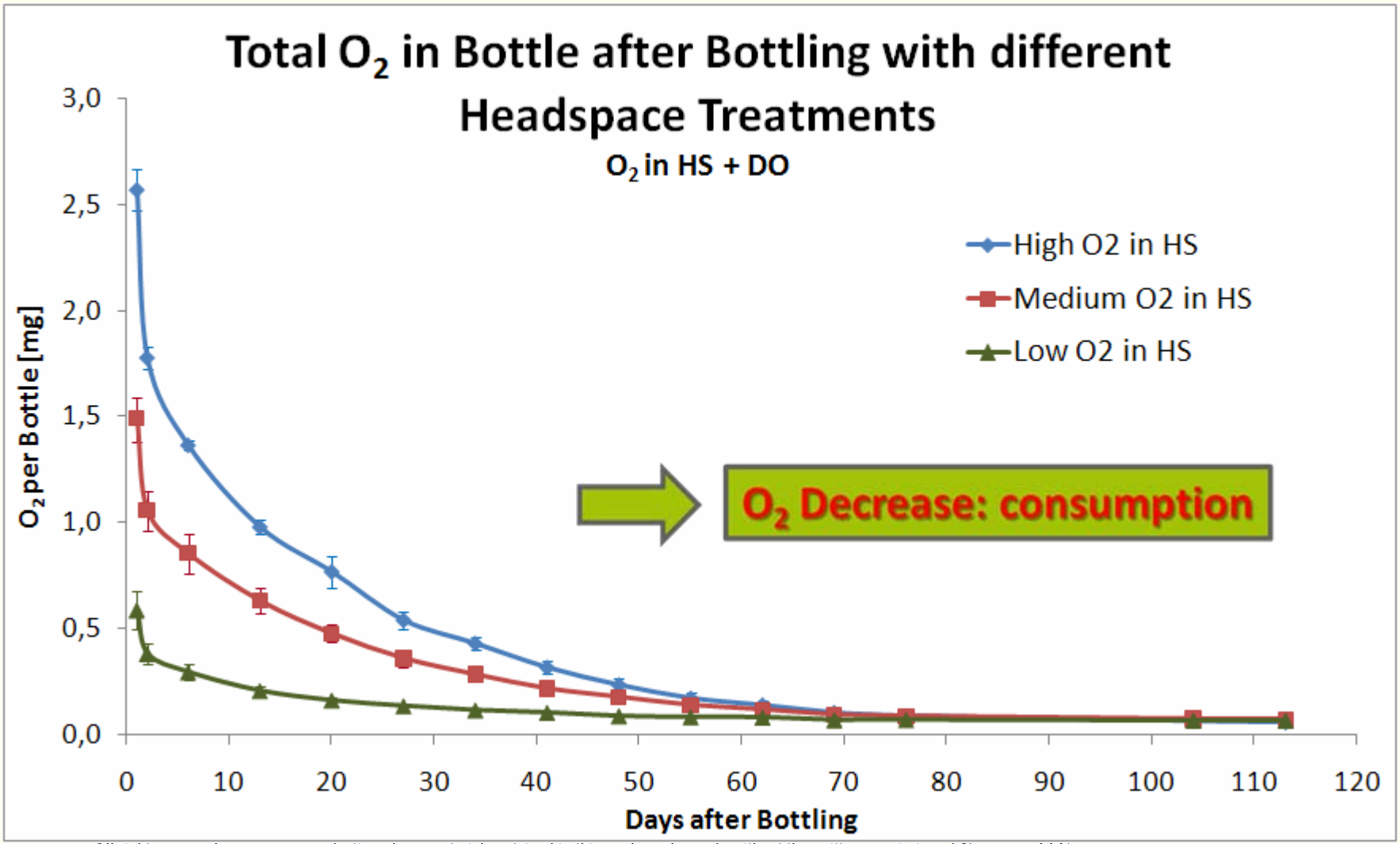

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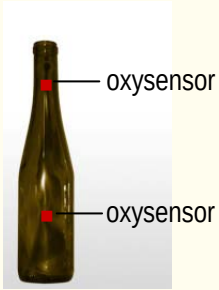
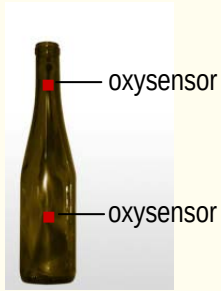
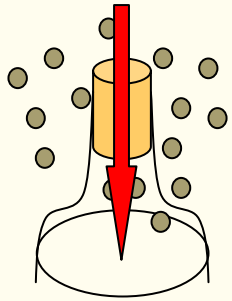
Effect of headspace treatment

How much O_2 is consumed after x days?







O_2 at day_0 – O_2 at day_x + ingressed O_2 through closure = O_2 consumption

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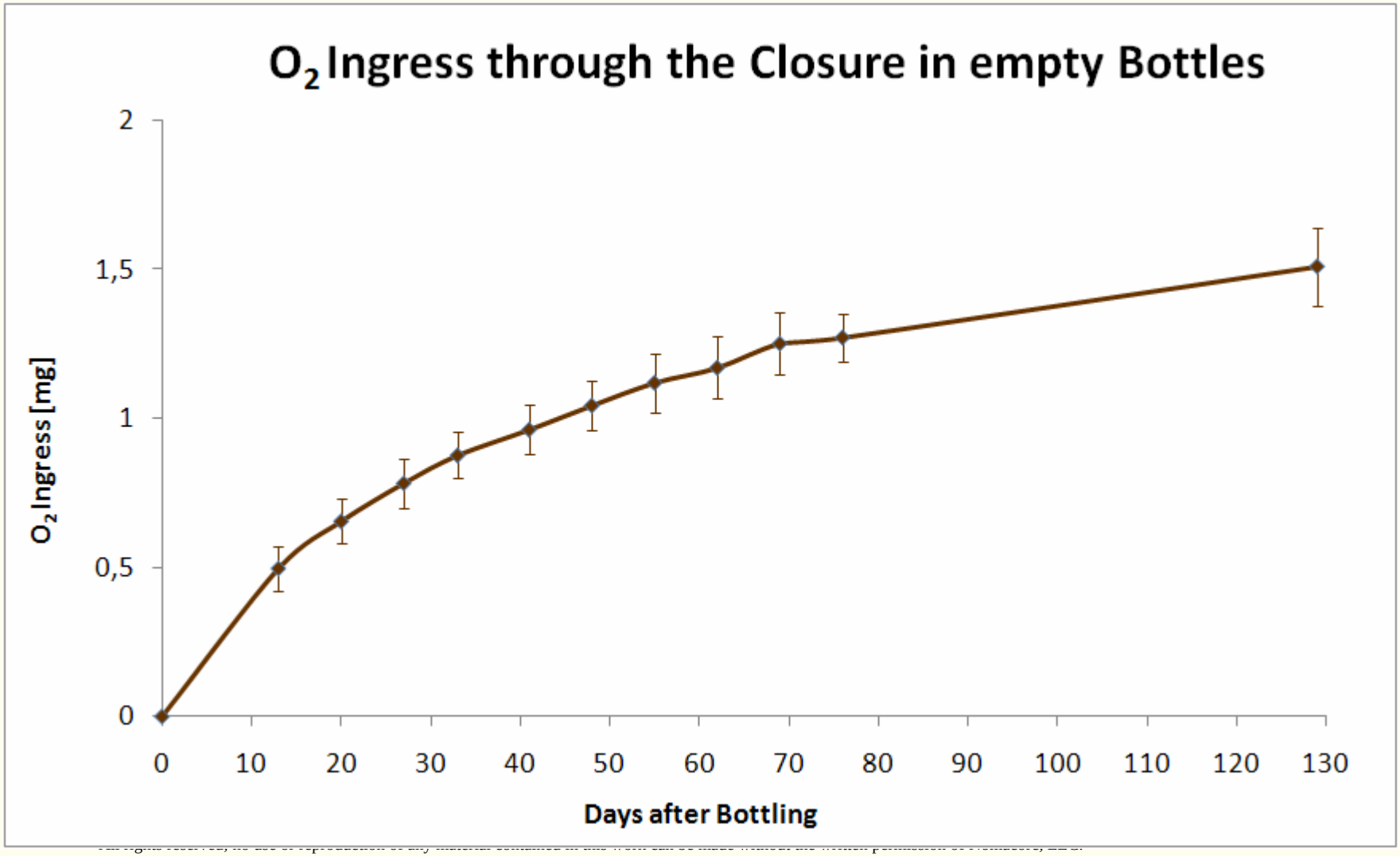
Effect of headspace treatment



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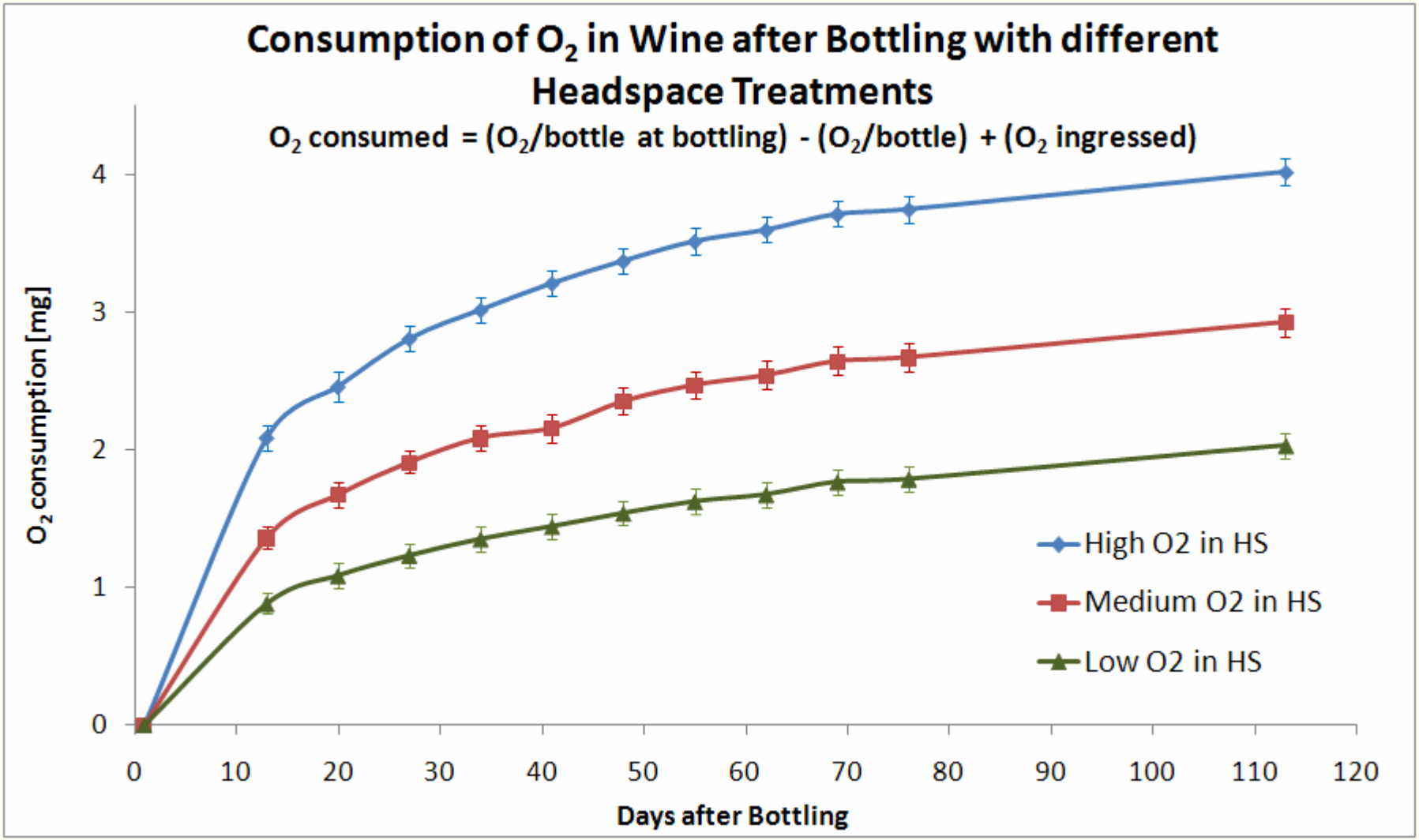

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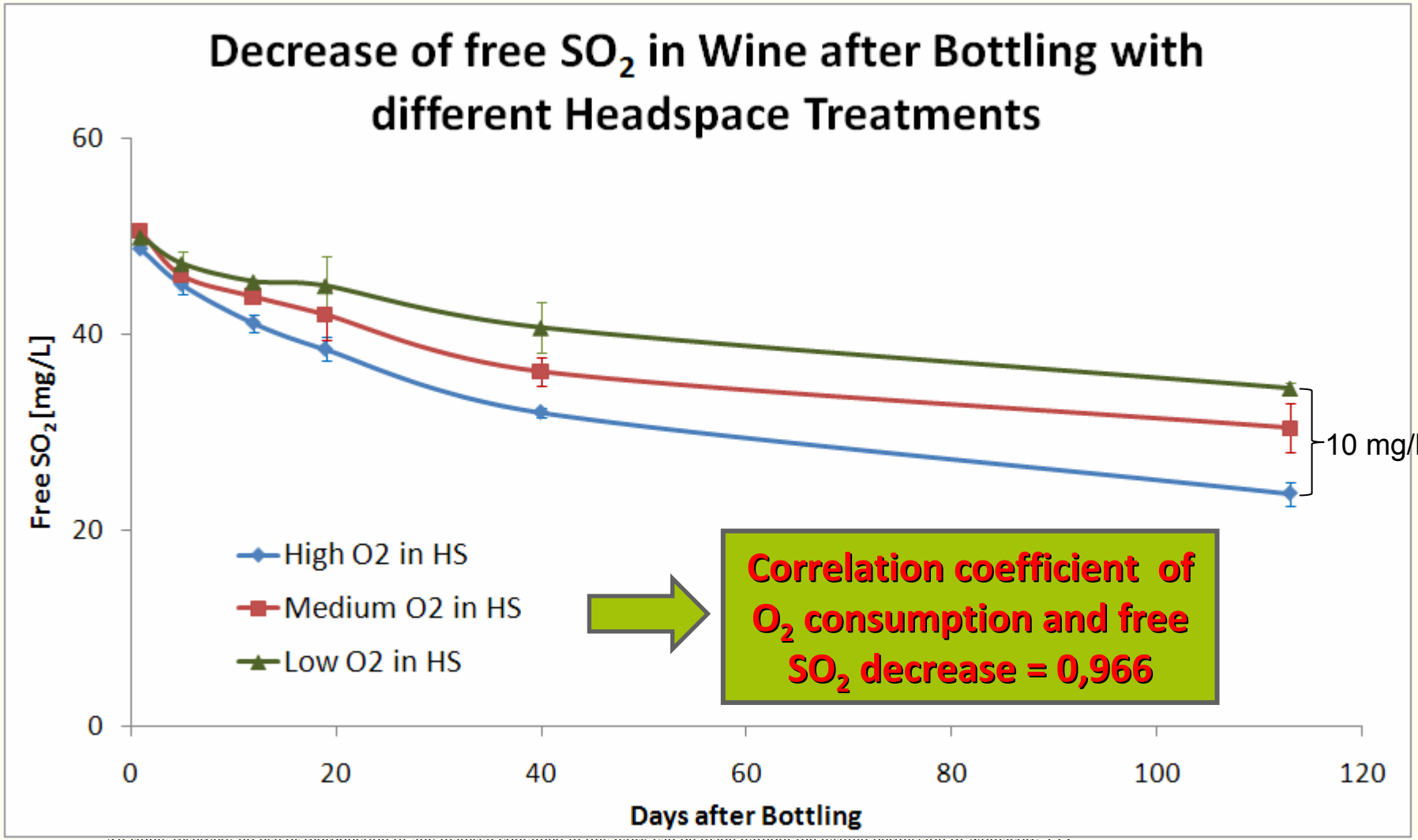

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Conclusions

- **Thanks to PreSens technology we can reliably measure oxygen and monitor oxygen consumption in a bottle**
- **Oxygen pickup (DO + headspace= TPO) at bottling is critically important for shelf life and wine quality**
- **OTR is a tool for the winemaker to extend its control on wine evolution beyond bottling**
- **The results of our research program is providing us with better knowledge everyday**

Acknowledgements: Nomacorc Research team and Academic partners

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