

The Australian Wine Research Institute

Reduction Redux – The Good, the Bad and the Nutty



The closure issues

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Senior Oenologist — AWRI

1999 Semillon wine bottled using 14 different closures



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Range of color 28 months after bottling



$OD_{420} \approx 0.14$ au

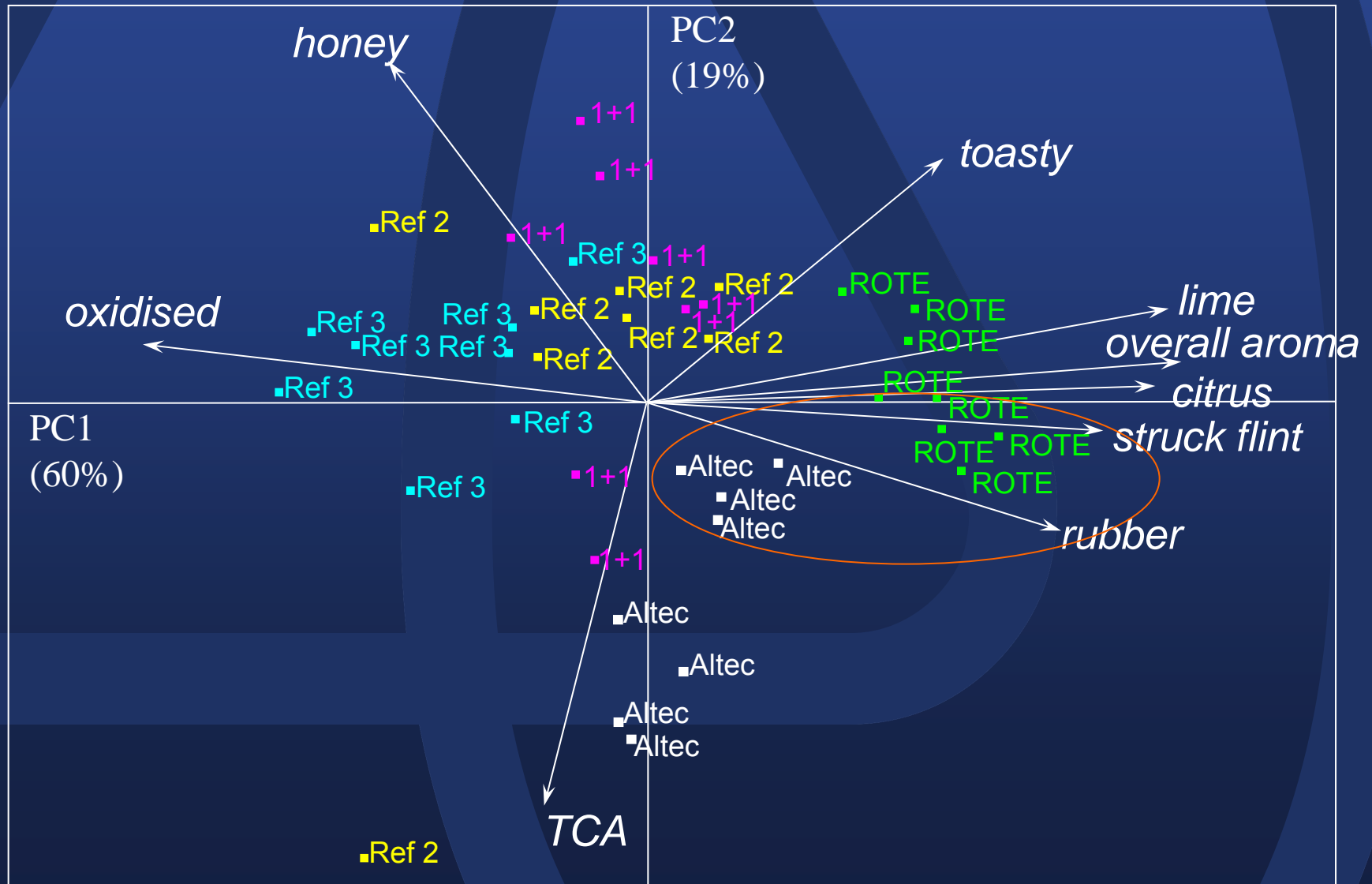
$OD_{420} \approx 0.19$ au

14 different closures \Rightarrow 14 different wines!

PCA 'map' of 63 month aroma data (1999 Semillon wine)



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Wine 'development'

- is closely connected with oxidation–reduction phenomena (redox reactions)
- depends on a whole series of factors relating to the wine's composition and storage conditions

Post-bottling: depends on wine composition, storage conditions and the properties of the closure



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Wine composition

- Dissolved oxygen
- Ascorbic acid
- SO₂
- Phenolic compounds
- Metal ions
- Flavour compounds
- Oak phenolics
- Fermentation-derived compounds (thiols)
-

Bottling

- Dissolved oxygen
- Oxygen in headspace
- Oxygen permeability of closures
- Filling height
- SO₂



Wine storage

- Permeability of closures (transfer of gases in and out of the bottle, closure type, storage position)
- Flavour scalping
- Temperature
- Time
-

Wine 'development'
oxidation/reduction,
and
consumer satisfaction



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AWRI 'commercial closure trial' bottled September 2002

ROTE (Auscap, tin liner) - four treatments at bottling

"Low" filling height
(48mm ullage,
Free SO₂ 38 mg/L)

"Low" filling height + SO₂
(47mm ullage,
Free SO₂ 54 mg/L)

"High" filling height
(30mm ullage,
Free SO₂ 39 mg/L)

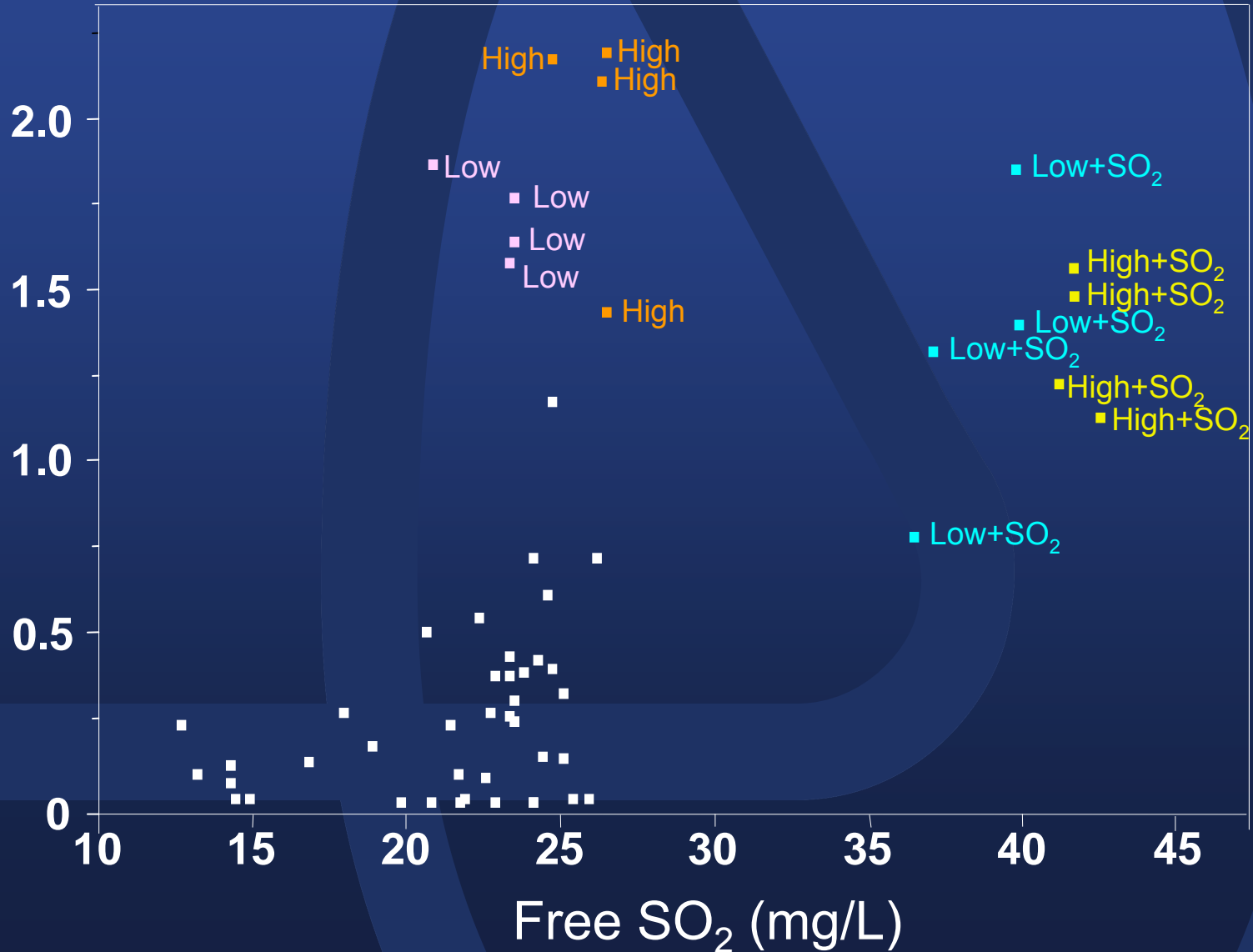
"High" filling height + SO₂
(29mm ullage,
Free SO₂ 59 mg/L)

Relationship between free SO₂ and 'struck flint' aroma score: 24 months storage



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Struck
flint
aroma
score



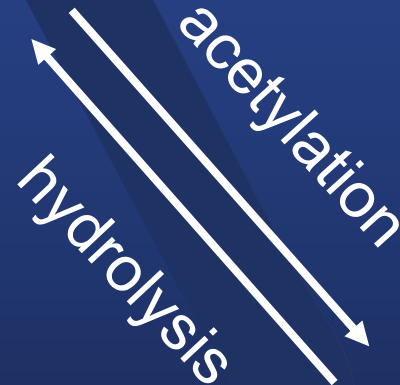
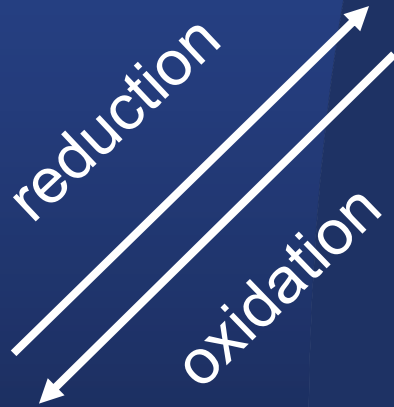


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Sulfur equilibrium in wine

methanethiol

1.5 $\mu\text{g/L}$



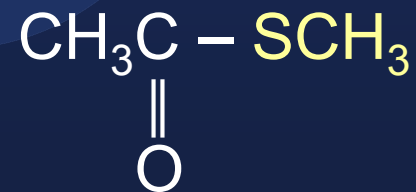
dimethyl disulfide

10 $\mu\text{g/L}$



methyl thioacetate

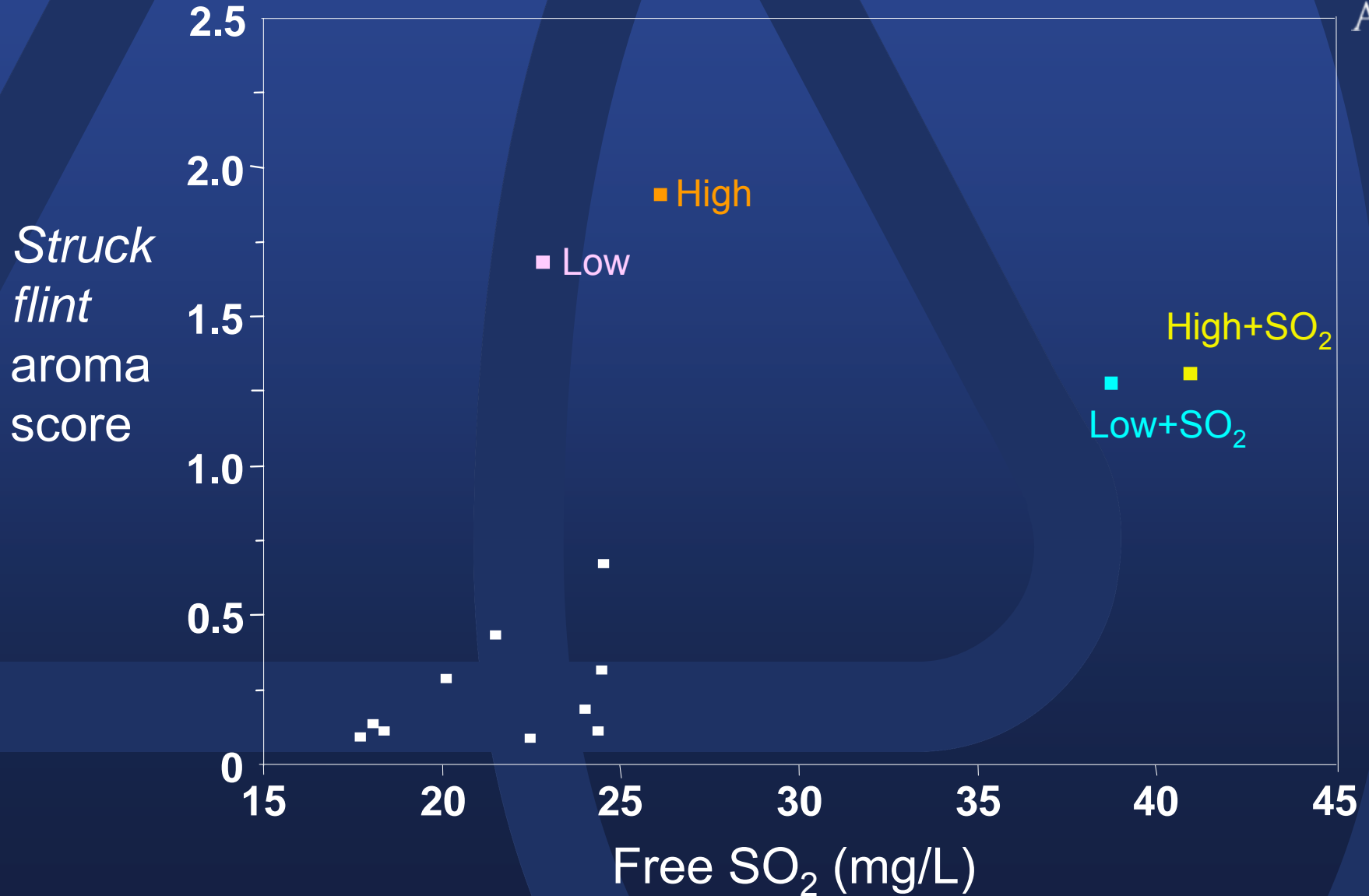
40 $\mu\text{g/L}$



Relationship between free SO₂ and 'struck flint' aroma score: 24 months storage (n=4)



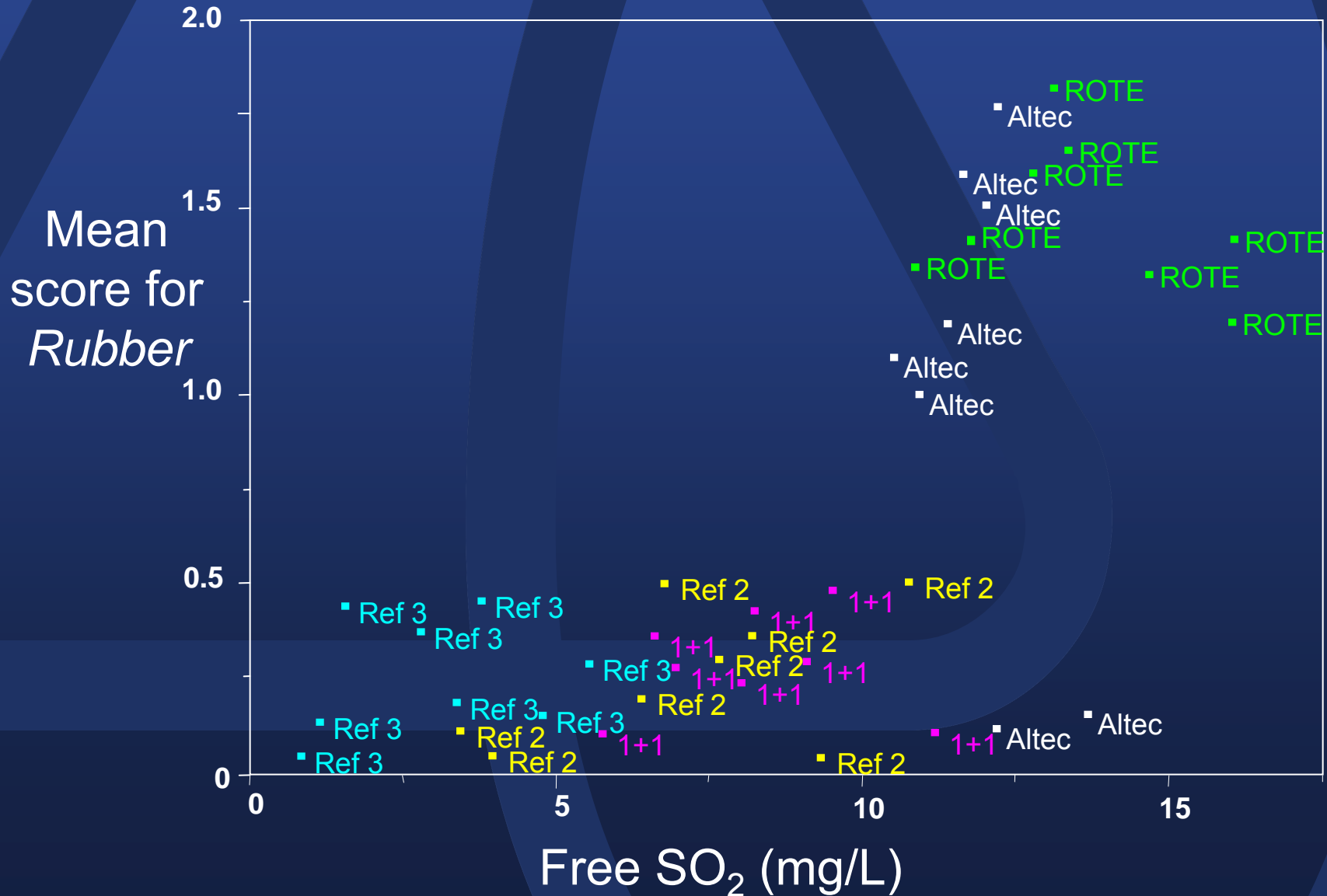
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Free SO₂ concentration and 'rubber' aroma score: 63 months storage



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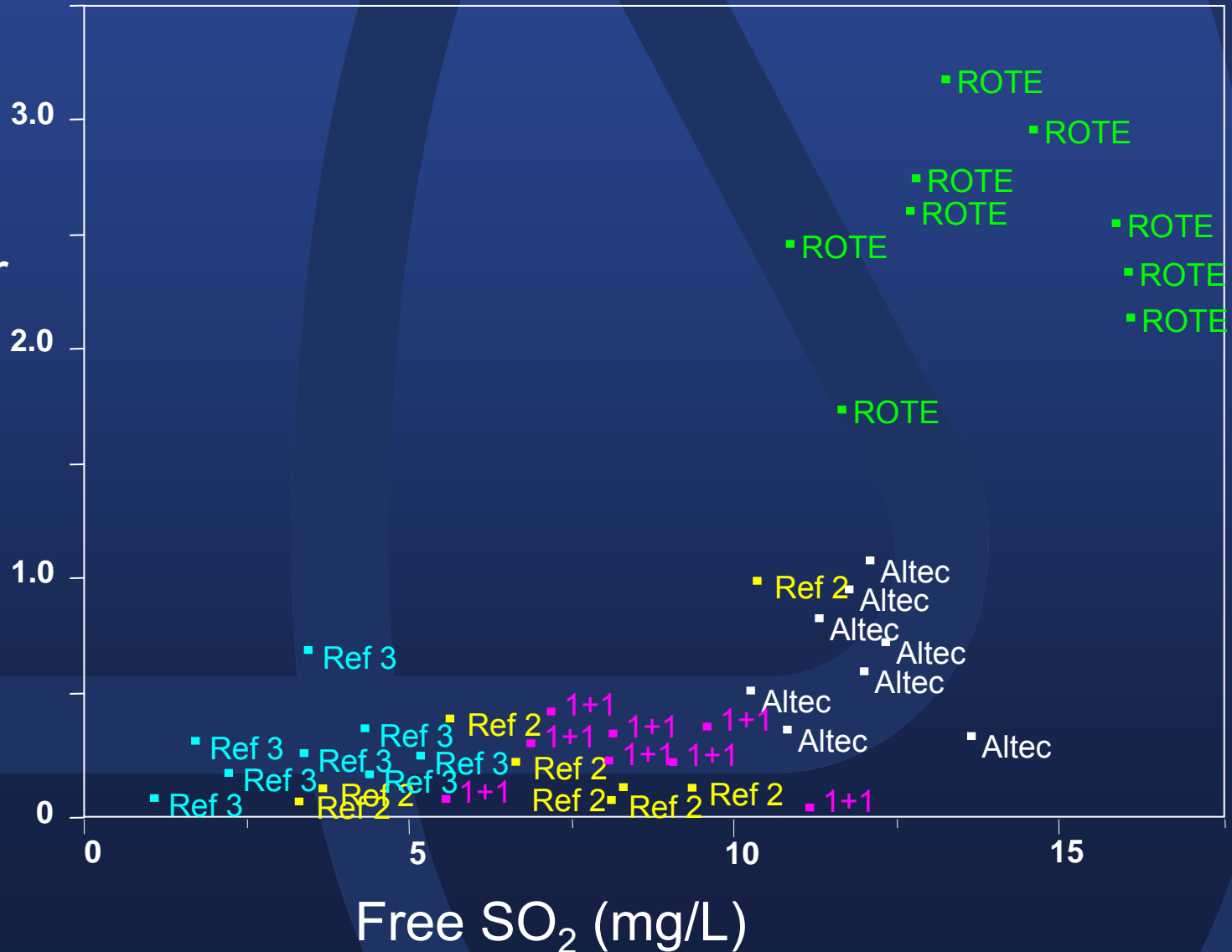


Free SO₂ concentration and 'struck flint' aroma score: 63 months storage



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Mean score for *Struck flint*





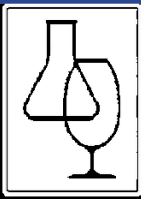
Development of 'reductive' characters in wine after bottling



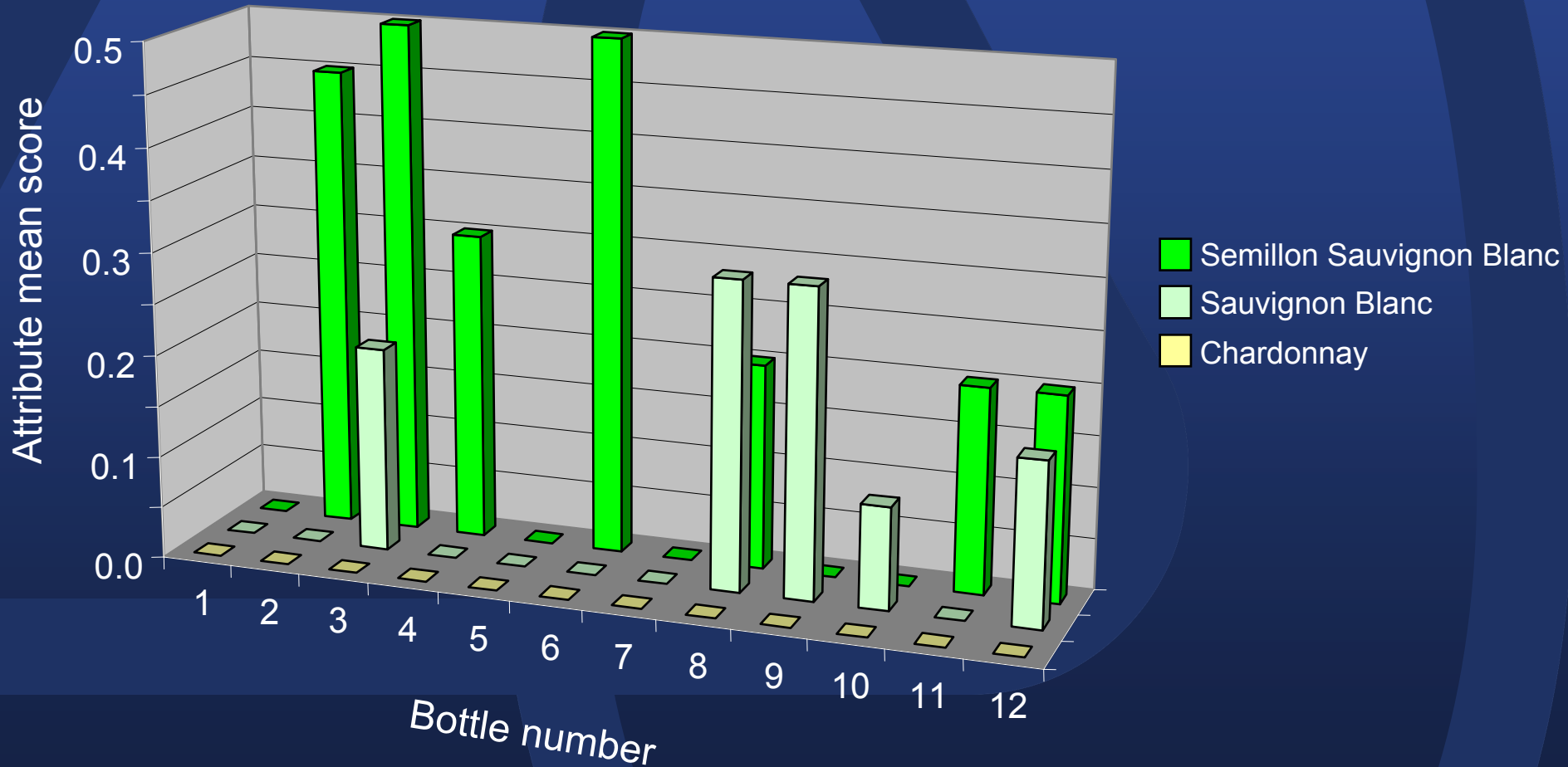
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Wines bottled with low oxygen permeation closures are more likely to develop *reductive* character in bottle, **if** those wines have a propensity to become reductive

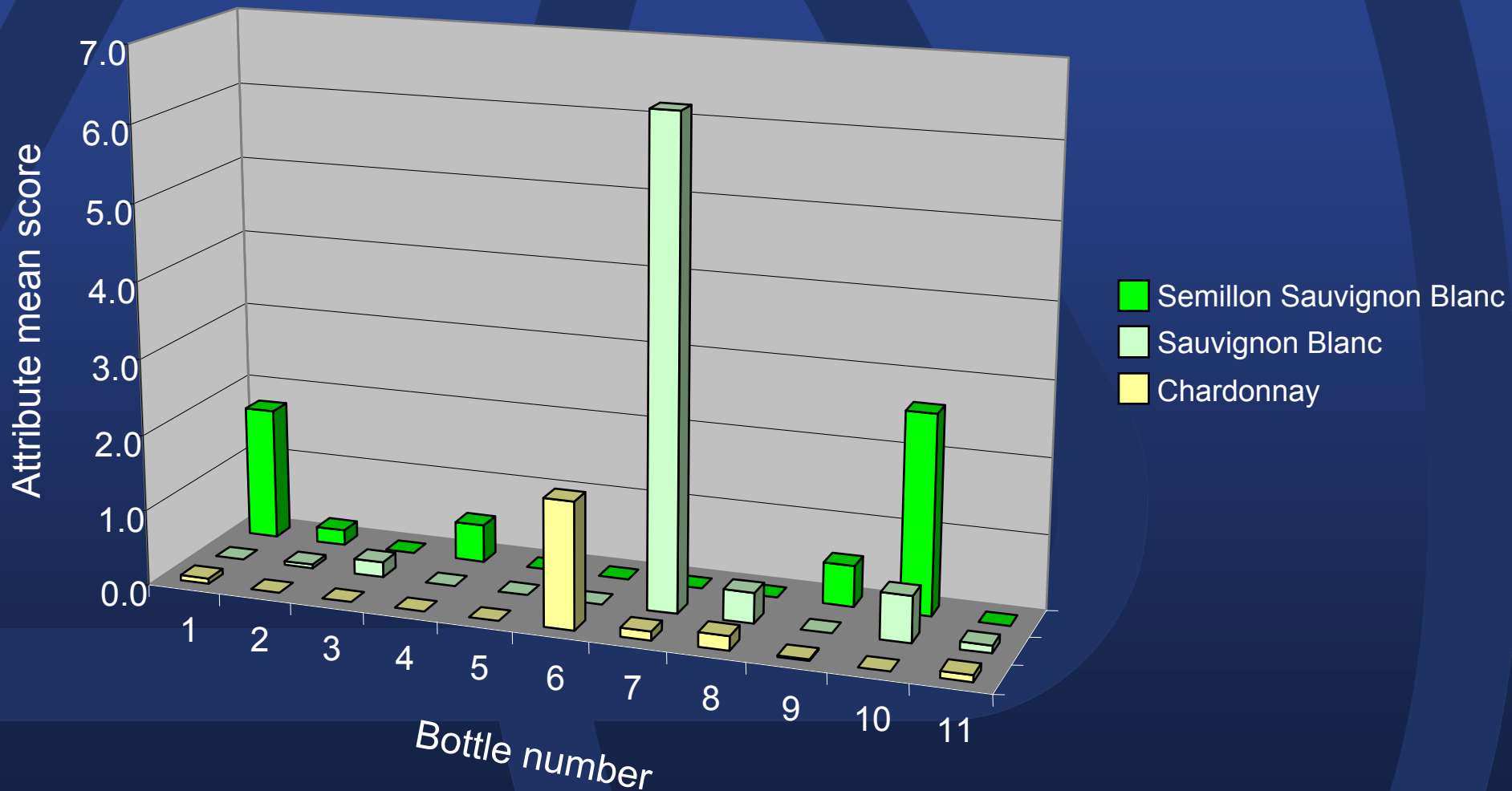
Panel mean scores for the attribute *reduced*



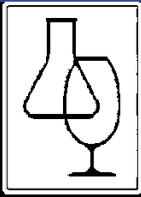
AWRI



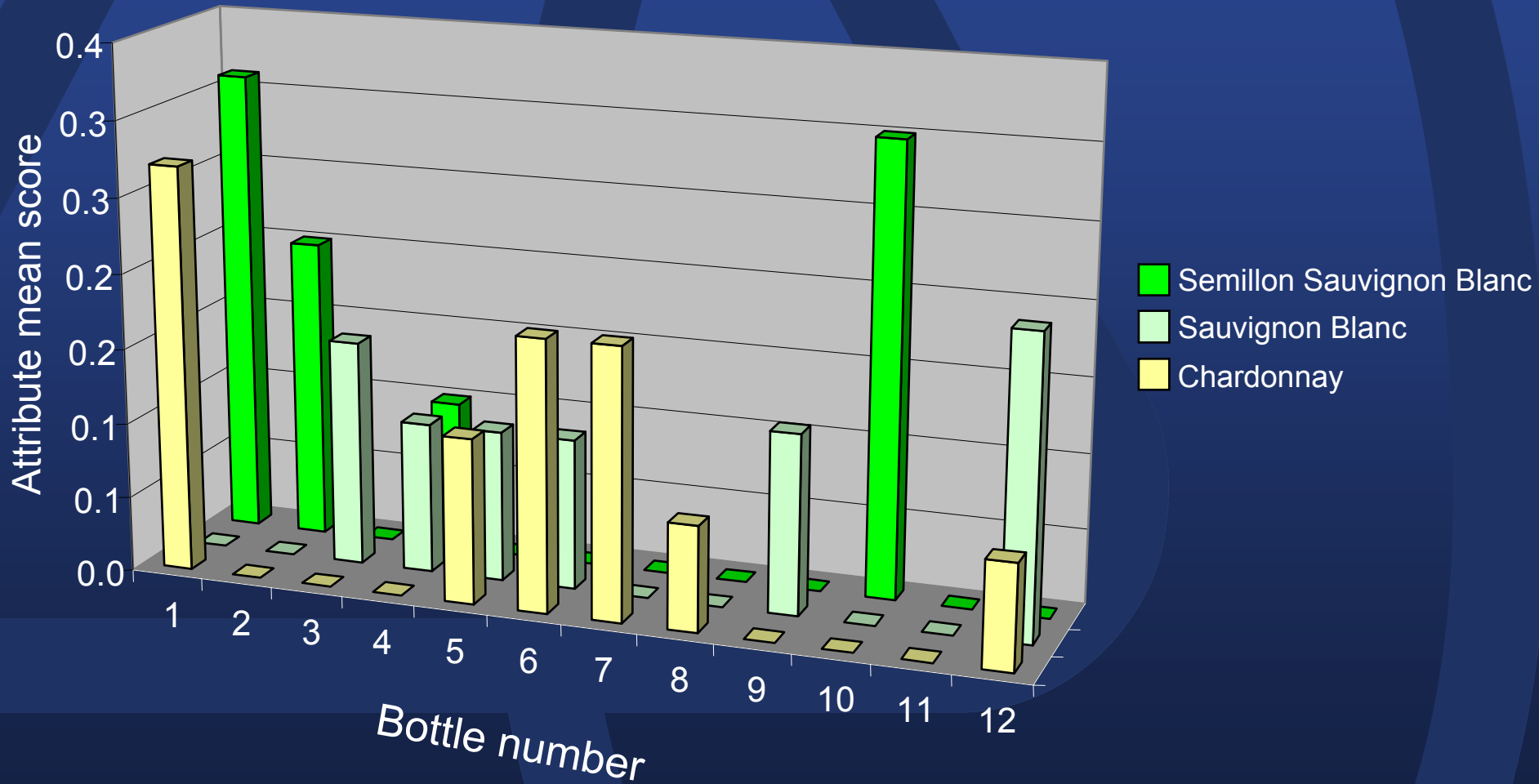
Panel mean scores for the attribute *TCA*



Panel mean scores for the attribute *oxidised*



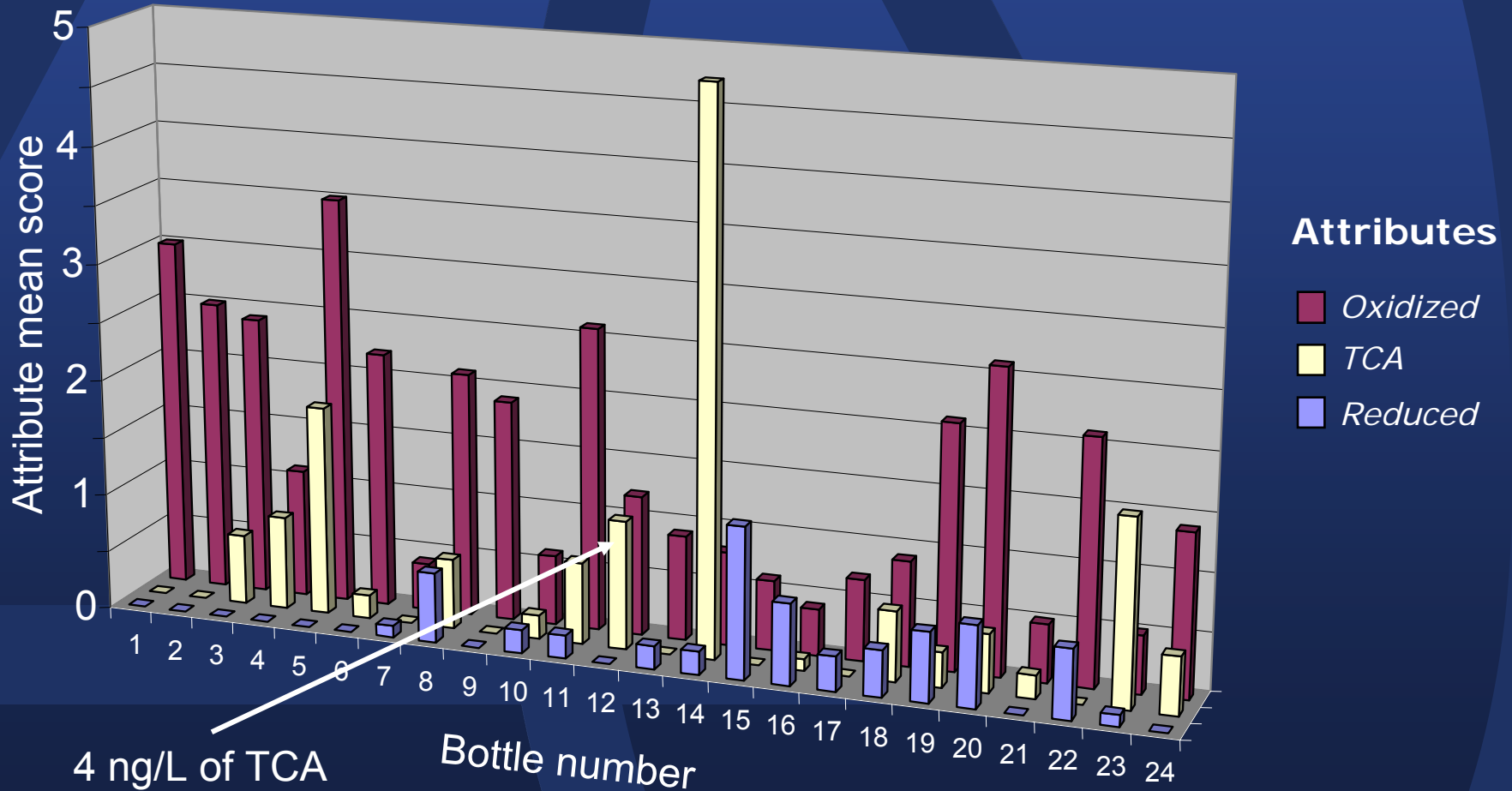
AWRI



Panel mean scores for a 2003 Chardonnay wine sealed with natural cork closures



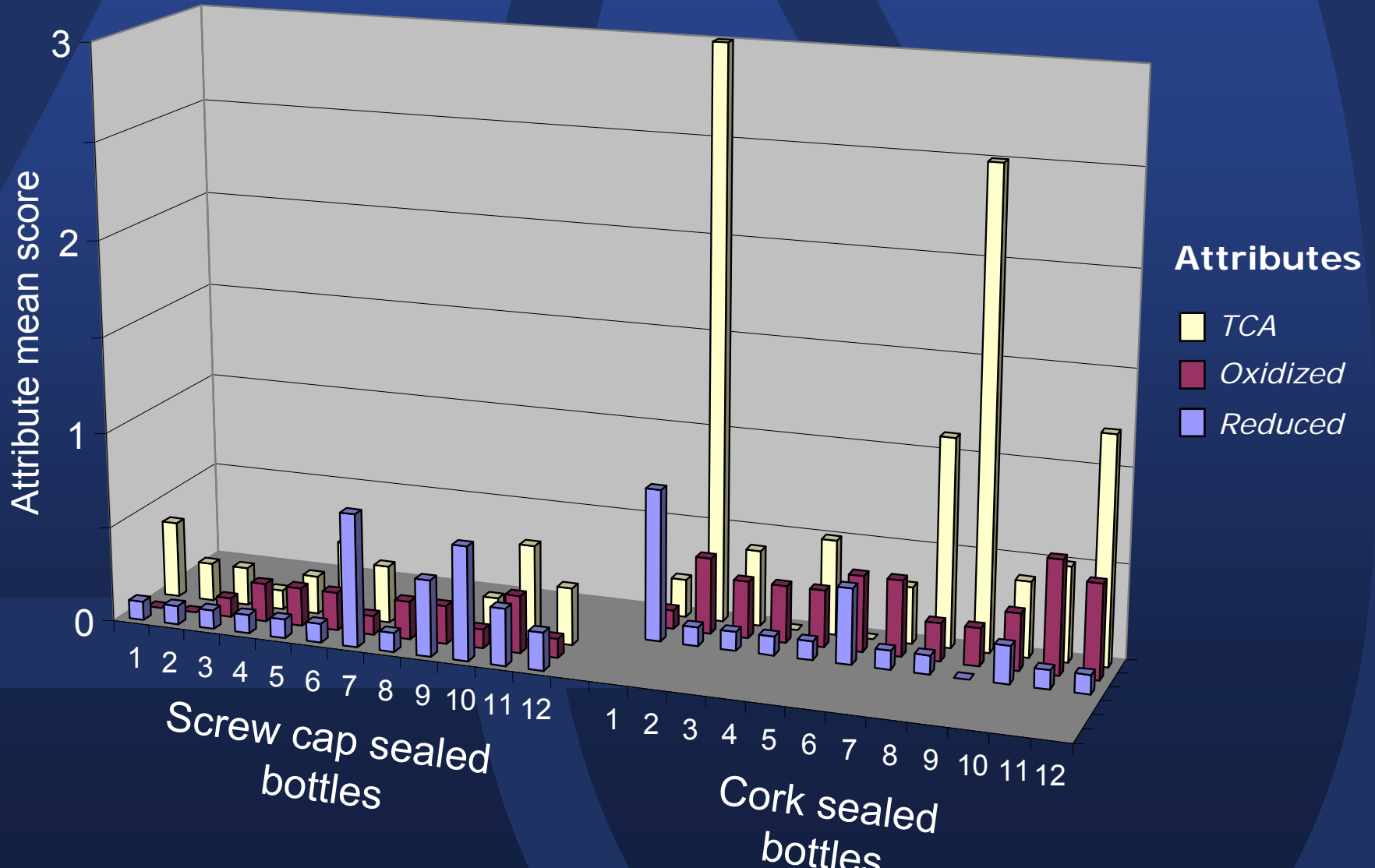
AWRI



Panel mean scores for a 2004 Shiraz wine sealed with screw cap and cork closures



AWRI



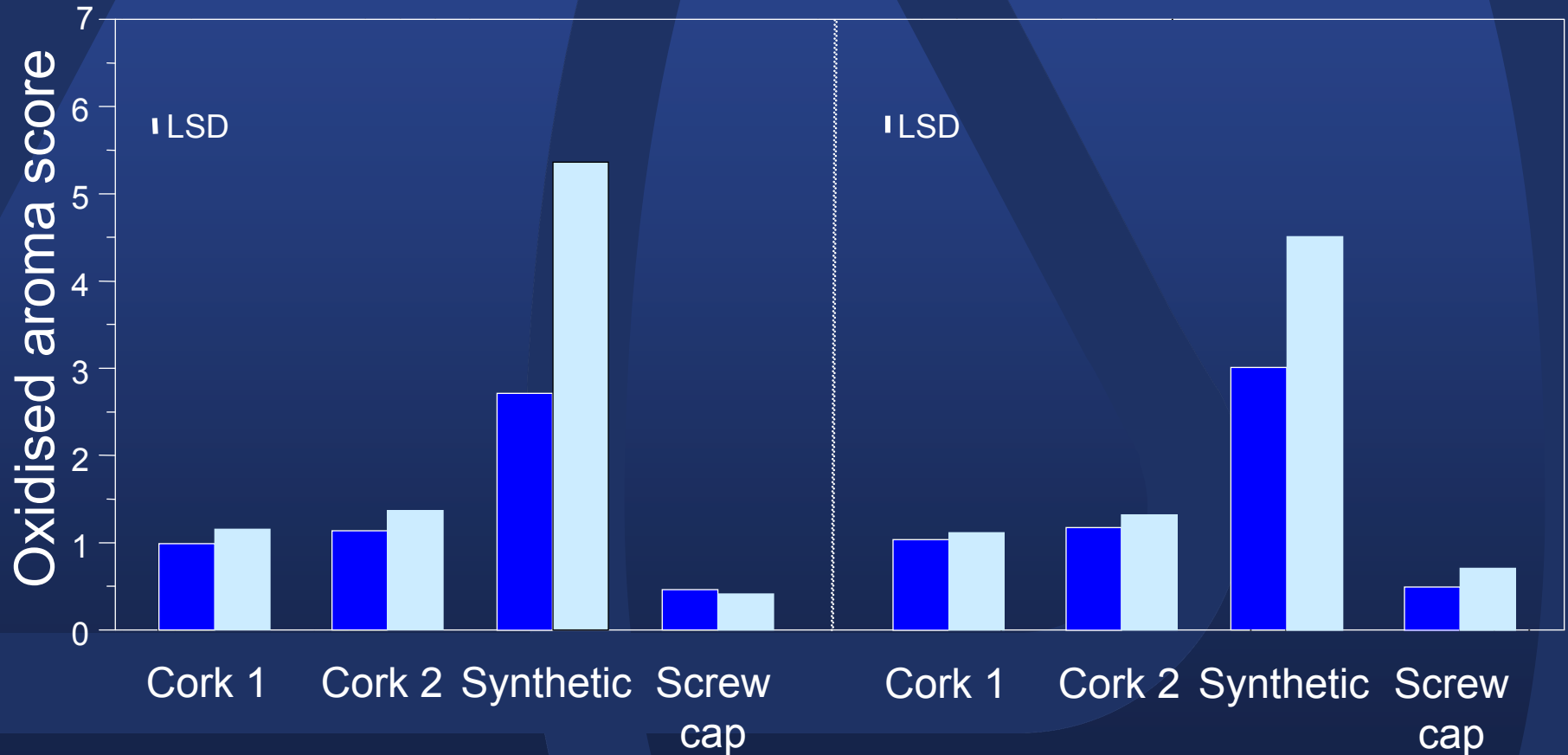
Impact of closure type and ascorbic acid addition on oxidized score after 3 years



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Chardonnay

Riesling

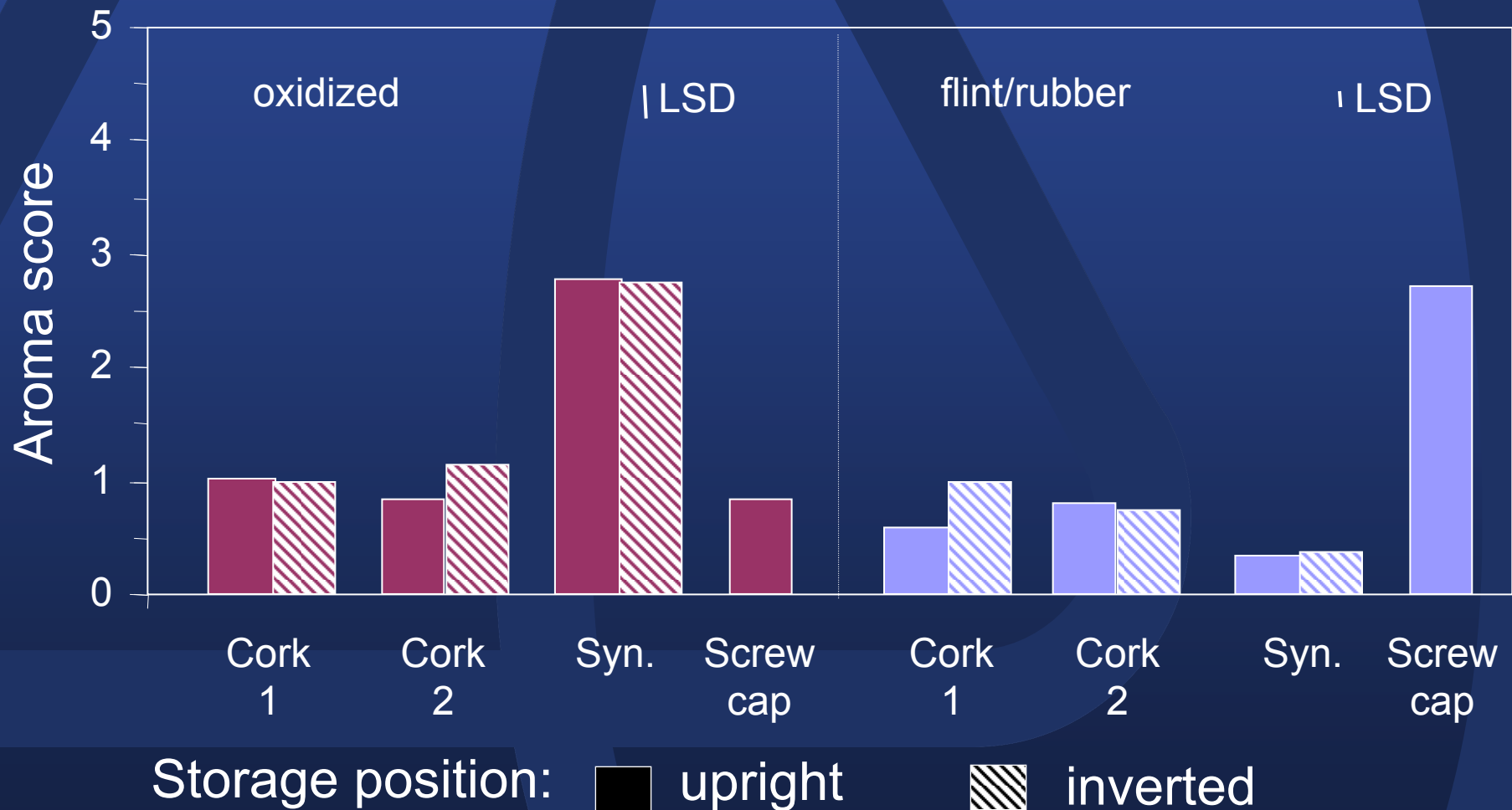


Ascorbic acid at bottling: ■ added ■ not added

Impact of closure type and storage position on a Chardonnay wine aroma after 3 years



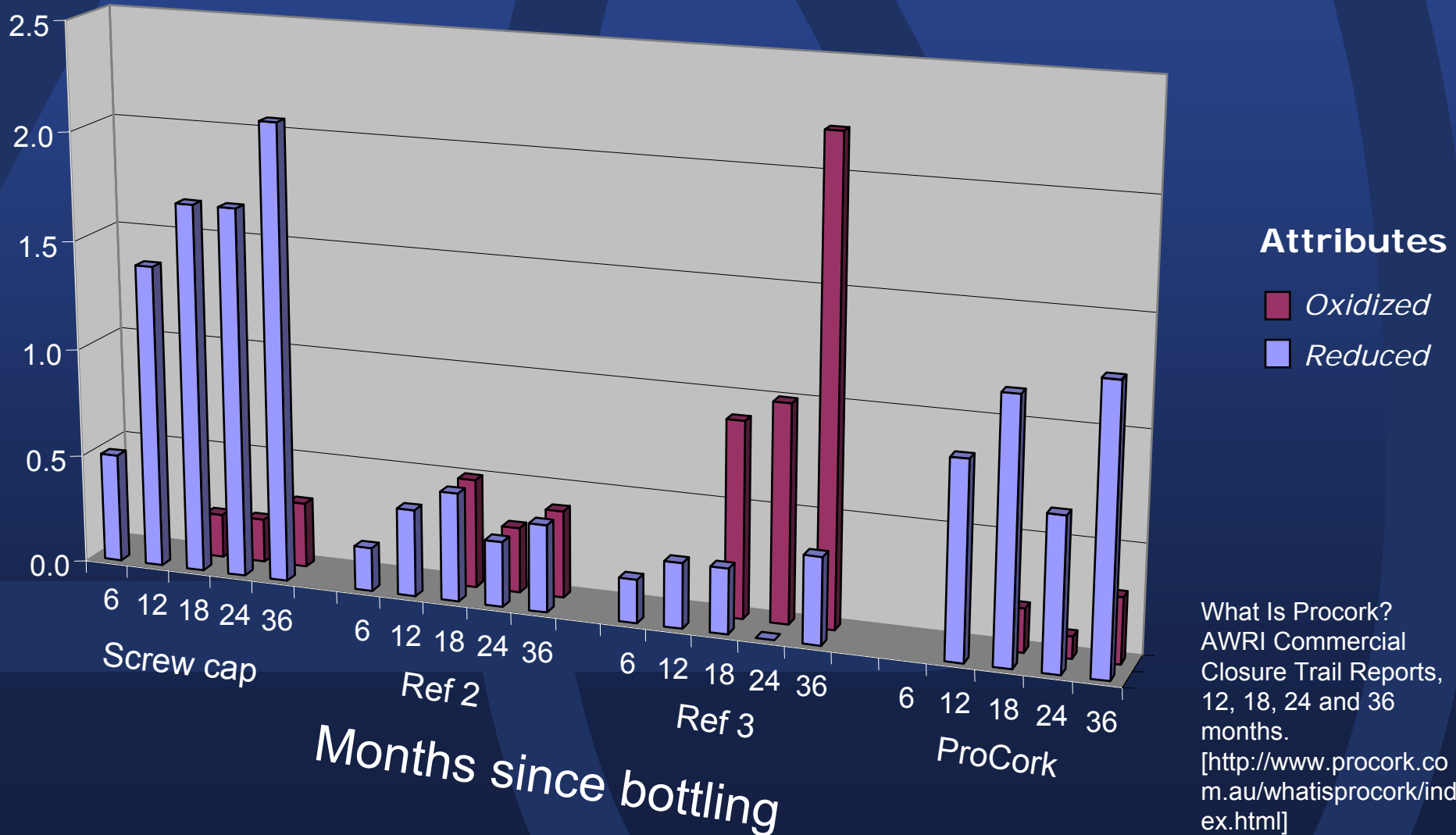
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Commercial closure trial: 2002 Semillon – different closures & times post-bottling



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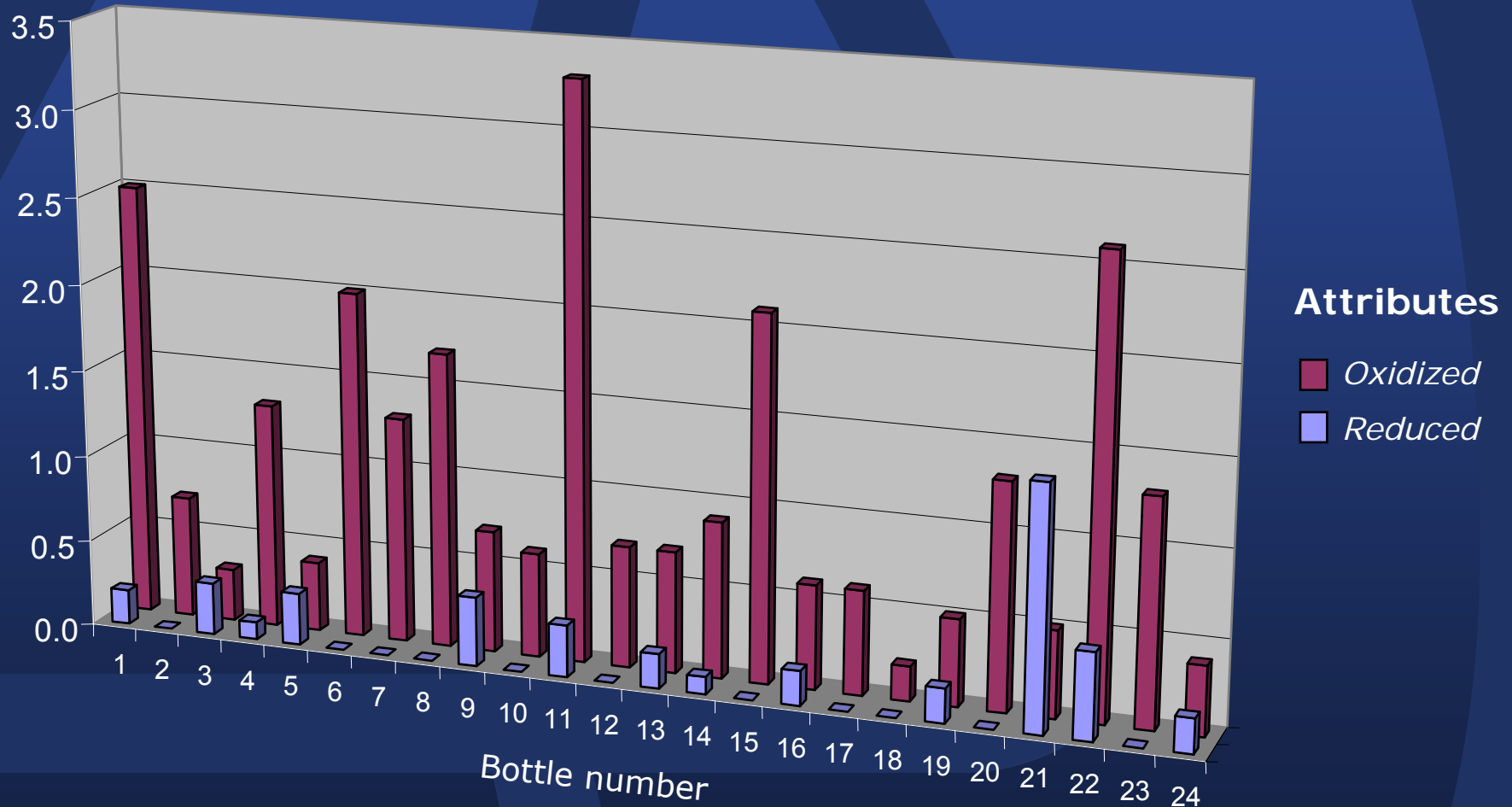


What Is Procork?
 AWRI Commercial Closure Trail Reports, 12, 18, 24 and 36 months.
[\[http://www.procork.com.au/whatisprocork/index.html\]](http://www.procork.com.au/whatisprocork/index.html)

2004 Chardonnay wine sealed with 'membrane' corks: 24 months post-bottling



AWRI



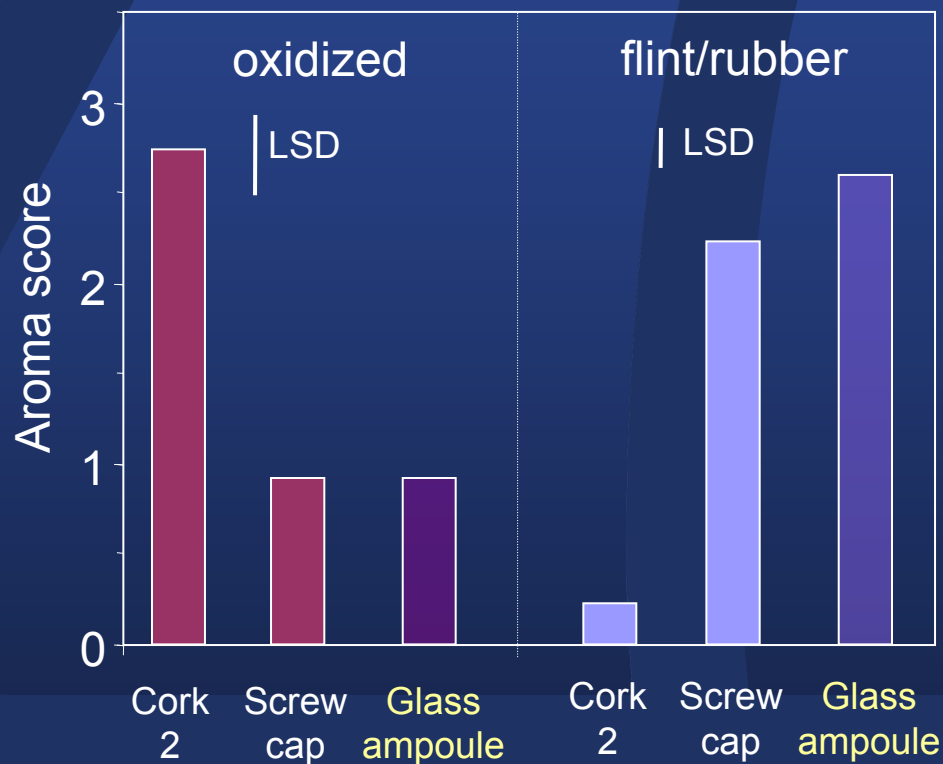
Bottles stored in an upright position for 18 months post-bottling

Impact of closure type, including glass ampoules, on wine aroma after 4 years

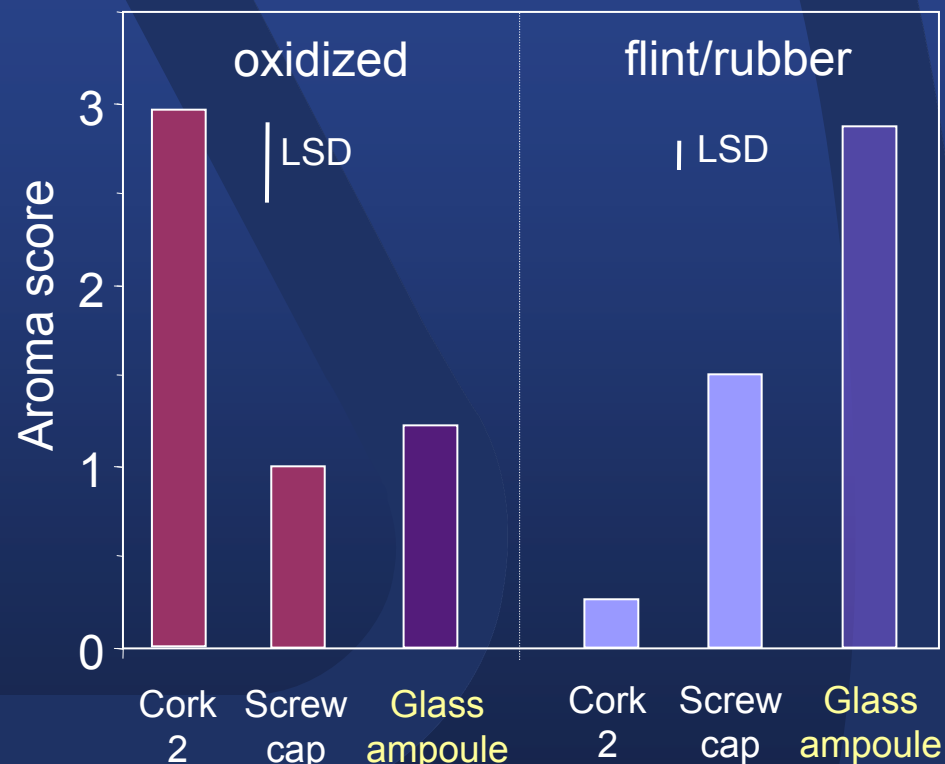


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Riesling



Chardonnay





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Wines bottled with closures with low oxygen transmission rates (OTRs) are more likely to develop *reductive* character in bottle, if those wines have a propensity to become reductive

It is therefore incorrect to say that low OTR closures **CAUSE** *reductive* character



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- Oxygen at bottling is consumed within weeks
- Reductive characters, probably thiols, are formed over months or years
 - Oxygen to oxidize the thiols is that permeating through the closure
 - Increasing the headspace volume is oxygen at the “wrong” time

Fermentation management



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- Yeast strain
- Problem or stressed fermentations are more likely to contain higher concentrations of thiols and their precursors.
- These wines will cause greater problems with post-bottling reduction

Fermentation management



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- Better yeast preparation, particularly during re-hydration, and aeration of the culture
- Avoid temperature shock
- Add air and nitrogen one third of the way through fermentation



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After fermentation

- Know what the sulfur compounds are before aerating wine after fermentation - copper cadmium test
- Add copper if necessary, but be aware that copper can impact on longevity as it is a catalyst for oxidation



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Acknowledgements

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