Application of Toasted Oak and Micro-Oxygenation to Aging of Cabernet Sauvignon

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Outline

1. Goals
2. Introduction
3. Grapes and Winemaking
4. Analysis
5. Results
6. Summary
7. Preliminary Sensory Results
8. Conclusions

Goal

Produce superior wines with enhanced control and consistency, more economically

Introduction

- The major goal of this study was to produce the best wine possible from Cabernet sauvignon grown in the Edna Valley region of San Luis Obispo County in California.
- Determine which technique or combination of techniques provide the best results?
- How do the application of these techniques affect winemaking logistics?
- How do the application of these techniques affect wine quality?
- Can these affects on wine be measured and quantified in an objective manner?

Grapes and Winemaking

Christian Roguenant, Orcutt Road Cellars

- Cabernet sauvignon was harvested at ≈22.5 brix
- Chardonnay juice concentrate was added to enable the completed fermentation to reach 14 % alcohol
- Fermentation trials included
  - tannins
  - color enzymes
  - toasted oak
  - punch down vs pump over
- Two barrel samples were pulled from each completed fermentor.
- All wine was composited and divided into lots as follows:

No Oxygen Treatments

Control – No oak, No oxygen
- tk 3010
- tk 3011

Staves only – No oxygen
- tk 3012
- tk 3013

Segments only – No oxygen
- tk 3014
- tk 3015

Oxygen Additions

Oxygen only
- tk 1203
- tk 1204

Staves + Oxygen
- tk 1201
- tk 6011

Segments + Oxygen
- tk 1202
- tk 6012

Treatment Protocols

1. Composited wine was inoculated with the malolactic culture Oeno.
2. Inoculated wines were divided into the treatment tanks and allowed to finish MLF.
3. Oak treatments were added prior to MLF at 3 g/L.
4. All tanks were clean racked and SO_2 added at 35 ppM.
5. Micro-Oxygenation was initiated at 10 mL O_2/L/month.
6. After three months the Micro-Oxygenation rate was reduced to 5 mL O_2/L/month.
7. After 6 months micro-oxygenation was halted.
8. Wines were bottled at 8 months and analysis started.

Ox Box


TANK #1
BACK PRESSURE
TANK #2
BACK PRESSURE
TANK #3
BACK PRESSURE
TANK #4
BACK PRESSURE
OFF
ON

French Oak Segments™ - 15lb bag

French Oak Fans or Bundles – 44sq.ft.

Analysis

ETS Laboratories, St. Helena, California

- •Basic chemistry panel
- •Oak volatile analysis
- •Sulfides
- •Price phenolic profile
- •Color profile

UC Davis, Dr. Andrew Waterhouse Laboratory

- •Folin Ciocalteu tannin assay
- •Adams tannins assay
- •Normal phase tannins
- •Reverse phase phenol compounds

FlavorSense Inc.

- •Difference testing
- •Descriptive sensory analysis
- •Consumer sensory analysis

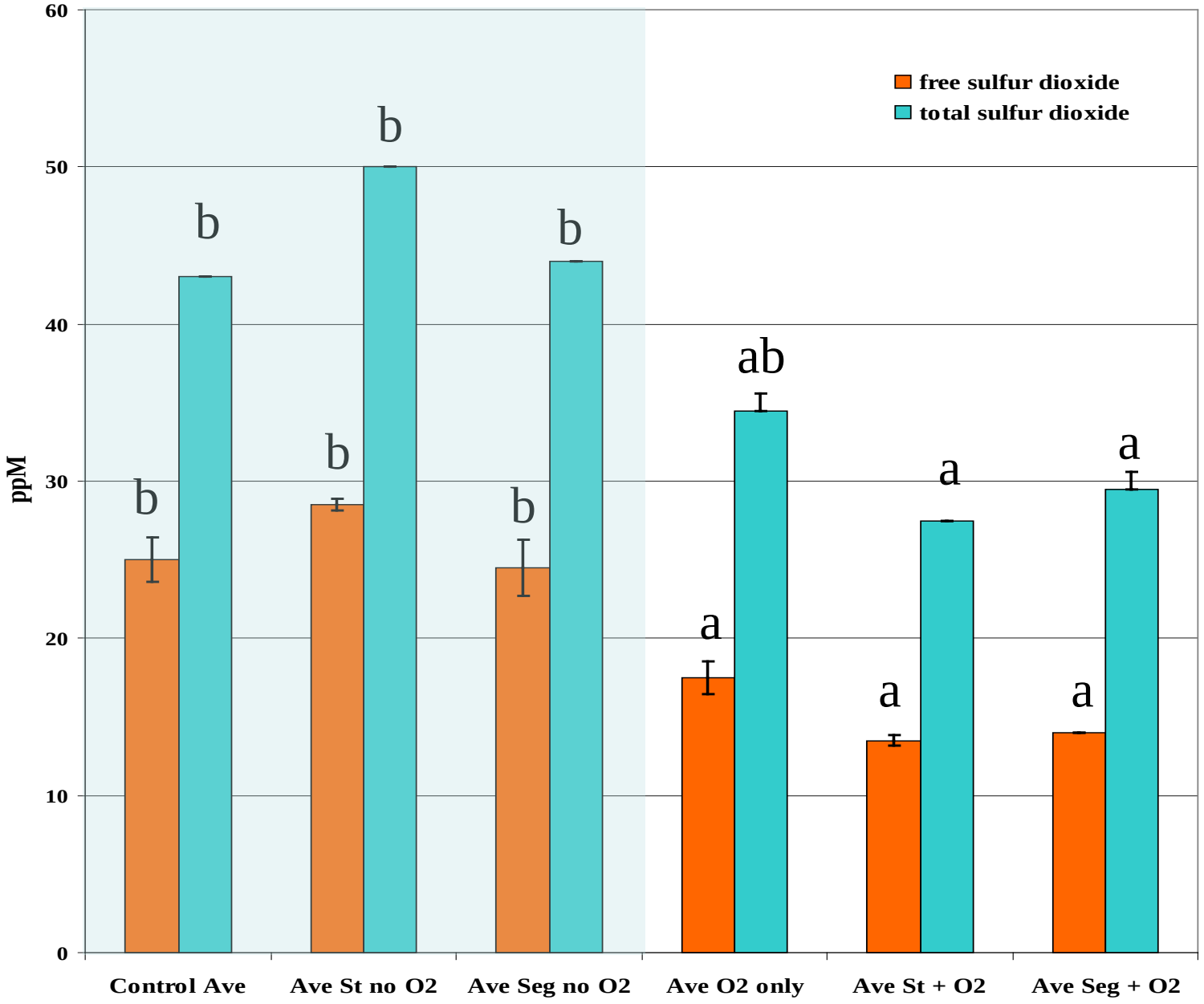
Tragon

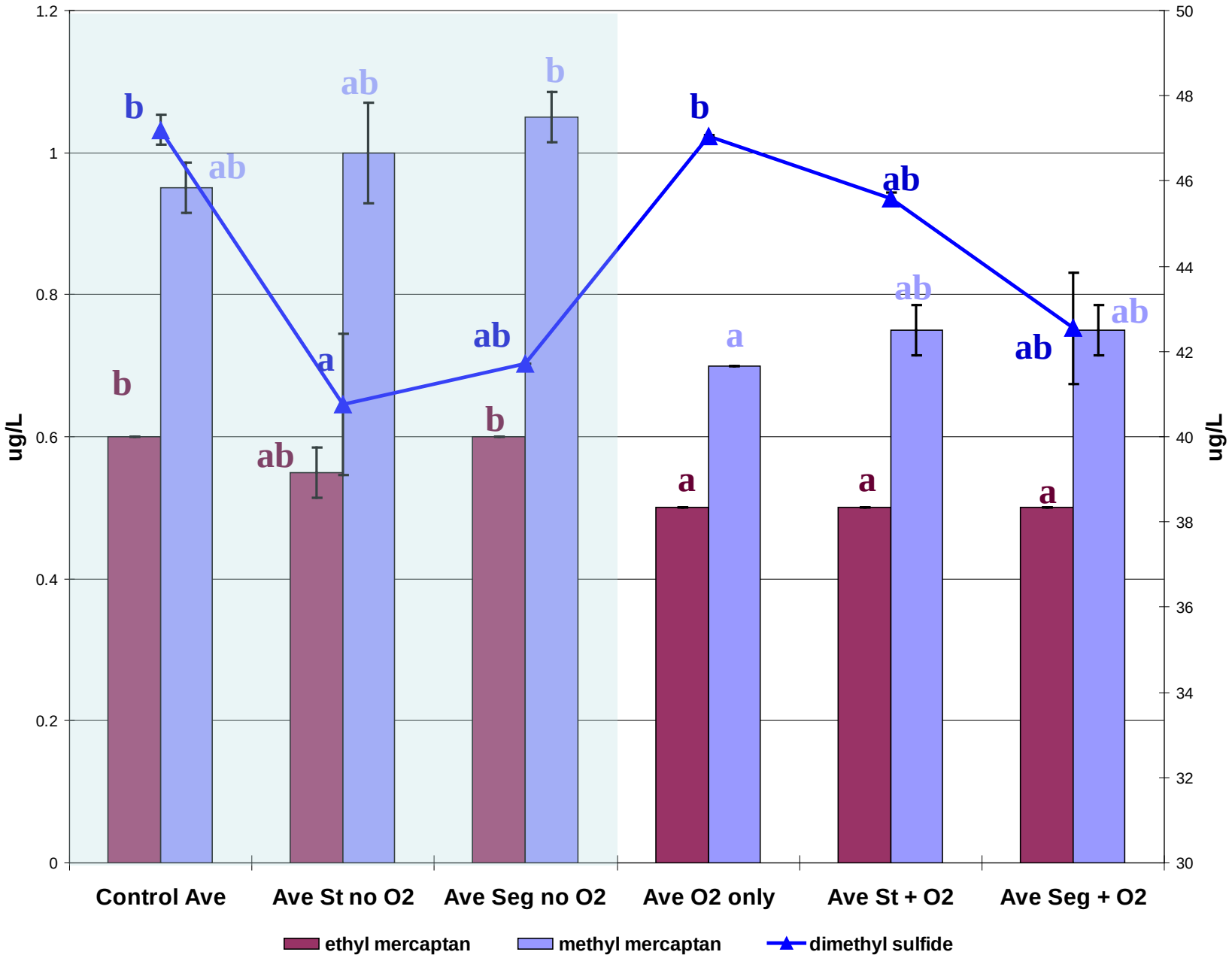
- •Data Analysis (Principle component analysis)

What results do we expect to see??

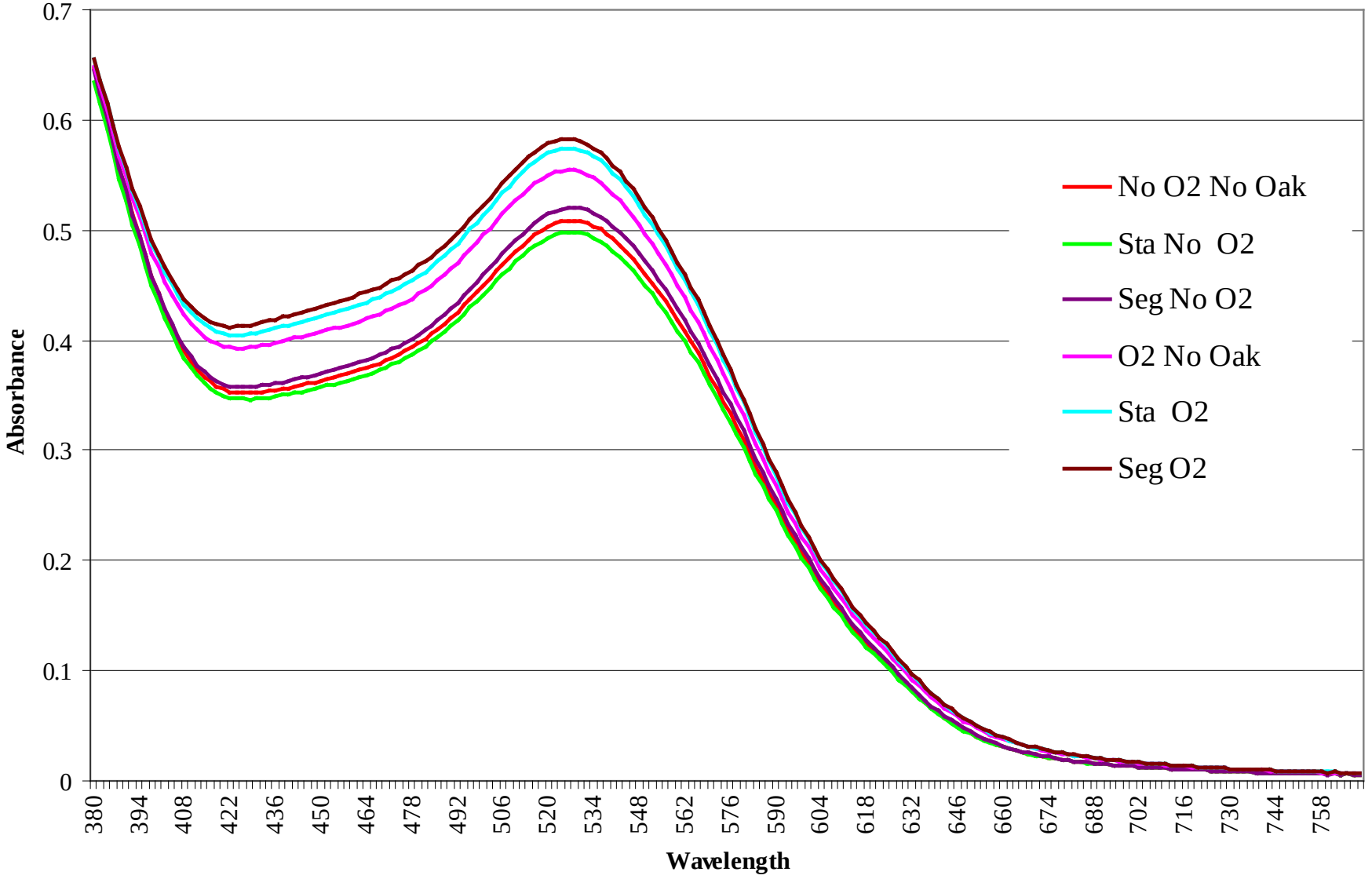
1. Does oxygenation affect compounds which we expect to effect mouthfeel?
   - Folin-Ciocalteu, Adams, HPLC measures of tannins and polymeric compounds.
2. Does oxygenation affect color or intensity of color?
   - Change in 420 & 520 nm measures, shifts in in spectra.
3. Can we discern the effects of toasted oak with or without added oxygenation?
   - Oak flavor, tannins, colored polymers
4. Will differences seen in analytical measurements be perceived in sensory measures?
   - Mouthfeel, smoothness,color, integration of flavors

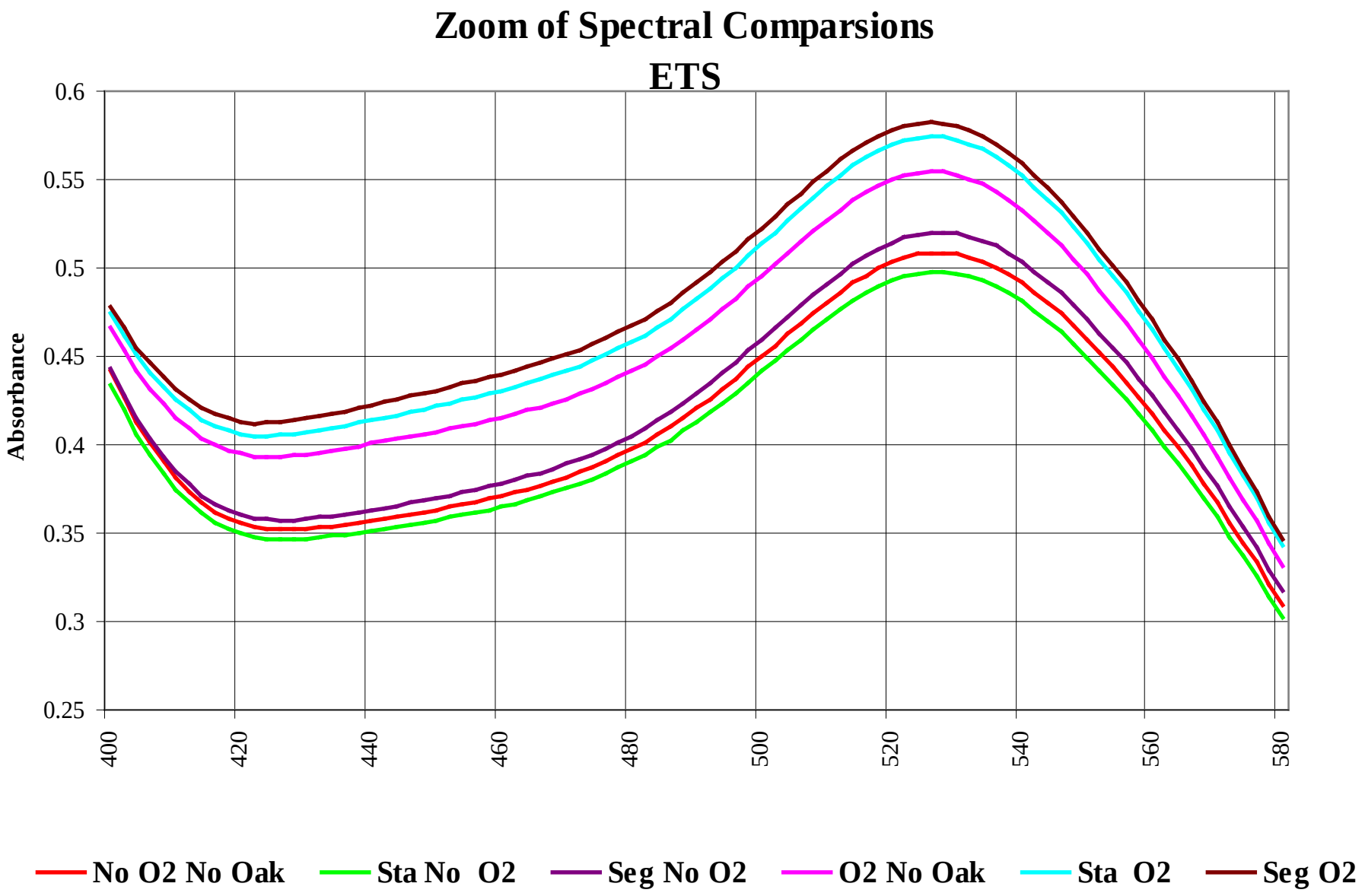
Significant Chemistry Panel Results



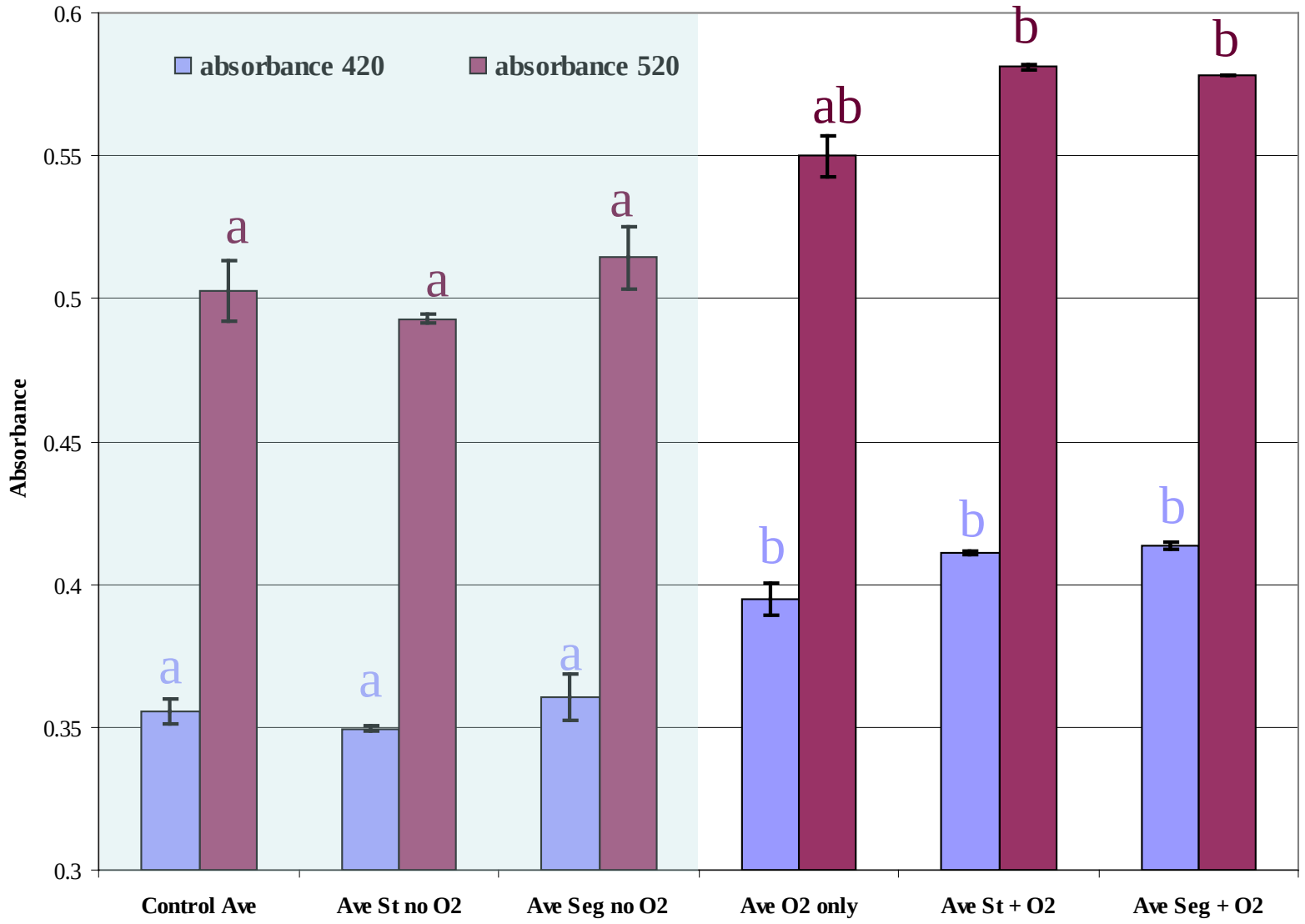

Significant Sulfides
ETS
ug/L
ug/L
1.2
1
0.8
0.6
0.4
0.2
0
50
48
46
44
42
40
38
36
34
32
30
b
ab
b
ab
b
ab
b
ab
a
ab
ab
a
a
a
a
ab
Control Ave
Ave St no O2
Ave Seg no O2
Ave O2 only
Ave St + O2
Ave Seg + O2
ethyl mercaptan
methyl mercaptan
dimethyl sulfide

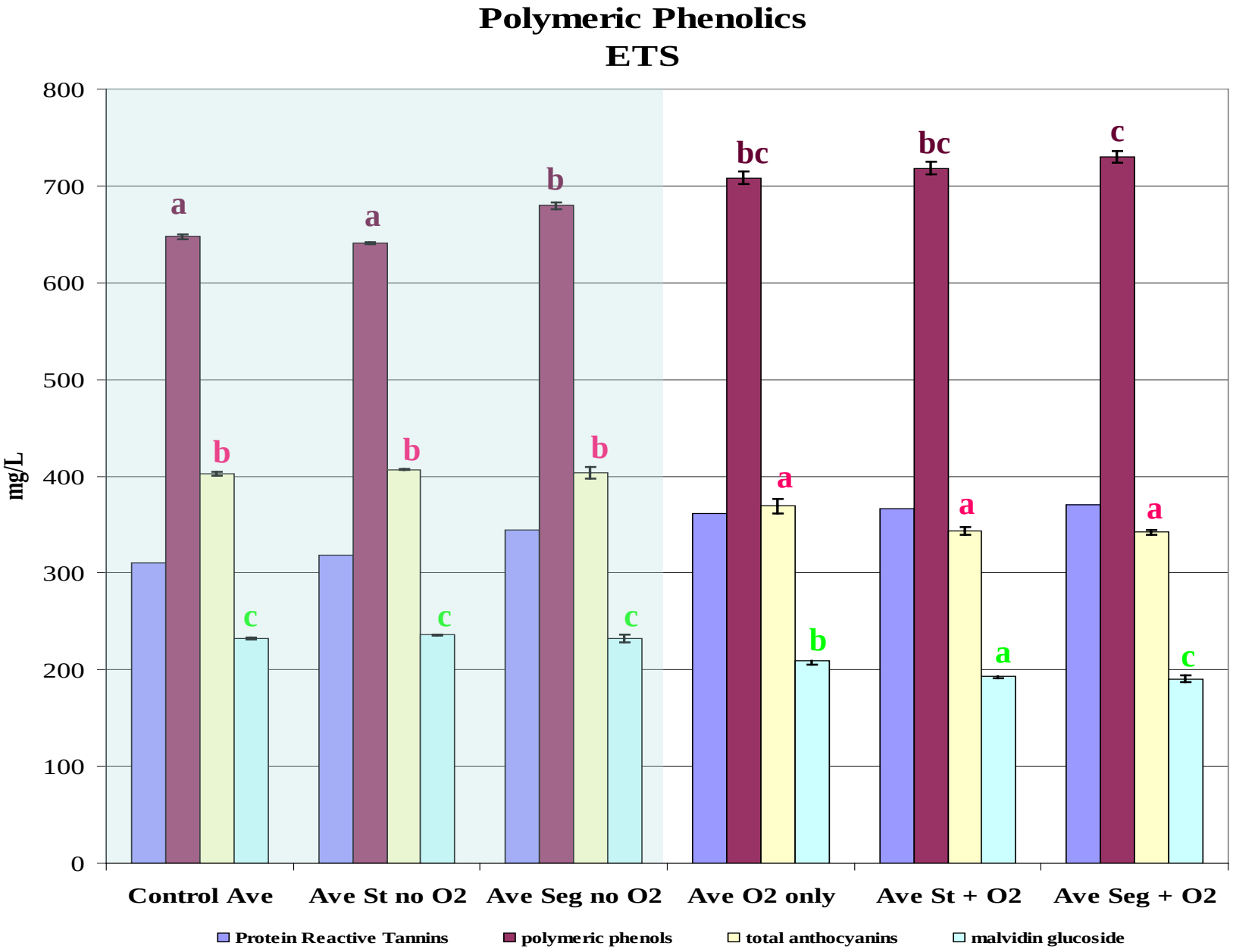
Spectral Comparisons
ETS

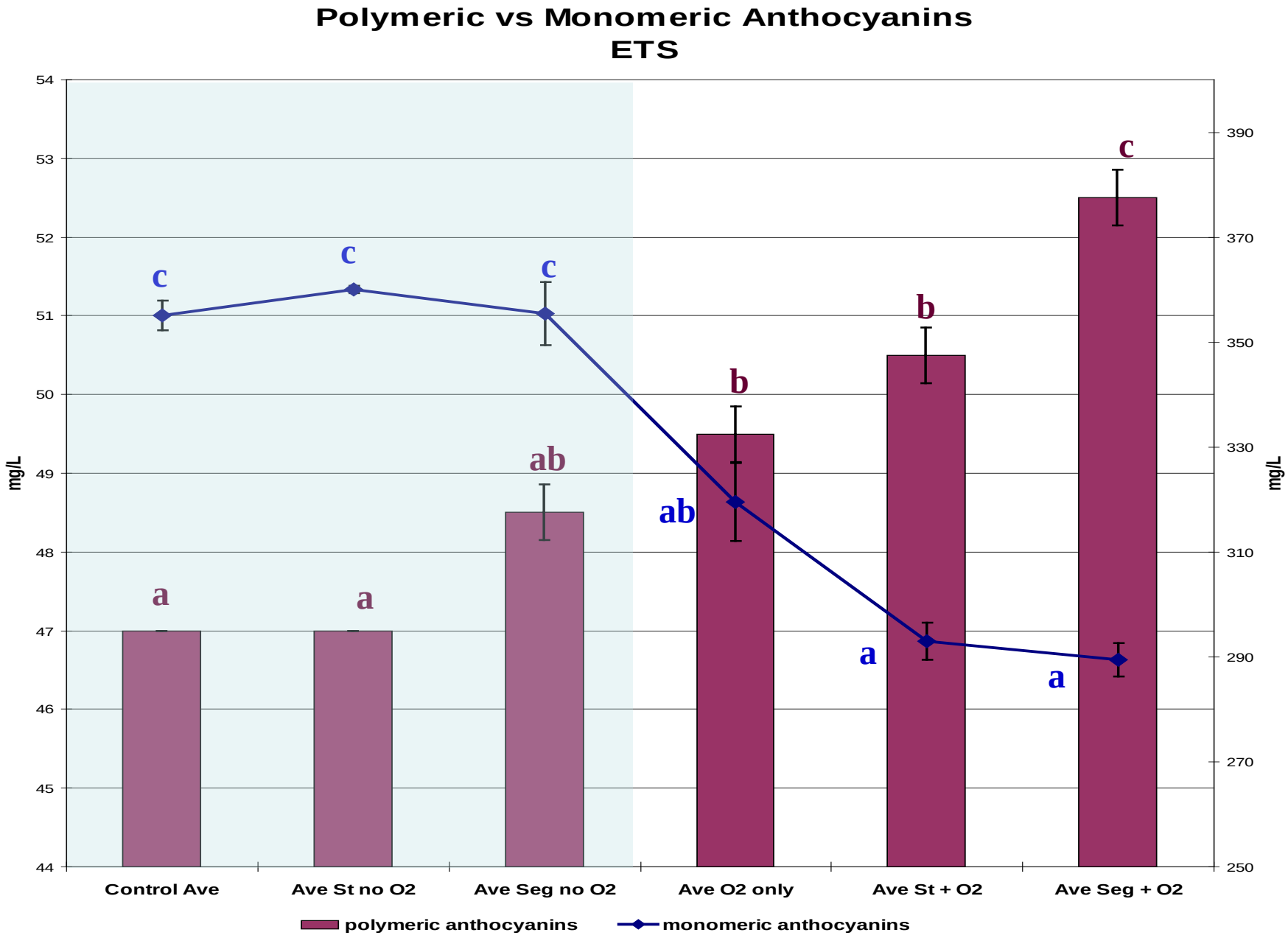



Zoom of Spectral Comparsions
ETS
Absorbance
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
400
420
440
460
480
500
520
540
560
580
No O2 No Oak
Sta No O2
Seg No O2
O2 No Oak
Sta O2
Seg O2

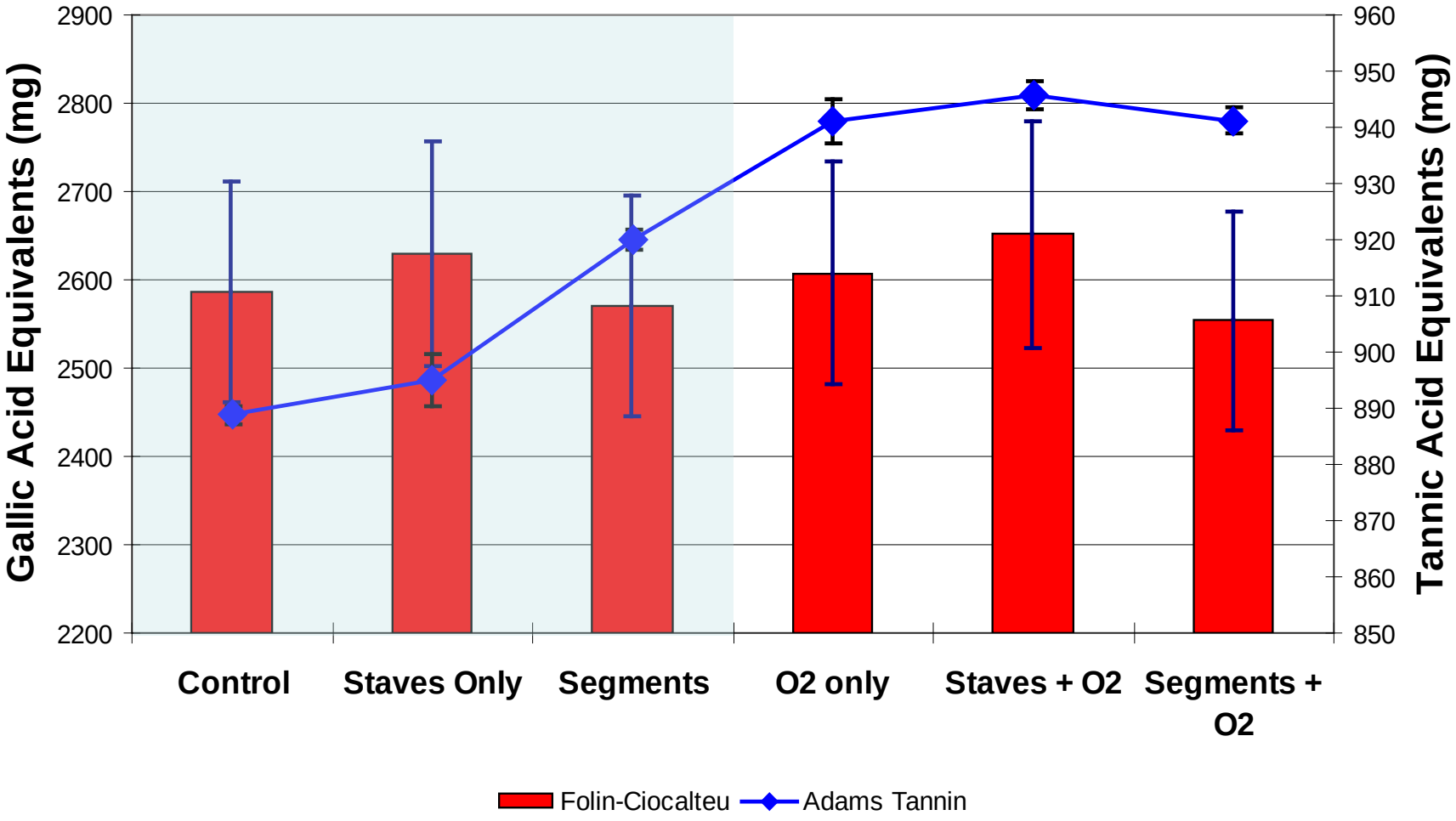
Red (520nm) vs Brown (420nm)
ETS



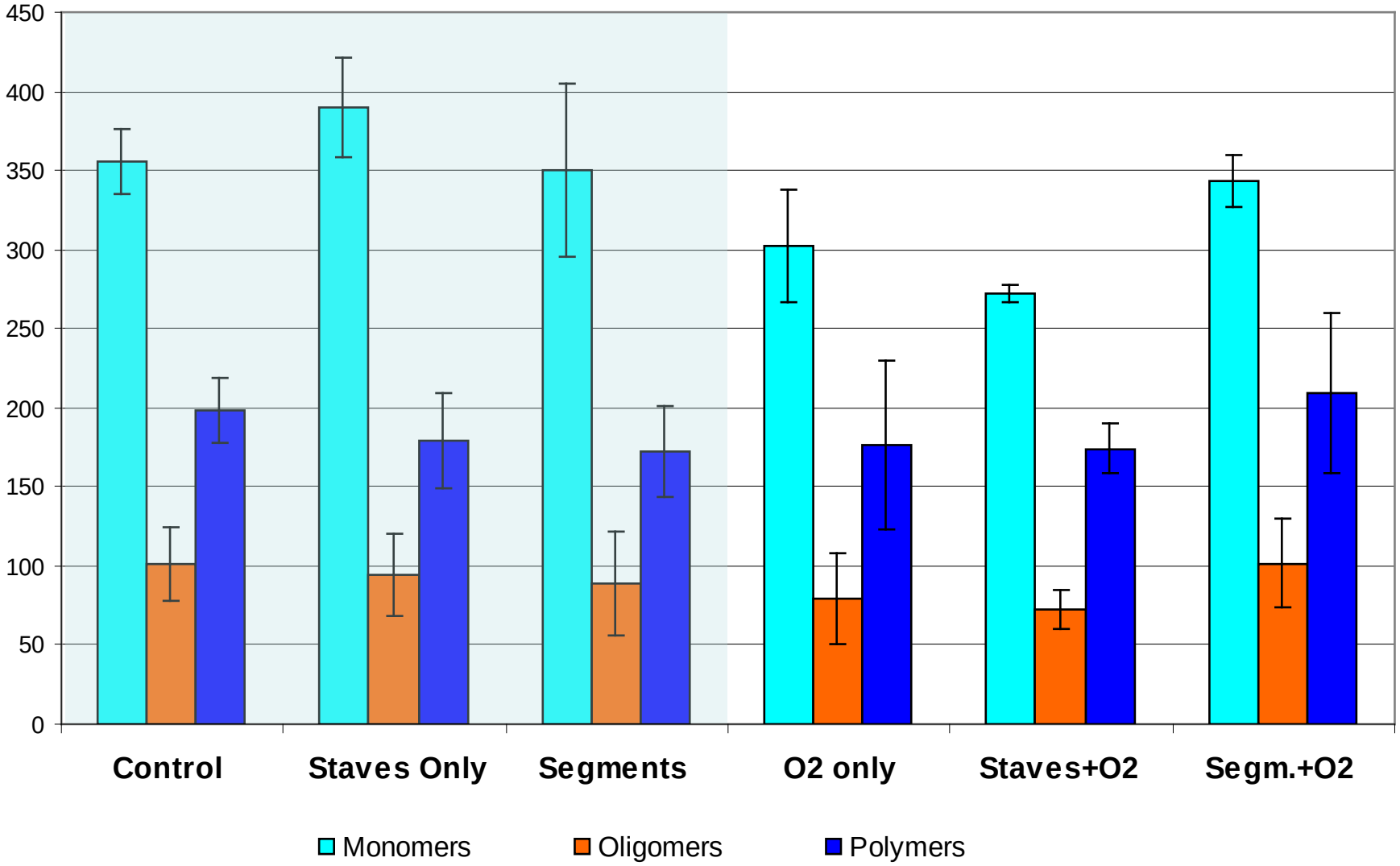

Polymeric Phenolics
ETS
mg/L
800
700
600
500
400
300
200
100
0
a
b
c
a
b
c
b
b
c
bc
a
b
bc
a
a
c
a
c
Control Ave
Ave St no O2
Ave Seg no O2
Ave O2 only
Ave St + O2
Ave Seg + O2
Protein Reactive Tannins
polymeric phenols
total anthocyanins
malvidin glucoside


Polymeric vs Monomeric Anthocyanins
ETS
mg/L
mg/L
54
53
52
51
50
49
48
47
46
45
44
390
370
350
330
310
290
270
250
c
c
c
b
b
c
ab
ab
a
a
a
a
Control Ave
Ave St no O2
Ave Seg no O2
Ave O2 only
Ave St + O2
Ave Seg + O2
polymeric anthocyanins
monomeric anthocyanins

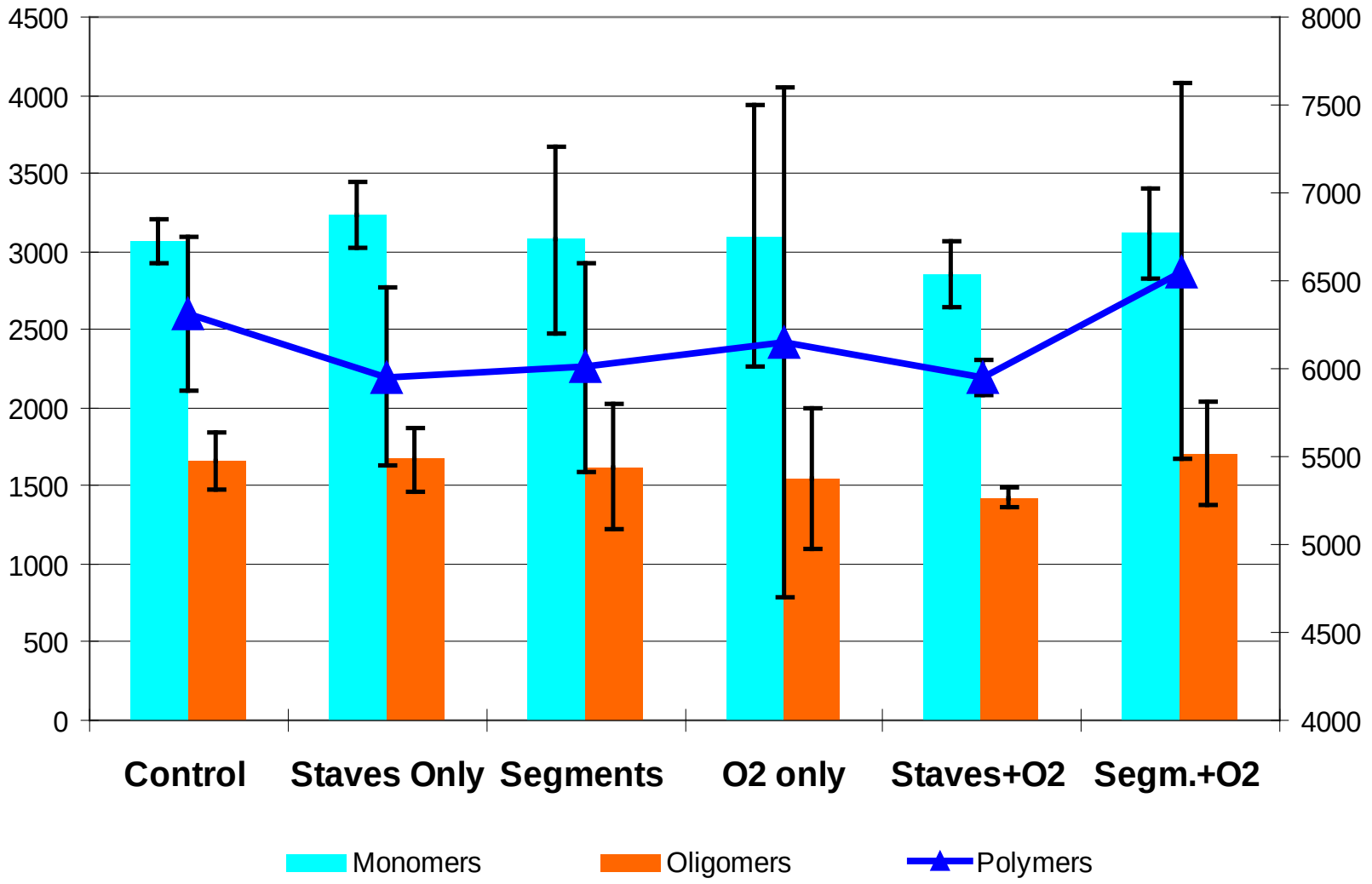
Adams vs Folin Tannin Assay
Waterhouse Laboratory



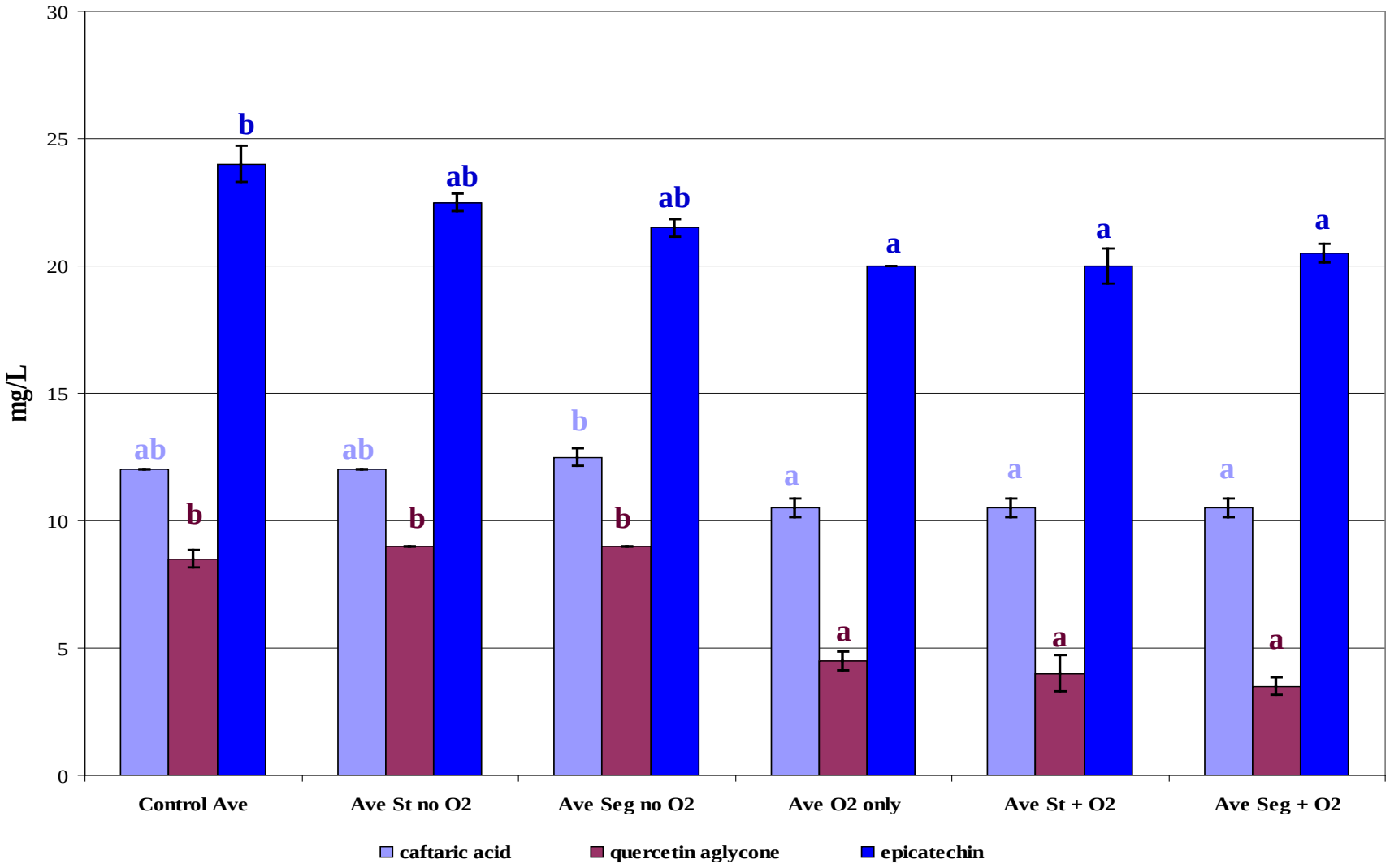
Normal Phase HPLC Analysis 520 nm Absorbance
Waterhouse Laboratory



Normal Phase HPLC Analysis - 280 nm
Waterhouse Laboratory

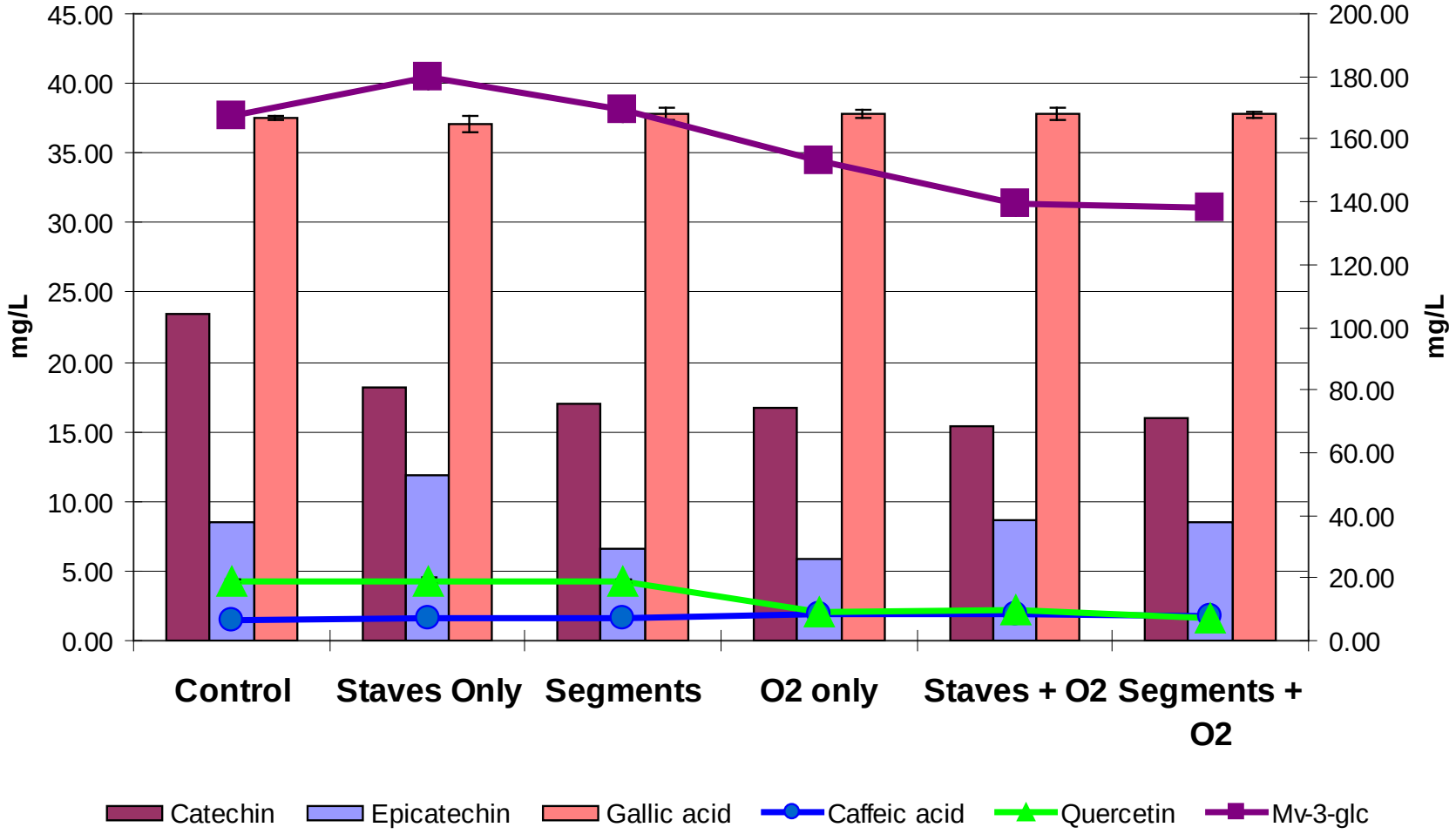


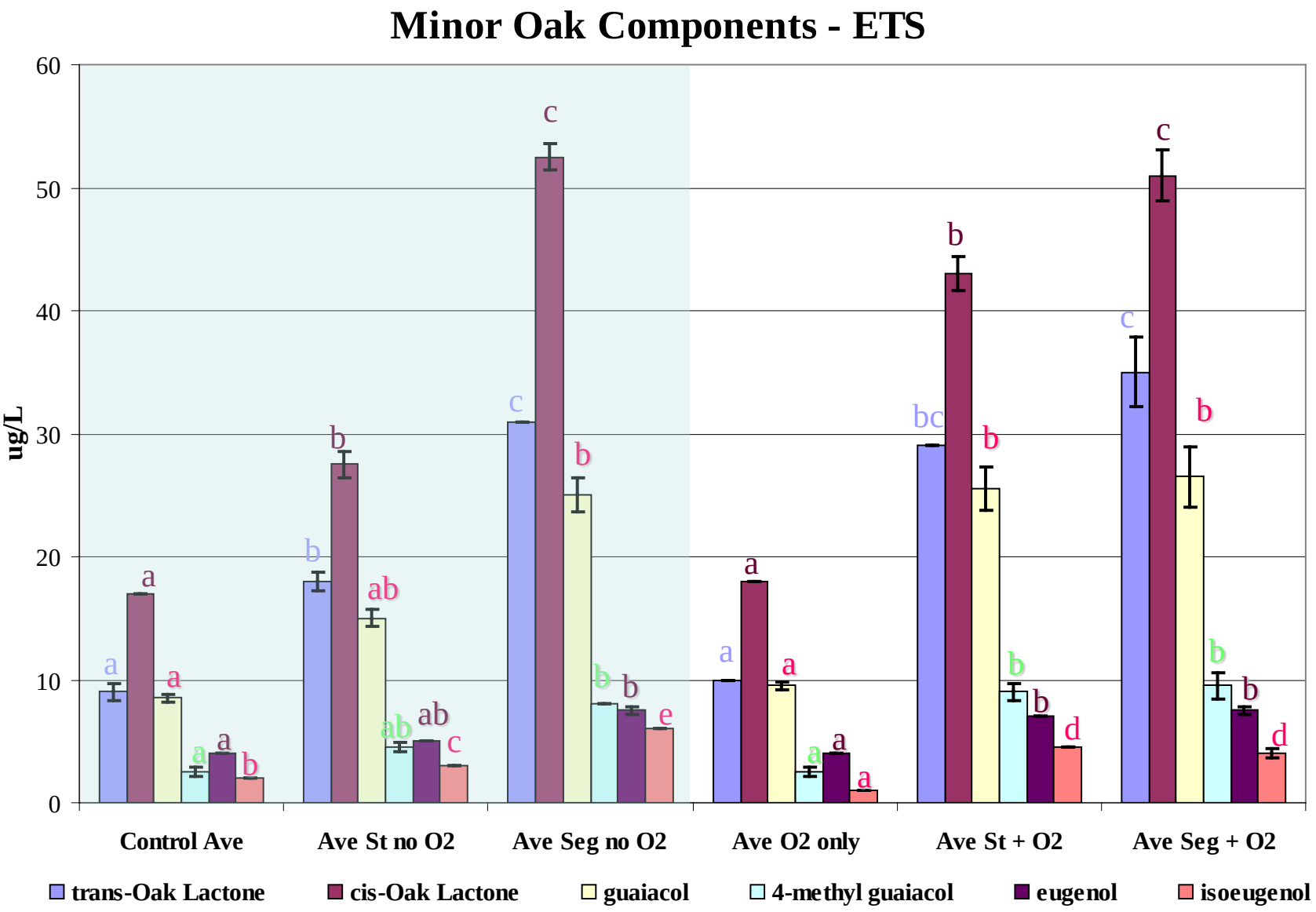
Grape Phenolics - ETS

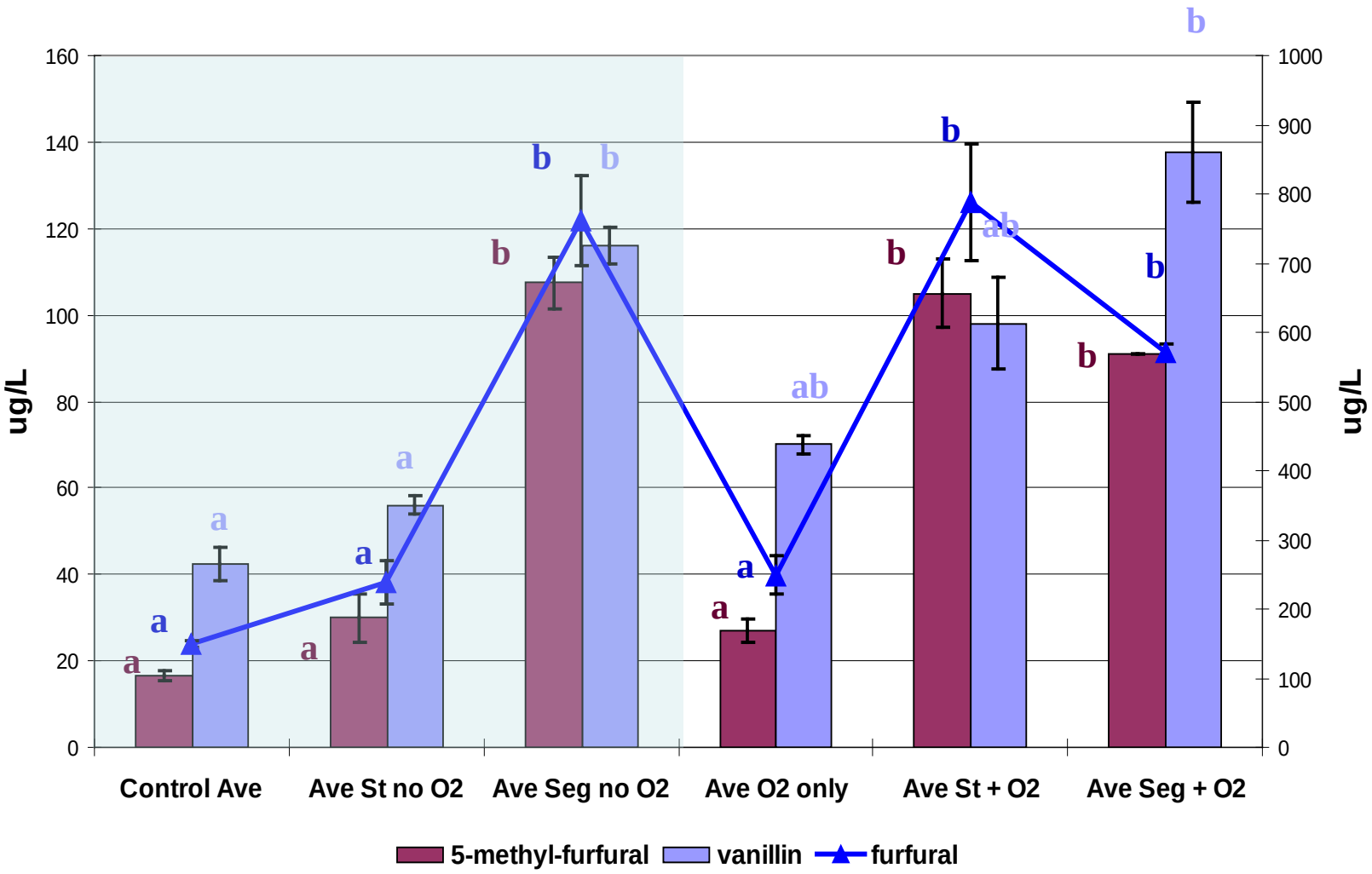


Reverse Phase Phenolic Analysis

Waterhouse Laboratory

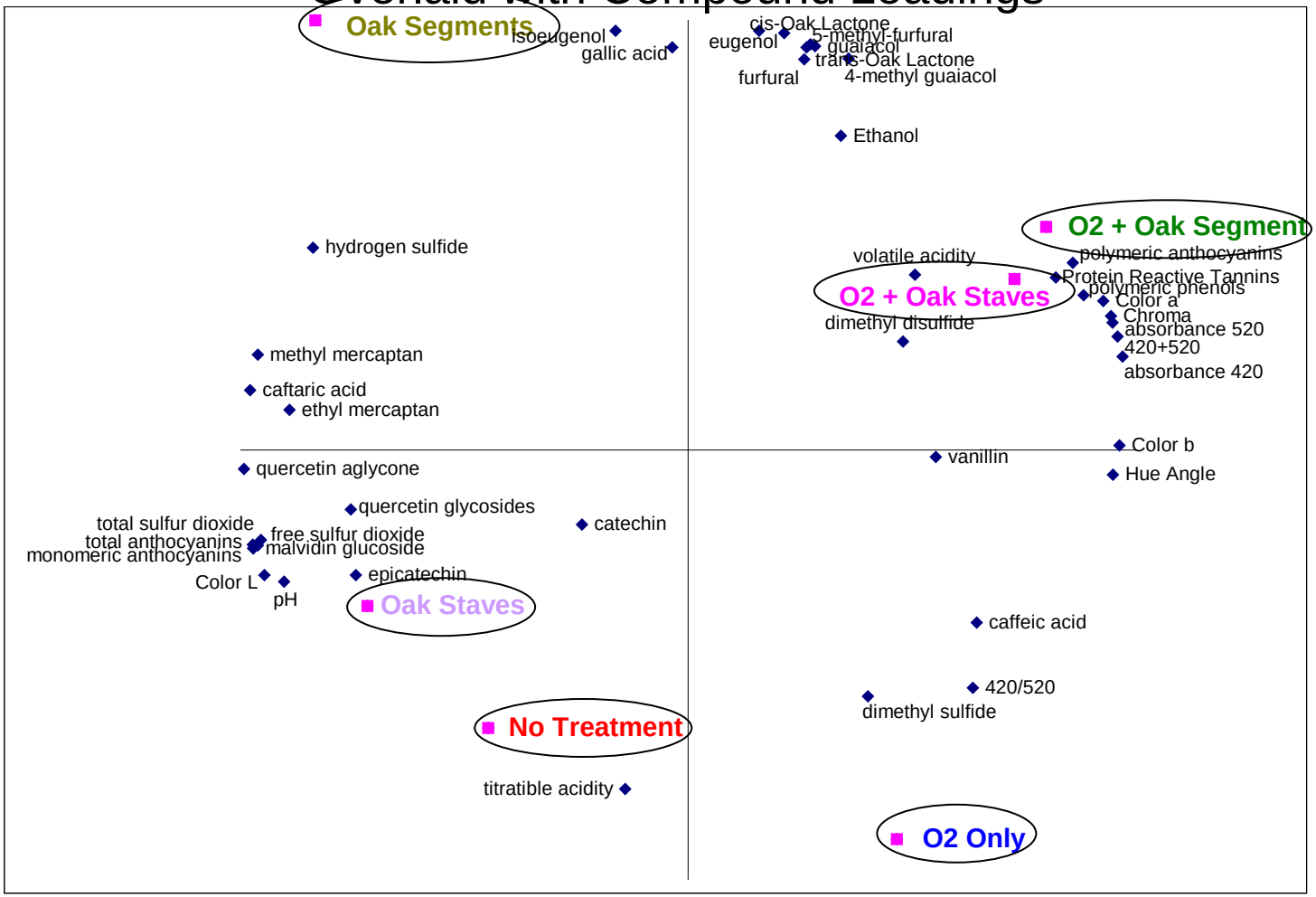



Minor Oak Components - ETS
ug/L
60
50
40
30
20
10
0
Control Ave
Ave St no O2
Ave Seg no O2
Ave O2 only
Ave St + O2
Ave Seg + O2
trans-Oak Lactone
cis-Oak Lactone
guaiacol
4-methyl guaiacol
eugenol
isoeugenol


Major Oak Components
ETS
ug/L
ug/L
160
140
120
100
80
60
40
20
0
1000
900
800
700
600
500
400
300
200
100
0
Control Ave
Ave St no O2
Ave Seg no O2
Ave O2 only
Ave St + O2
Ave Seg + O2
5-methyl-furfural
vanillin
furfural

Analytical Results

Product Principal Component Analysis Overlaid with Compound Loadings



Summary

1. Free SO_2 concentrations drop with O_2.
2. Total SO_2 concentrations drop with O_2.
3. Methyl and ethyl mercaptans decrease with O_2.
4. Dimethyl sulfide concentrations were lower with Oak.
5. Caftaric acid & quercetin aglycone decreased with O_2.
6. Epicatechin decreased with O_2.

Summary (cont.)

7. Red, absorbance at 520 nm increases with O2.
8. Brown, absorbance at 420 nm increases with O2.
9. Monomeric anthocyanins decreased with a concurrent increase in polymeric anthocyanins.
10. Most measures of phenolic polymers did not show significant differences.
11. Adams assay for tannin did show an increase with O2.

12 Concentrations of oak flavor compounds from staves increased with O2.

Preliminary Results of Sensory Screening Tests

• Replicates	not different
• No oak vs oak segments	different
• No oak vs oak segments with oxygen	different
• Oak segments vs oak segments with oxygen	different
• No oak vs oak staves	not different
• Oak staves vs oak staves with oxygen	not different

Conclusions

1. Addition of oxygen does have measurable effects on wines.
2. There appears to be an interaction between stave oak and O2.
3. Stave oak extracts and interacts with wines differently then segment oak. Further studies are needed to confirm these findings.
4. Correlation of analytical measures to sensory measures needs further study.
5. Effects on fruity based compounds should be quantified.
6. Other analytical measures should be included in future studies.
7. Complex measurements do not revel the story, simpler assays need further investigation for use in wineries..

Acknowledgements

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