Oregon Wine Symposium

SMART OAK STRATEGIES

Anne Sery, Director of Winemaking, NW Wine Co.

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NW WINE COMPANY

ABOUT THE WINE

2025 Willamette Valley Pinot Noir to be bottled in early summer

Fermented in 50T fermenters

Machine Picked

Current labs:

- ML complete
- pH: 3.60
- TA: 6.3 g/L
- Alc: 13.9%
- Free SO2: 28 ppm

ABOUT THE TRIAL

- Comparison of 4 different oak products:
  - Staves – Seguin Moreau
  - Blocks - Seguin Moreau
  - Barrels - Seguin Moreau
  - Barrel Inserts - Seguin Moreau

- All wines in tank are under micro-ox treatment

- About the tasting :
  - 1 sample each treatment + 1 tank control + 1 neutral barrel control
  - The staves and blocks dose is meant to be a 20% new oak equivalent
  - The barrel sample was blended down to a 20% new oak for the tasting

- Tasting blind

LET’S TAKE A FEW MINUTES TO TASTE

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Can you guess which one is which?

Do you have a preference?

REVEAL

498- Barrel insert

919 – Barrel control

876 – Tank + Blocks

277 – New barrel (20%)

483 – Tank + Staves

928 – Tank control

SMART OAK STRATEGIES

Arnaud Mennesson, Seguin Moreau

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SEGUIN MOREAU

MAIN ADVANTAGES

ECONOMIC

- Chips 0,01 - 0,1 $ / L
- Staves 0,1 – 0,4 $ / L
- Barrels 2 - 3 $ / L

PRACTICAL

- Less maintenance (barrel washing, sulfur addition, racking, topping)
- Fewer microbiological issues

FLEXIBLE

- Possibility to create blends/formulations (curative use possible)
- Preliminary trials to support technical decision-making
- Easier sourcing/supply
- Suitable for all types of wines

DIFFERENTS FORMATS

THICKNESS

- Rapid extraction of oak-derived compounds
- Faster oak integration
- Lower long-term stability
- Less complexity compared to barrel aging
- Wines intended for rapid turnover / early release

- Slow extraction of oak-derived compounds
- Oak integration over time
- Greater long-term stability
- "Barrel-aged" profile
- Wines intended for aging / cellaring

SEGUIN MOREAU

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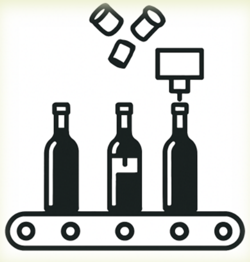
SEGUIN MOREAU'S RANGE

CONTACT TIME

4 to 8 months	2 to 4 months	1 to 3 months	1 to 2 weeks	BOTTLING



Oenostave & Oenoblocks

Oenosticks

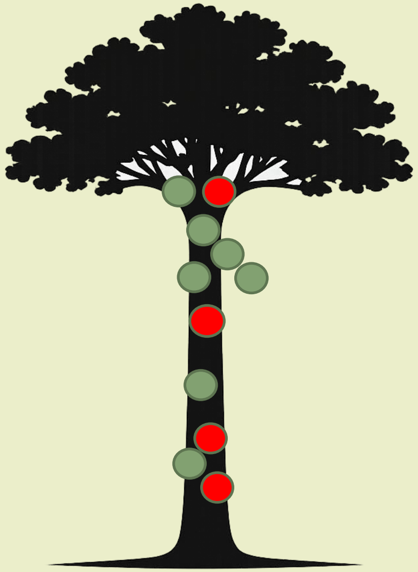
Oenochips

Oenofinisher

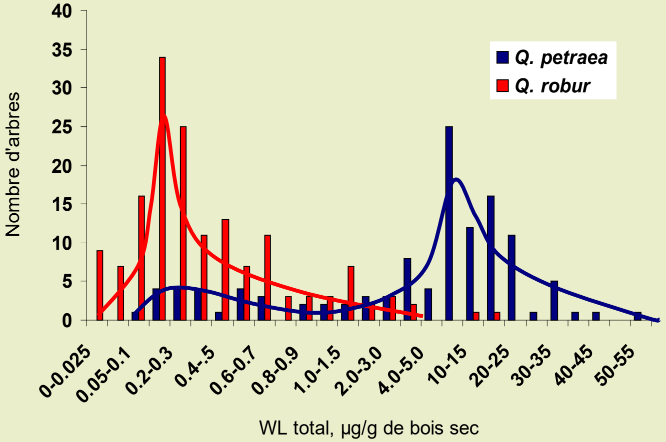
QUALITY

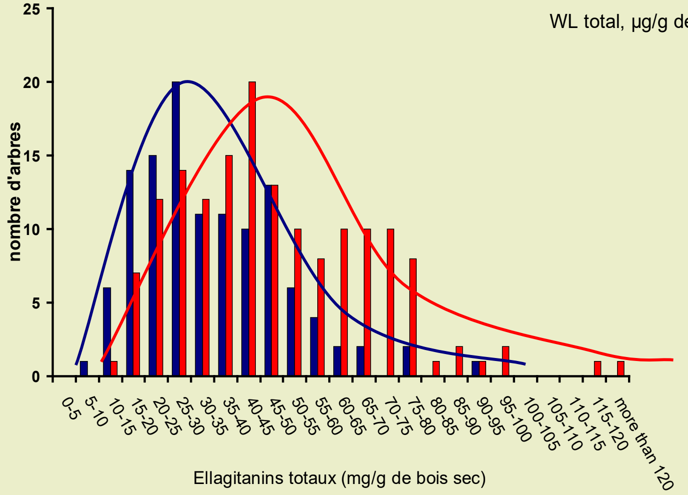
EXCEPTION

EXCEPTION RANGE

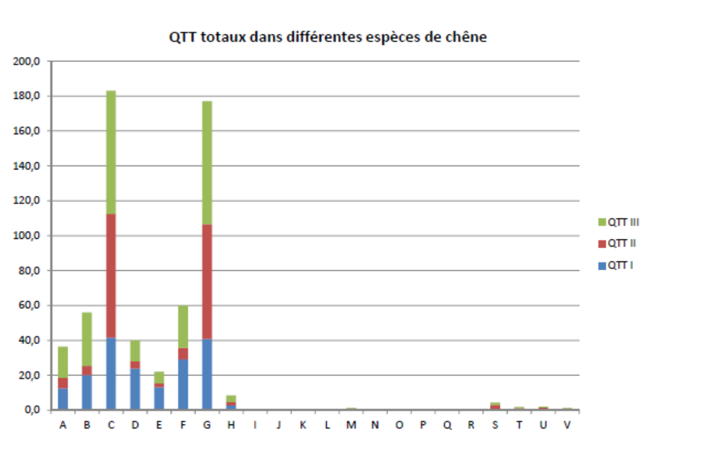


- « Targeted » compounds
- Other compounds



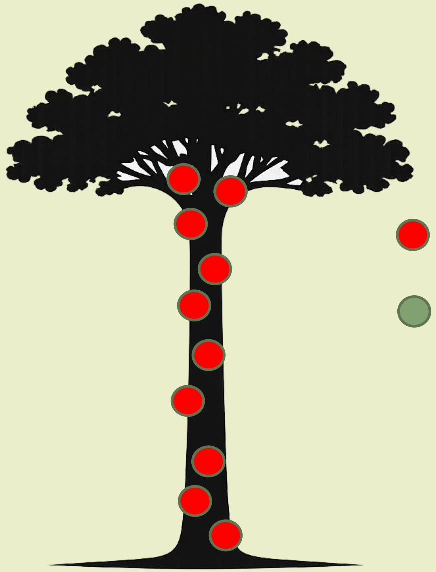


Prida et al. 2006



Marchal et al. 2016

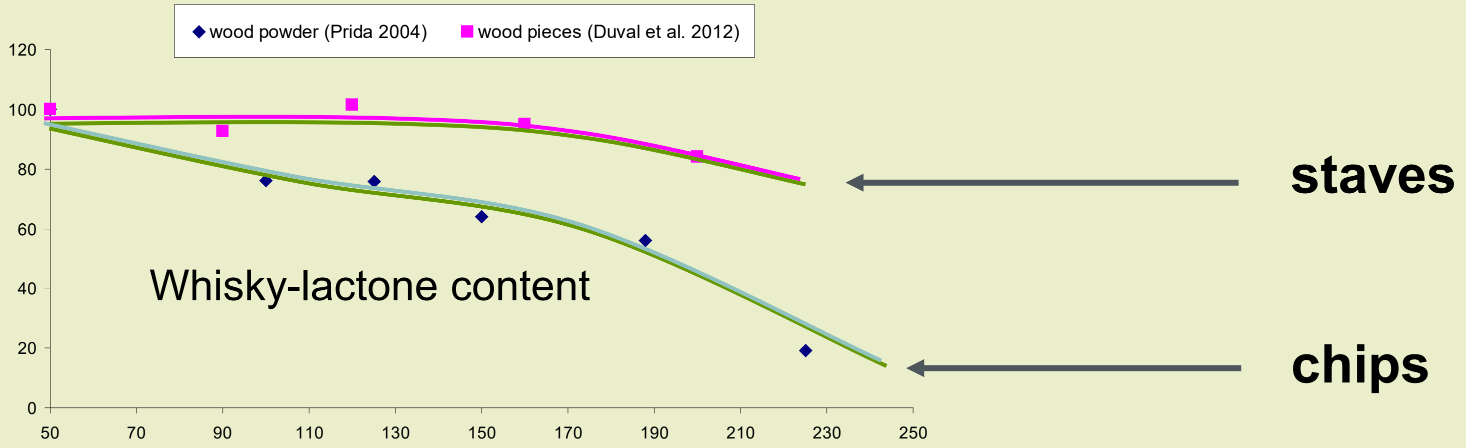
EXCEPTION RANGE



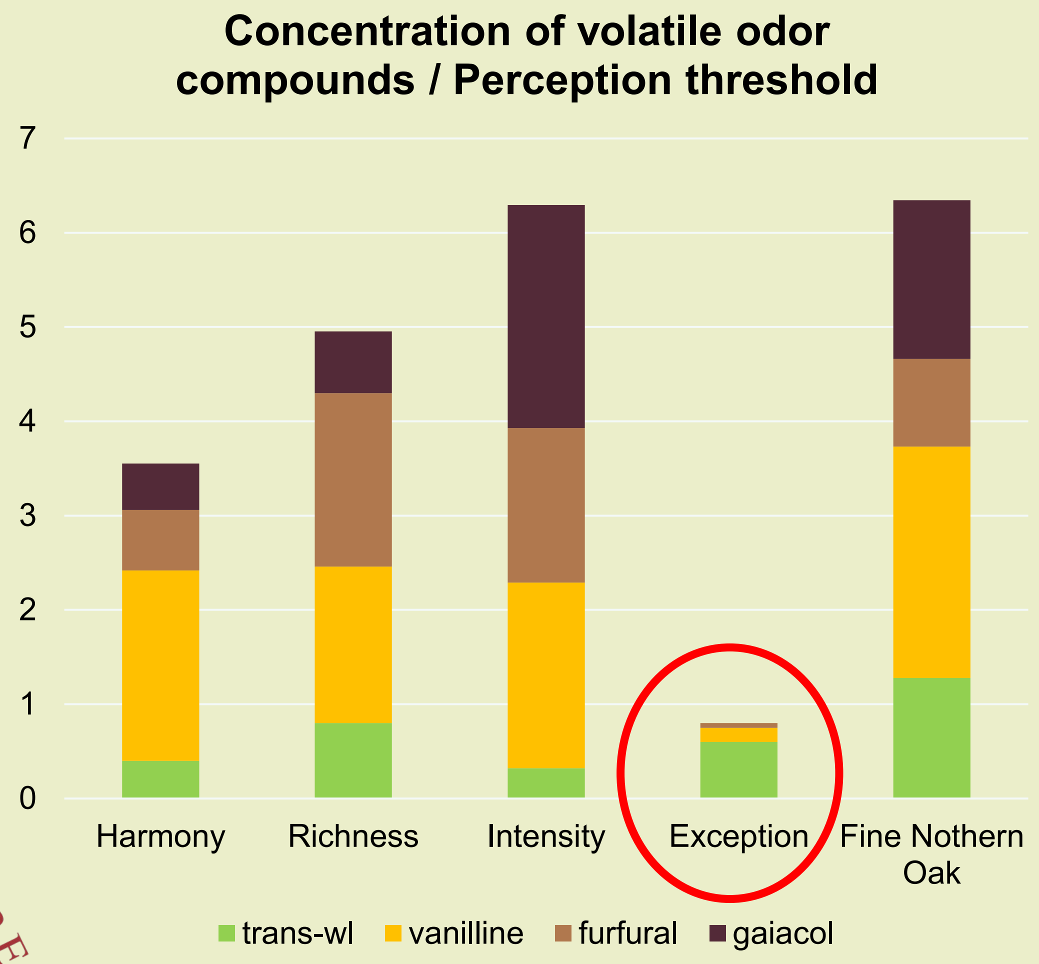
« Targeted » compounds

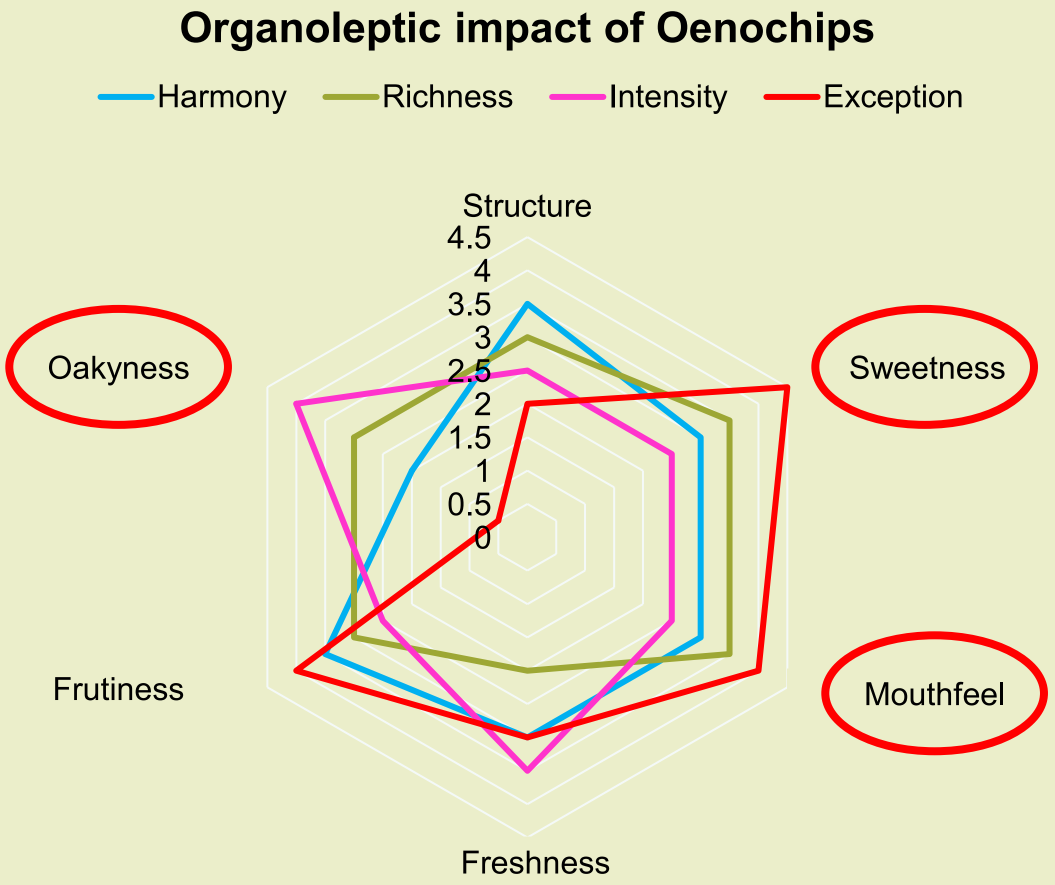
Other compounds

- Homogeneity, as it comes from the same type of tree
- Minimum maturation period of 2 years
- Specific toasting process to prevent significant loss of QTTs and ellagitannins



EXCEPTION RANGE





PROTOCOL

CONTROLS

TANK
Ø MOX
Ø OAK

NEUTRAL BARREL

20% NEW OAK EQUIVALENCE

MOX
BLOCKS
- 50% EXCEPTION
- 50% M TOAST

MOX
STAVES
- 50% EXCEPTION
- 50% M TOAST

NEW BARREL*

NEUTRAL BARRELS + INSERTS
(Oenostick exception)

** (sample blended with neutral to match 20% new)*

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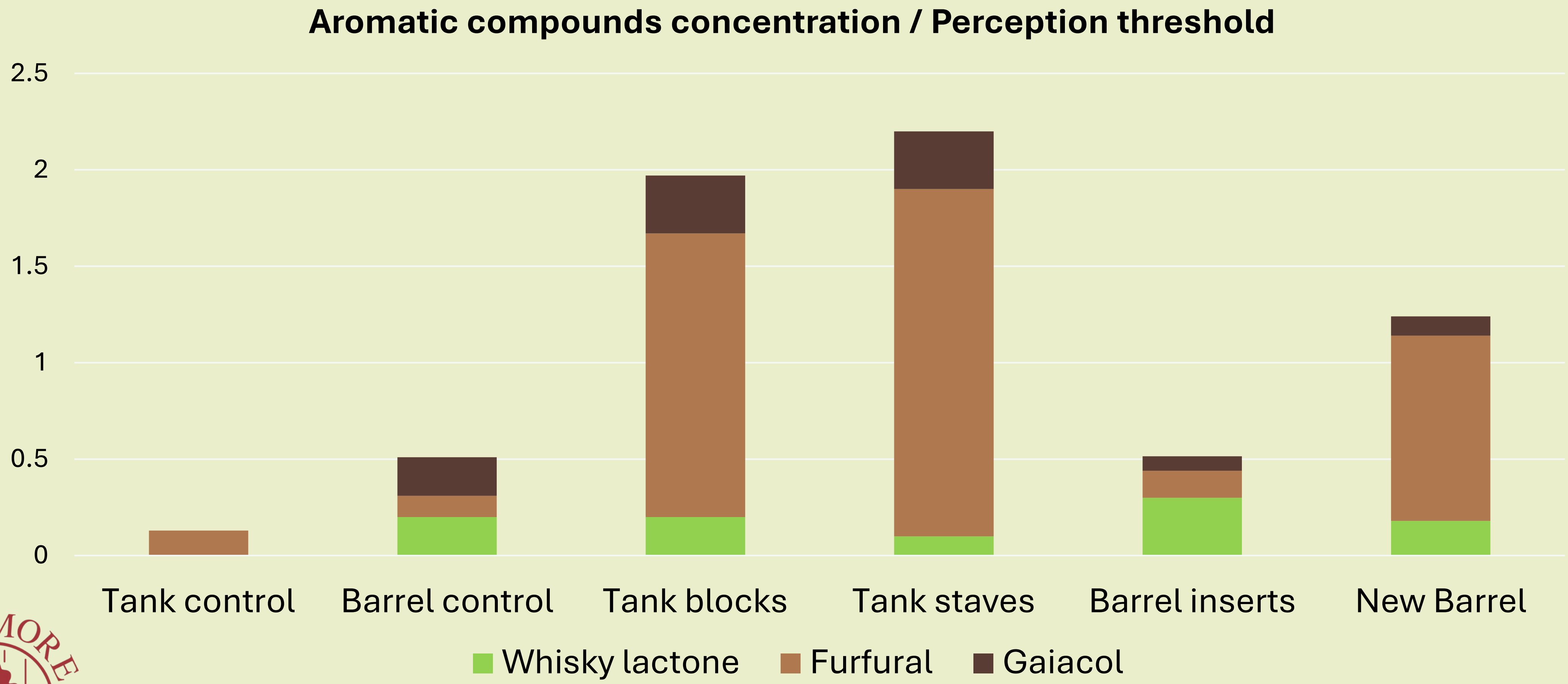
TRIAL ANALYSIS



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SELECTION CRITERA

I. Wine color

WHITE	RED
• Richness and volume • Aromatic finesse and fruit expression • Contribution to complexity (nose/palate) • Improved aging potential	• Texture, reduction in astringency, addition of volume/sweetness • Aromatic finesse and fruit expression • Development of toasted/roasted aromas • Improved aging potential

SELECTION CRITERA

I. **Wine color**
II. **Contact time**
III. **Sensory objective**

1) *Oak essence effect*

French oak ➔ structure, volume, and sweet spices

American oak ➔ intense oaky notes and sweetness

2) *Toast effect*

Fresh oak → *TOASTING INTENSITY* → Medium + / Heavy toast

Freshness, structure → *Toasted / mocha / vanilla notes*

3) *Dosage effect*

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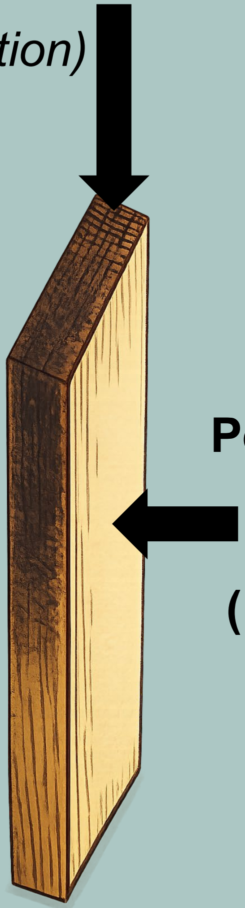
DIFFERENCES IN EXTRACTION BETWEEN ALTERNATIVE OAK PRODUCTS AND BARRELS

Preferential wine penetration direction in the use of alternatives

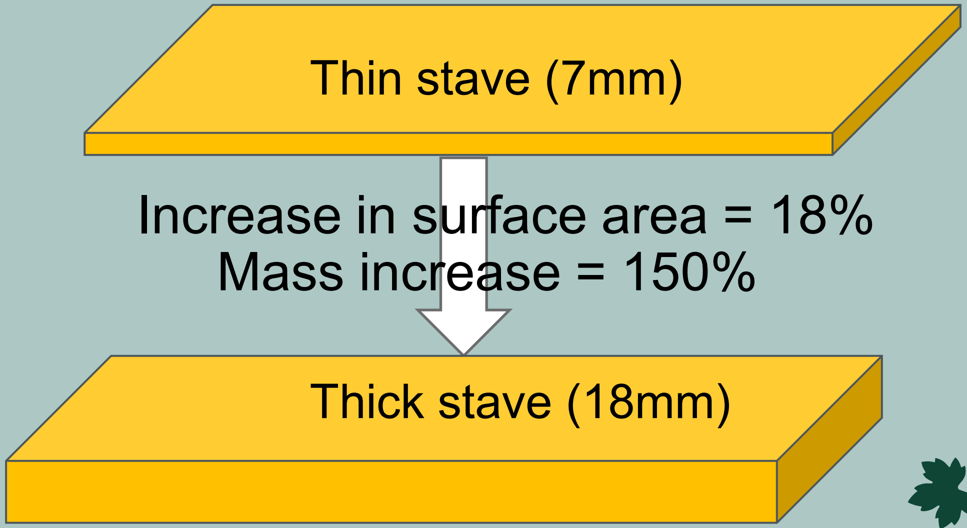
(Longitudinal direction)



Perpendicular to the radial cut (barrel)

(*Tangential direction*)

	Barrels	Staves	Chips
Amount of oak in contact with the wine	12 – 15 g/L	2 – 8 g/L	1 – 5 g/L
Transfer of oak extractables	Partial 30 to 50%	Almost 90% complete	Complete 100%



SELECTION CRITERA

I. **Wine color**
II. **Contact time**
III. **Sensory objective**

1) *Oak essence effect*
2) *Toast effect*
3) *Dosage effect*

	WHITE	RED
Not perceivable	0,5 – 1 g/L	1 – 3 g/L
Perceivable	1 – 3 g/L	3 – 5 g/L
Very perceivable	3 – 5 g/L	5 – 8 g/L

**depends significantly on the concentration of the wine*

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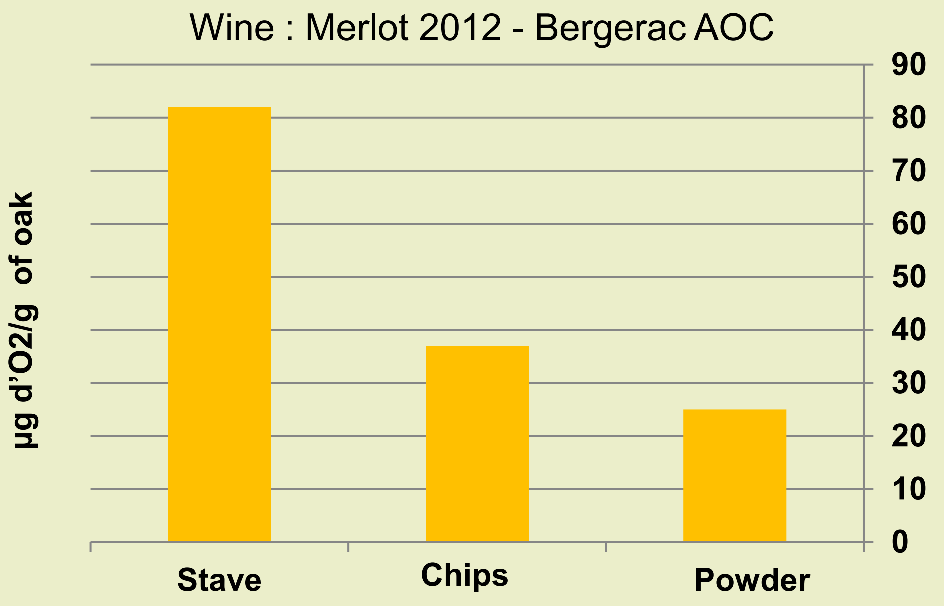
KEY POINTS

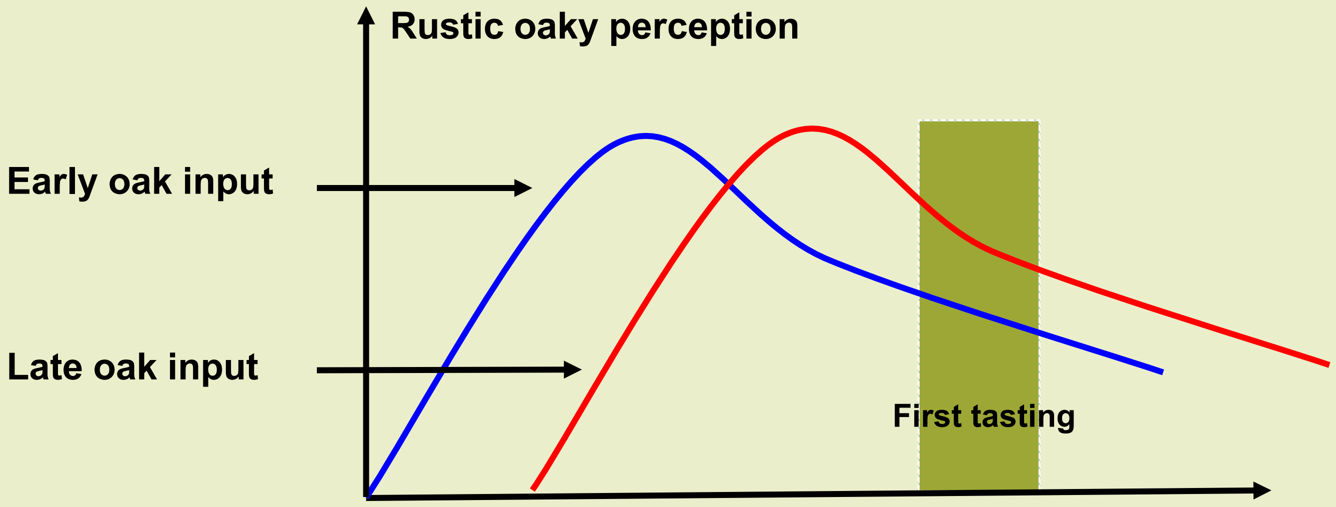
- Dissolved oxygen
- Free SO2



1 mg/L of O_2 consumes approximately 2,5 to 4 mg/L of free SO_2.

Check Free SO_2 maximum two weeks after contact.

- The tasting



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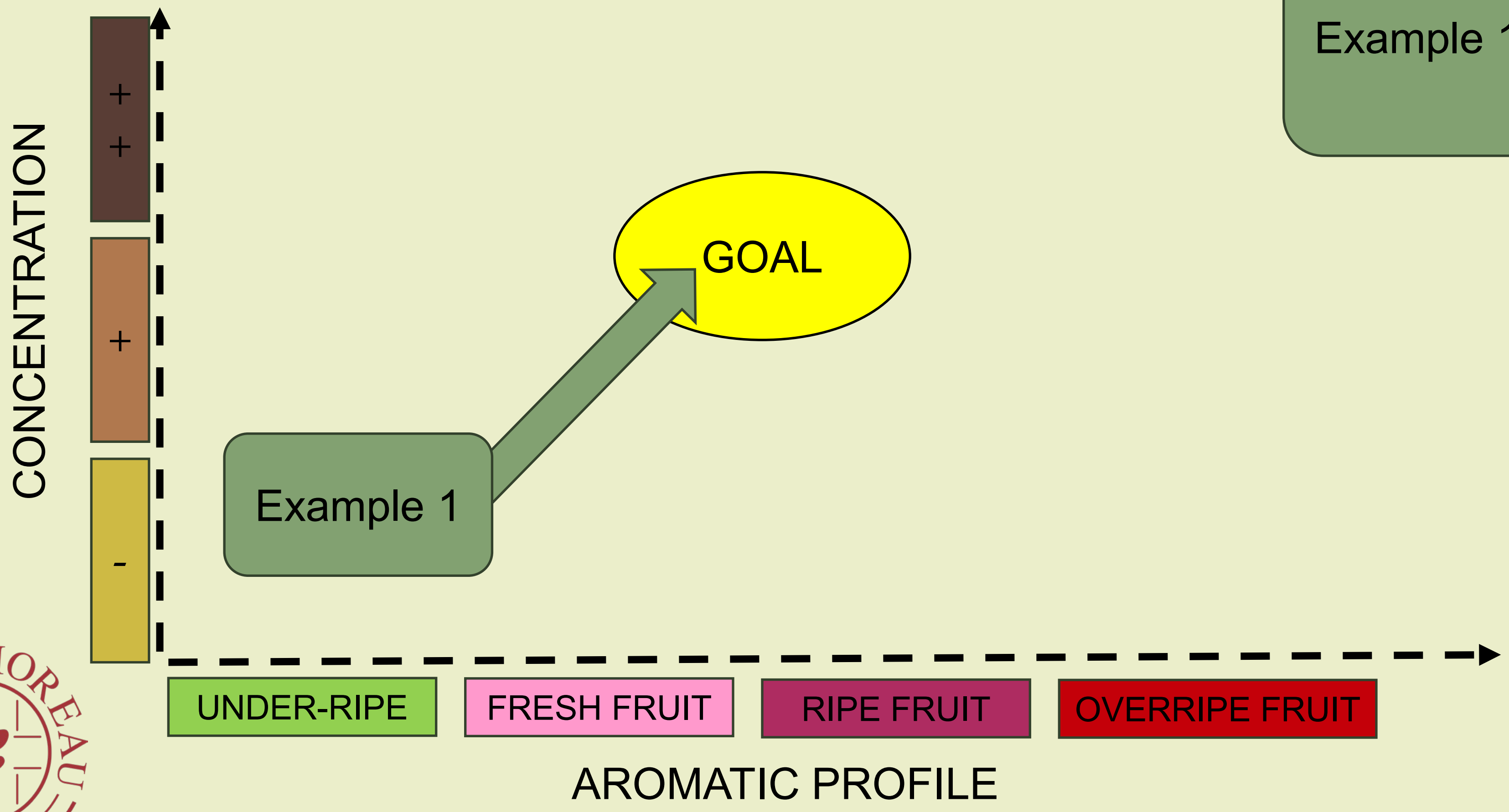
SOME EXAMPLES OF SOLUTIONS TO SPECIFIC PROBLEMS



Example 1

➔ **Need to concentrate (structure + mouthfeel) and mature the fruit**

Recommandation :

- French Oak Medium (High dosage)
  (+)
- American Oak Medium+

THANKS FOR YOUR ATTENTION

Kinetics of Oak volatiles

Mackenzie Aragon, PhD Candidate

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Overview

- Toasting and Oak Alternatives - Repeatability
- Extraction Kinetics
- Application of the Two-Dimensional Kinetic Model




The Advantages of Oak Alternatives

- Products made from oak that are not in barrel format.
- Advantages:
  - Cost reduction relative to oak barrels
  - More sustainable than barrels
  - Shorter extraction time

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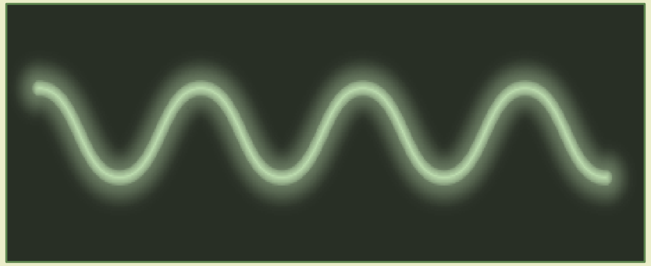
Commercial Oak Alternative Products

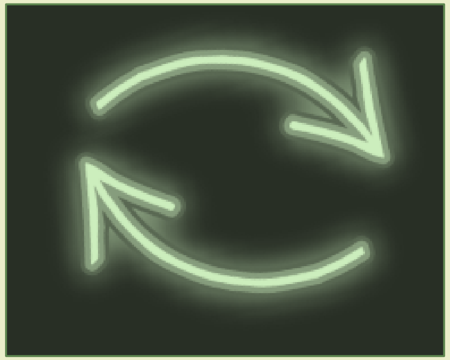
There are five methods commercially used for alternative oak products.

Fire (F)

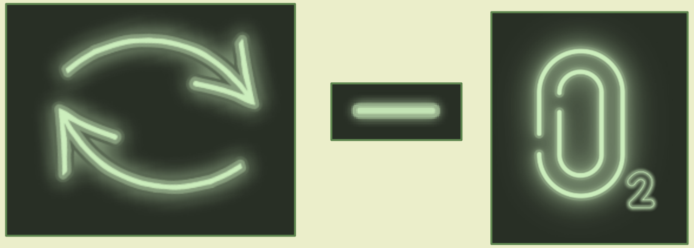
Infrared (I)



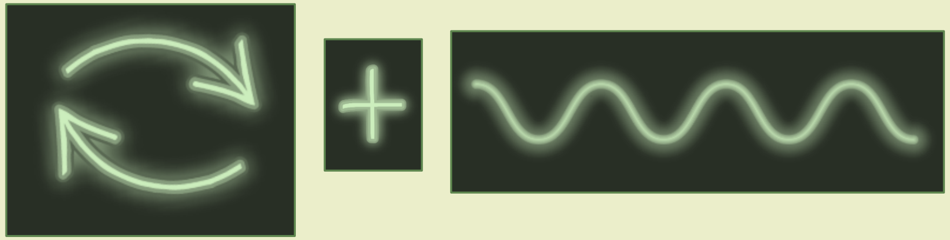
Convection (C)



Vacuum (V)



Double Toast (DT)



A Survey of Commercially Available Oak Alternatives

- Examples of alternative products made using the five methods were evaluated.
- Three separate production lots, each of various toasting intensities.
  - Medium
  - Medium plus
  - Heavy
- Extracts (20 g/L) were prepared from shavings of the collected alternatives.
- Volatile compounds analyzed using GC-MS
  - Measured specific aroma compounds associated with consistency

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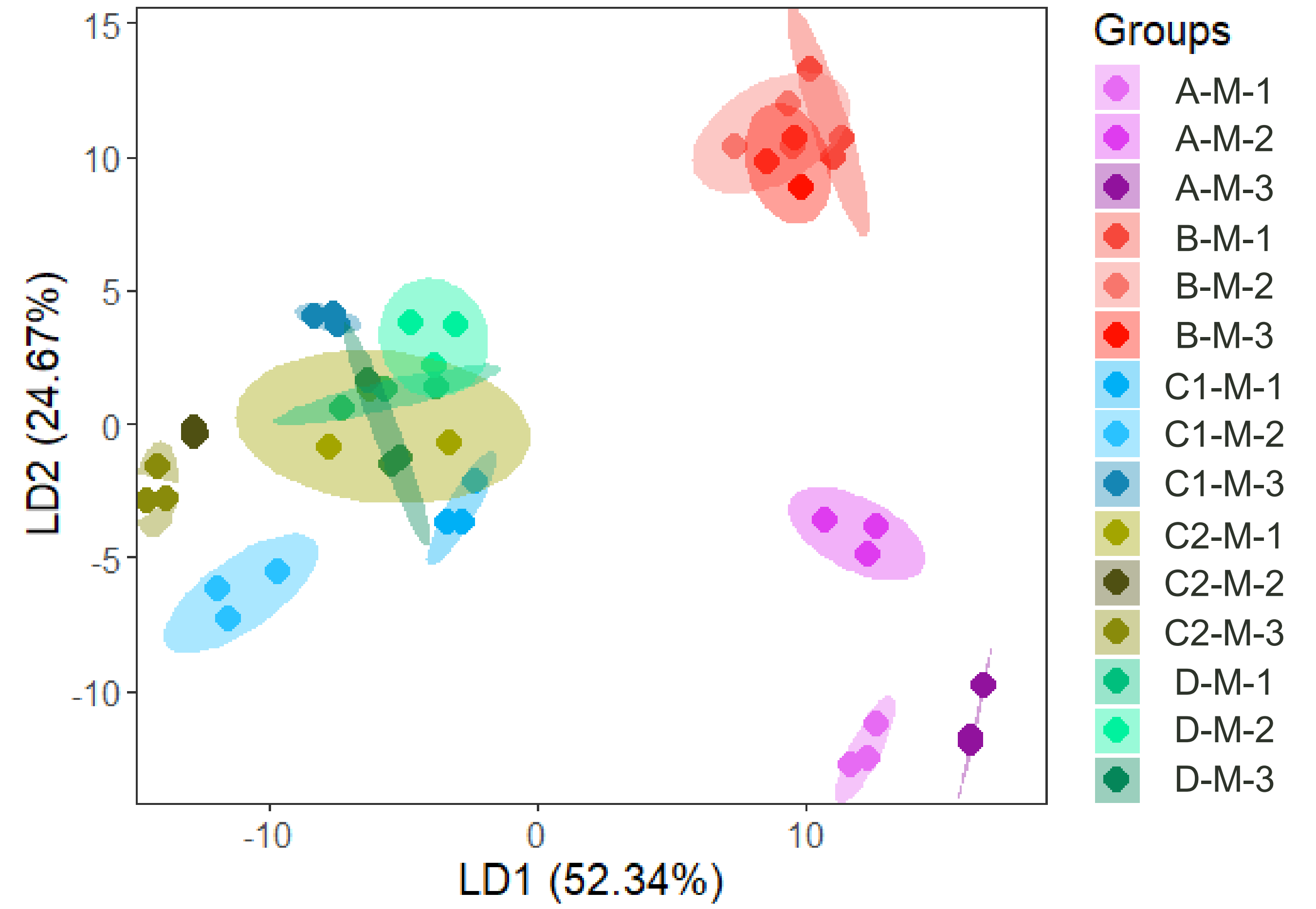
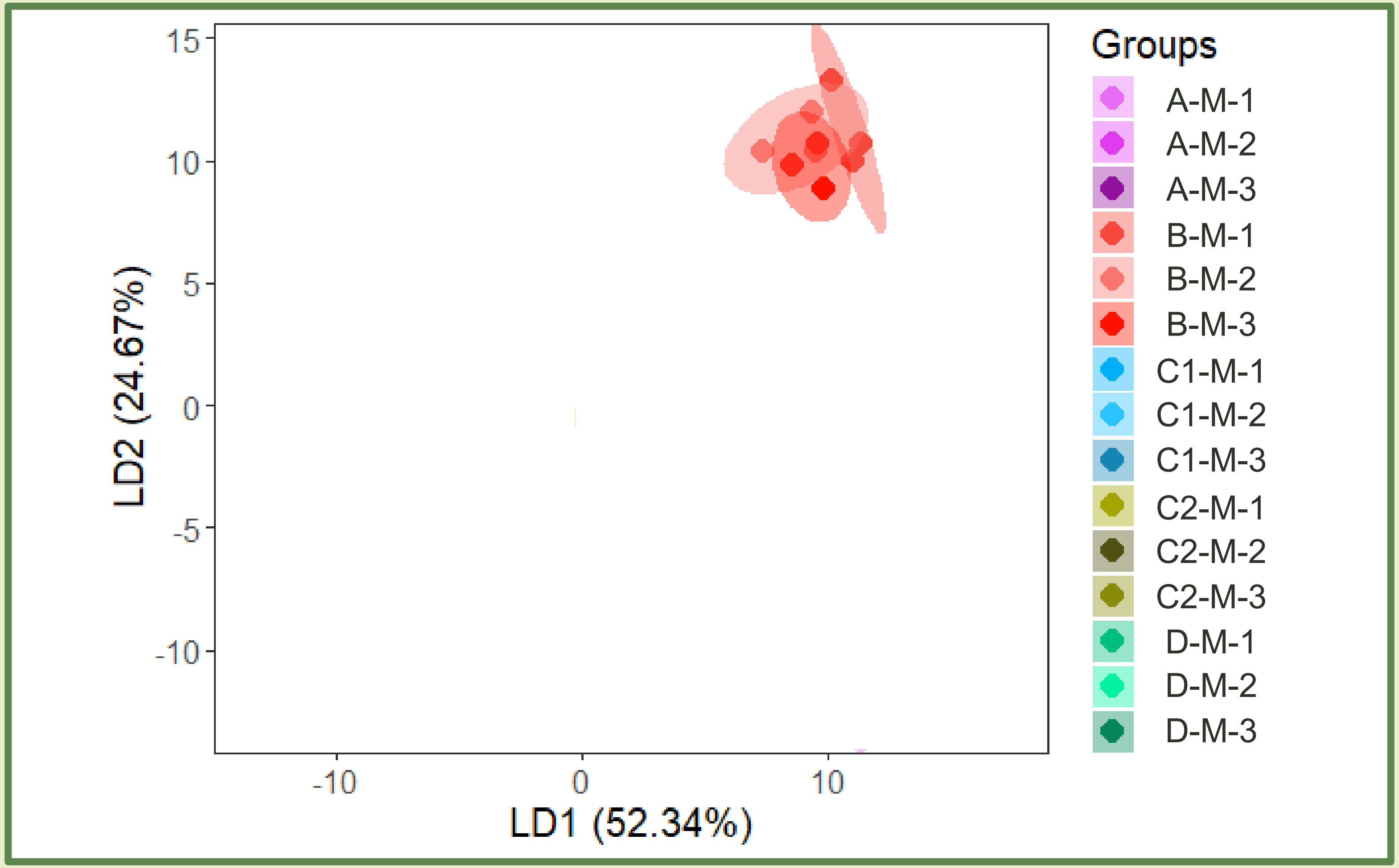
Medium Toasted Oak Alternatives



The linear discriminant analysis (LDA) explains 77.01% of the variance of the medium toast intensity products from the rapid extracts.

Medium Toasted Oak Alternatives



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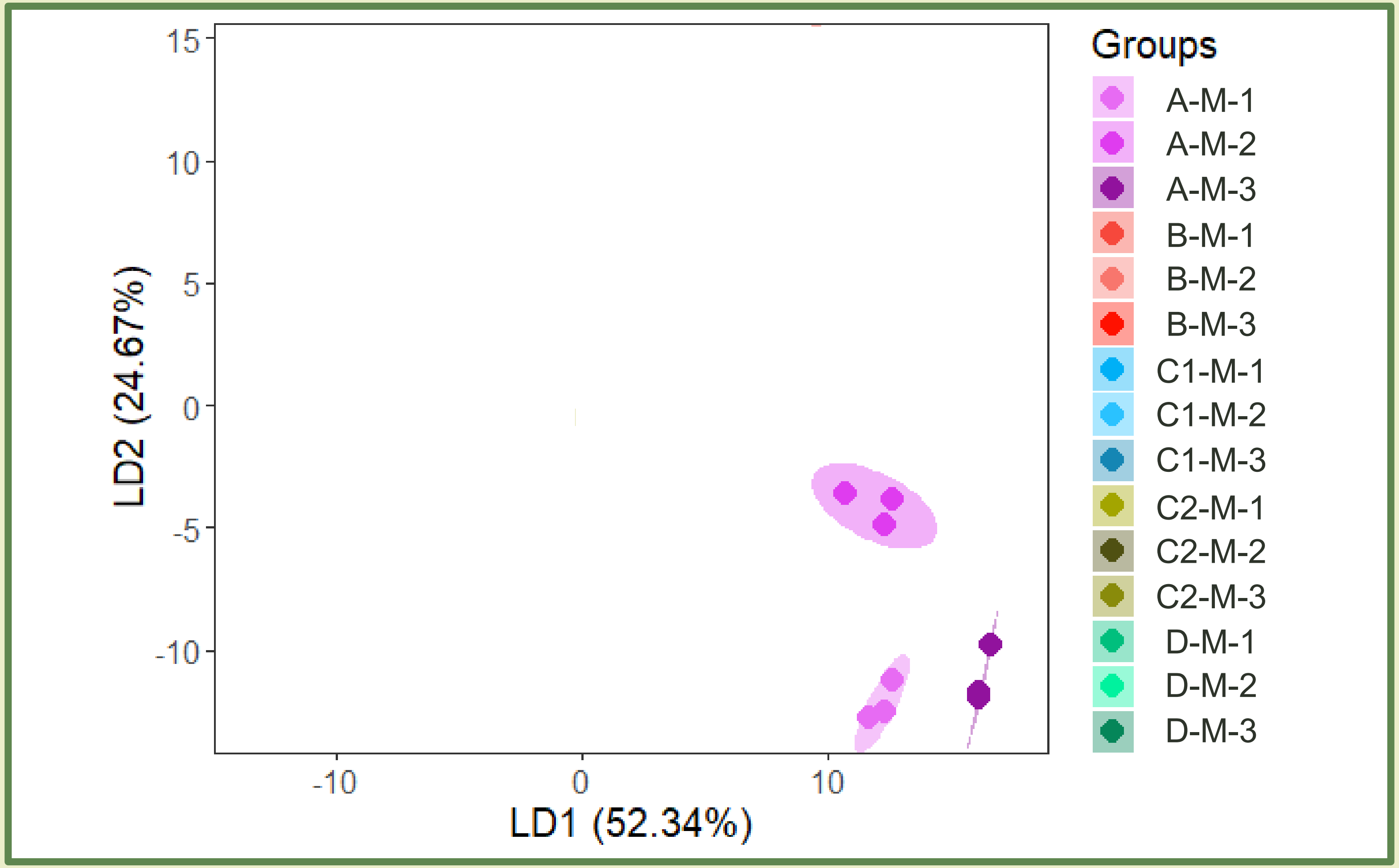

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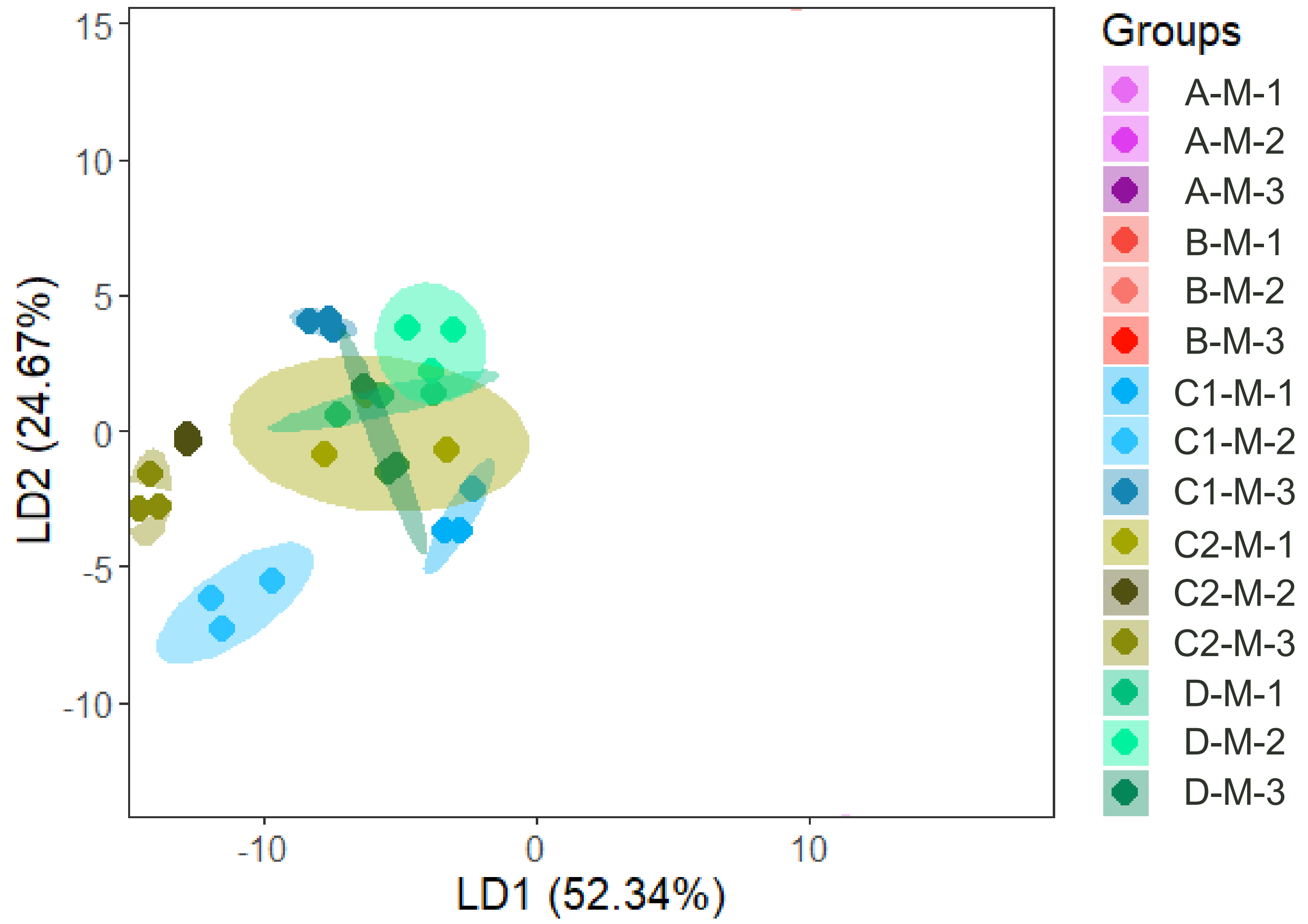
Medium Toasted Oak Alternatives



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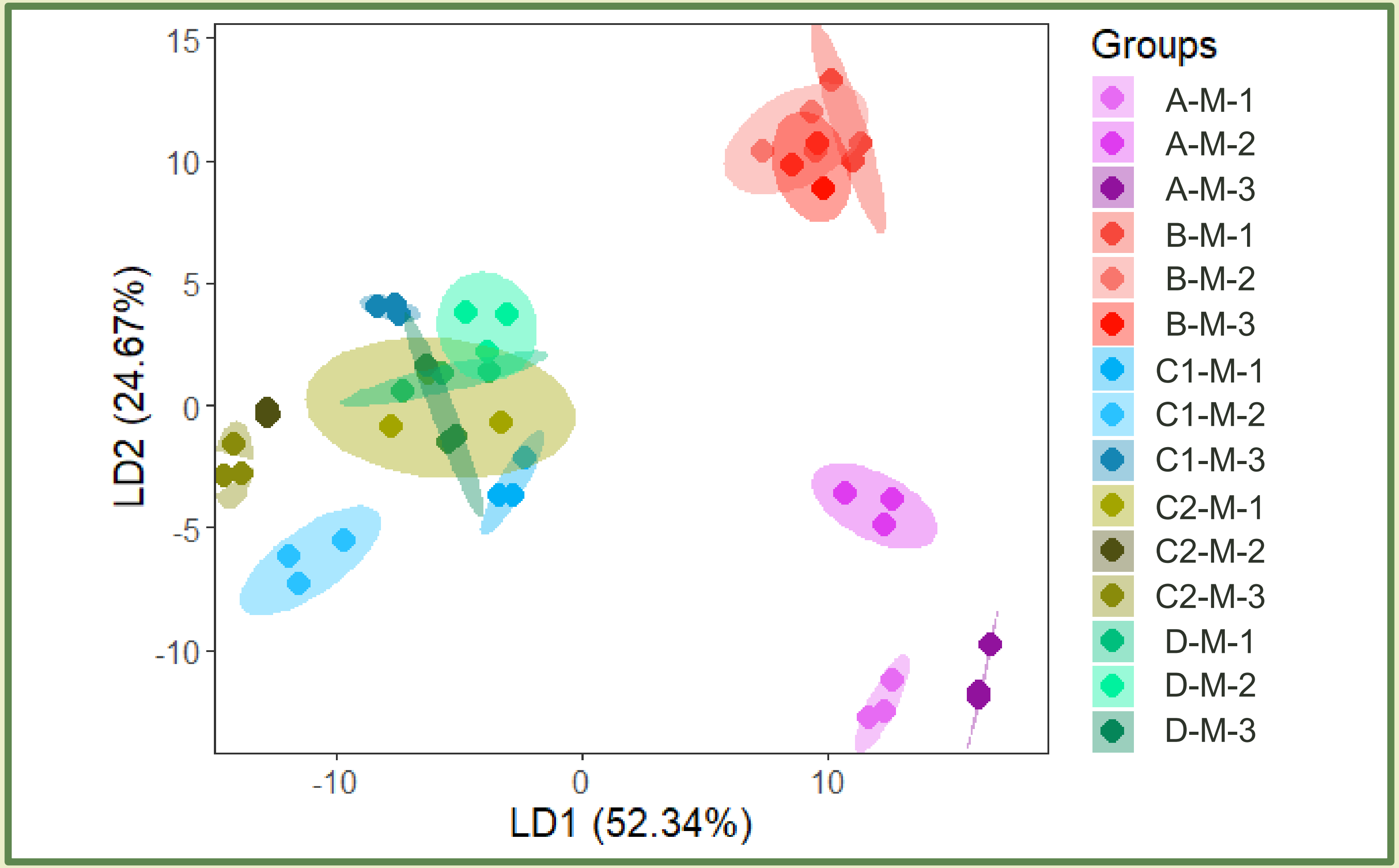
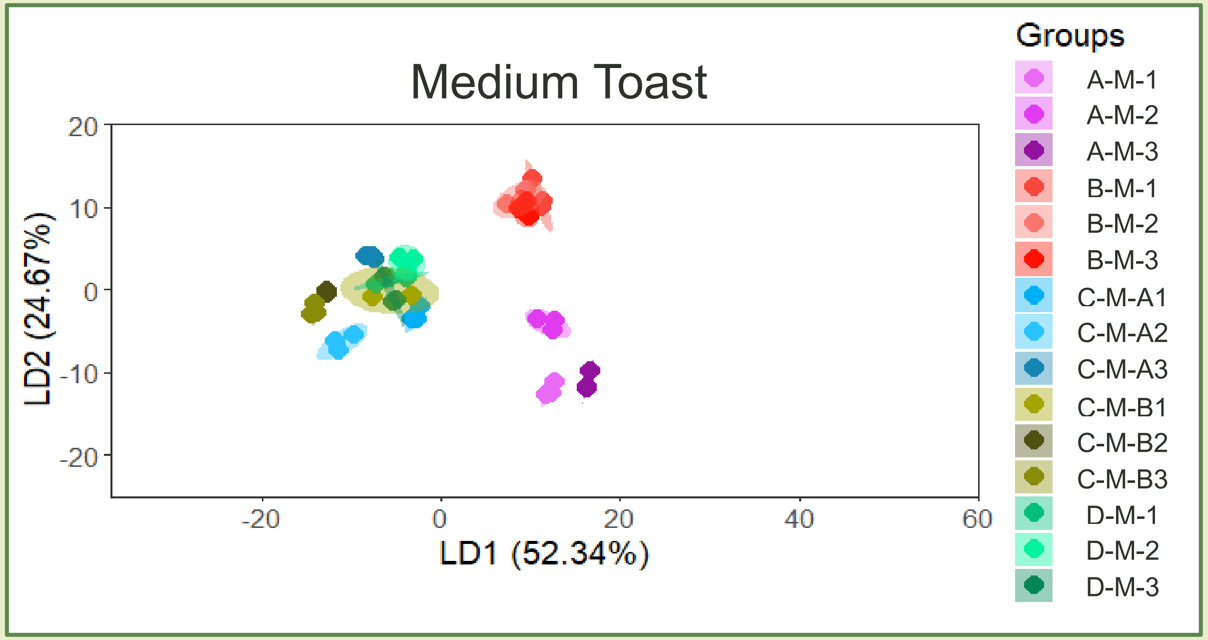
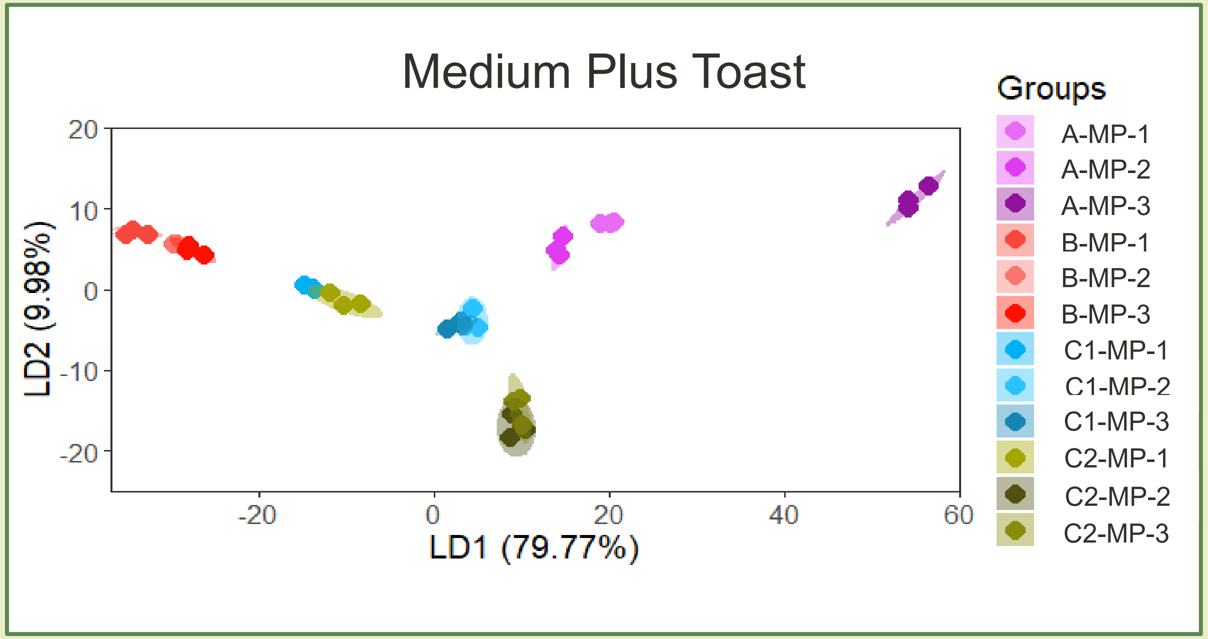
Medium Toasted Oak Alternatives

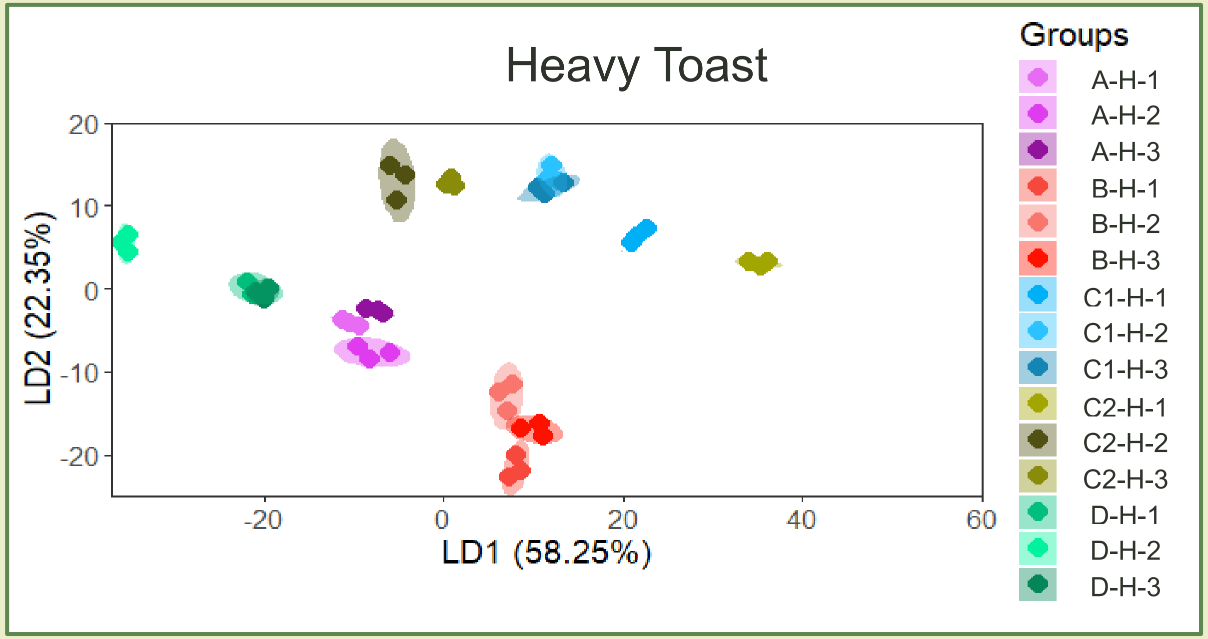


The linear discriminant analysis (LDA) explains 77.01% of the variance of the medium toast intensity products from the rapid extracts.

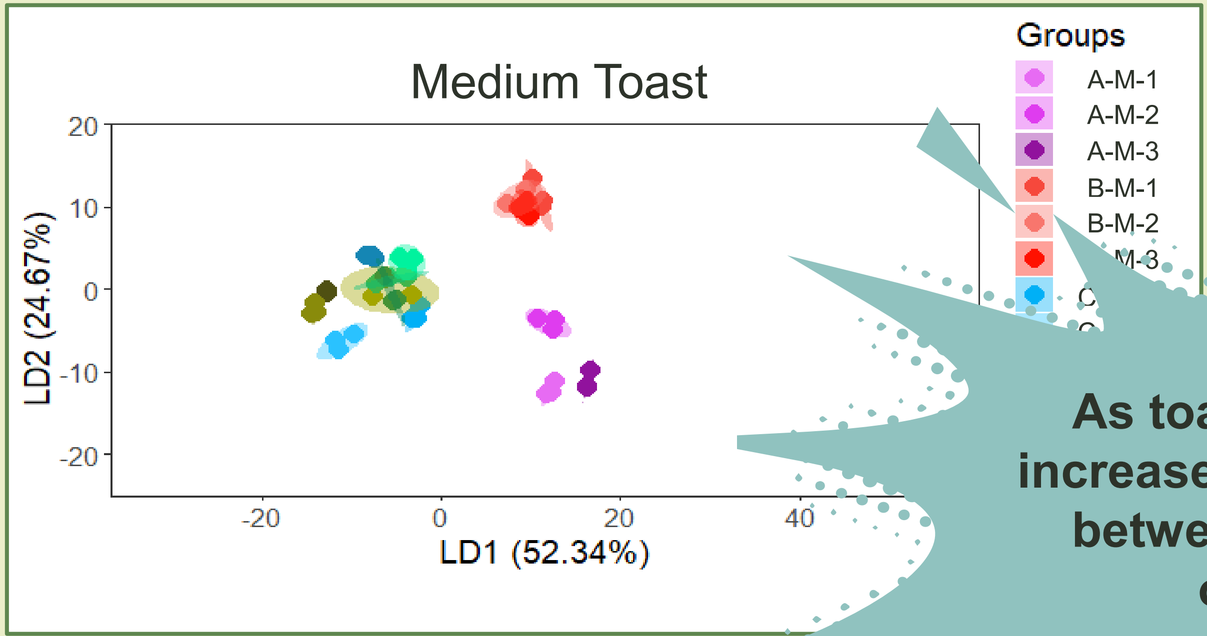
Comparison Across Intensities



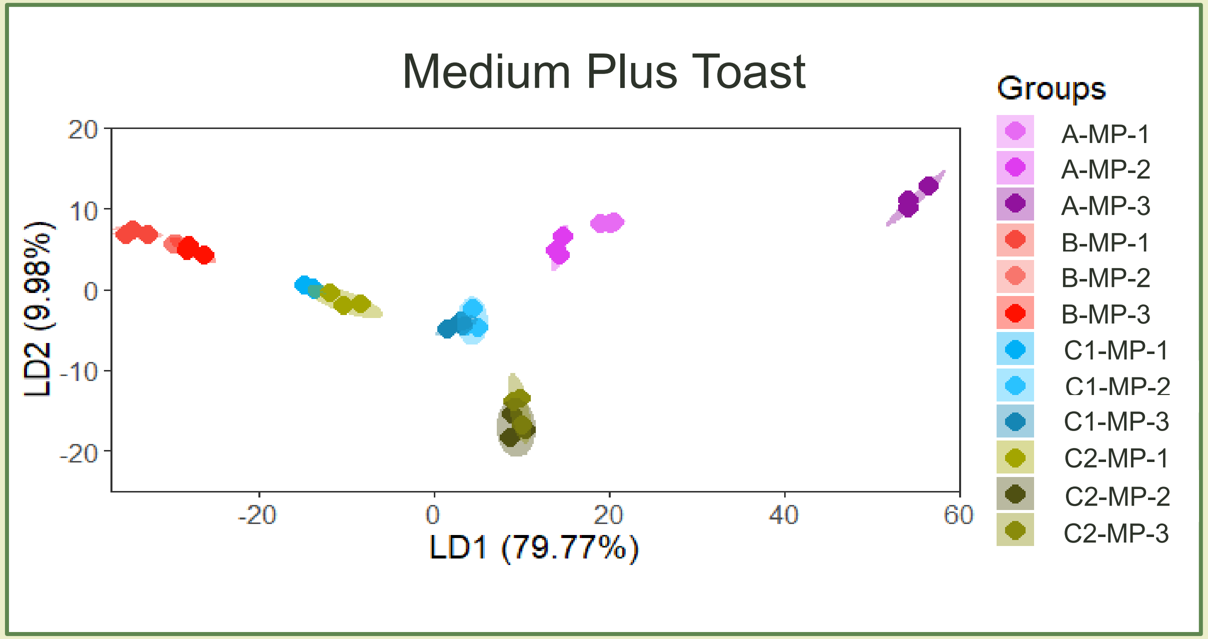


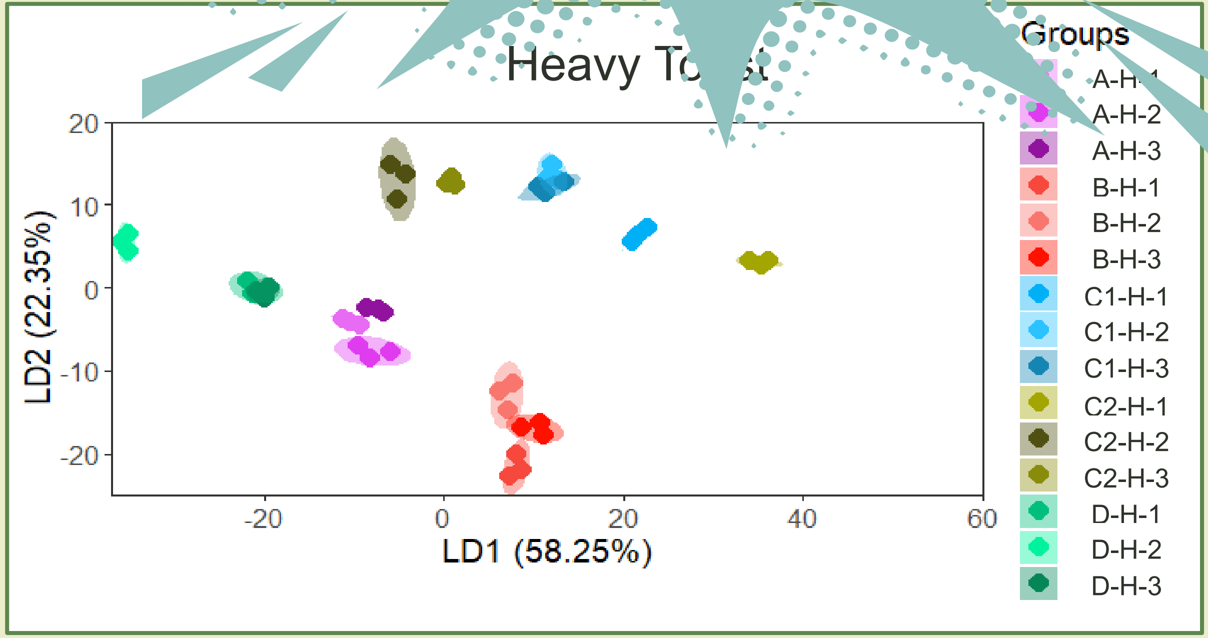


Comparison Across Intensities



As toasting intensity increases, more variation between suppliers is observed.





Summary

- Different processing methods produce distinct volatile compositions at the same toast level.
- As intensity increases, there is greater variation between coopers
  - Method repeatability increases with toast

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The Advantages of Oak Alternatives




- Products made from oak that are not in barrel format.
- Advantages:
  - Cost reduction relative to oak barrels
  - More sustainable than barrels
- **Shorter extraction time**
  - Has been attributed to increased surface area (SA) to volume ratio, without regard to grain type (cross- vs end-grain)…

Grain Extraction Experimental Design

- French oak medium convection toasted staves cut sequentially in length, resulting in 5 treatments
  - ↑Surface area (SA) and end-grain to cross-grain (EG:CG) ratio with shorter segments
- 120-day model wine extraction
  - An average dosage of 20.9 ± 1.4 g/L
  - Extracts were made in triplicates
- All samples held in cellar conditions
  - 20 mL samples collected on days 2, 4, 6, 8, 10, 15, 30, 60, 90, and 120
- Volatile analysis was done using HS-SPME-GCMS
  - A range of oak-related volatile compounds was evaluated

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Stave Segments

45% ↑ SA
1600% ↑ EG:CG

2% ↑ SA
50% ↑ EG:CG

5% ↑ SA
49% ↑ EG:CG

12% ↑ SA
53% ↑ EG:CG

15% ↑ SA
51% ↑ EG:CG

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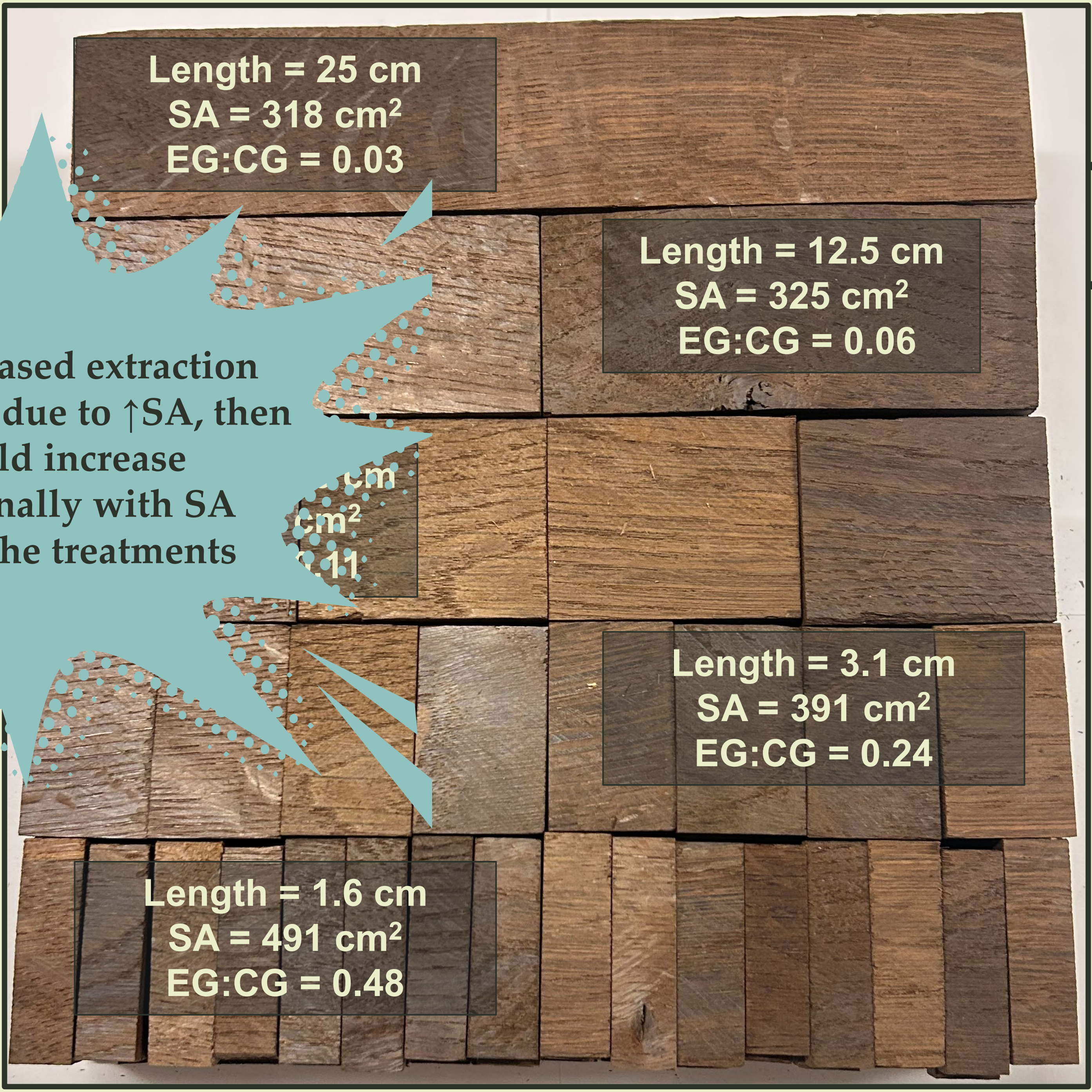
Stave Segments



If the increased extraction rate is solely due to ↑SA, then it should increase proportionally with SA between the treatments

45% ↑ S
1600

2% ↑ SA
50% ↑ EG:CG

5% ↑ SA
49% ↑ EG:CG

12% ↑ SA
53% ↑ EG:CG

15% ↑ SA
51% ↑ EG:CG

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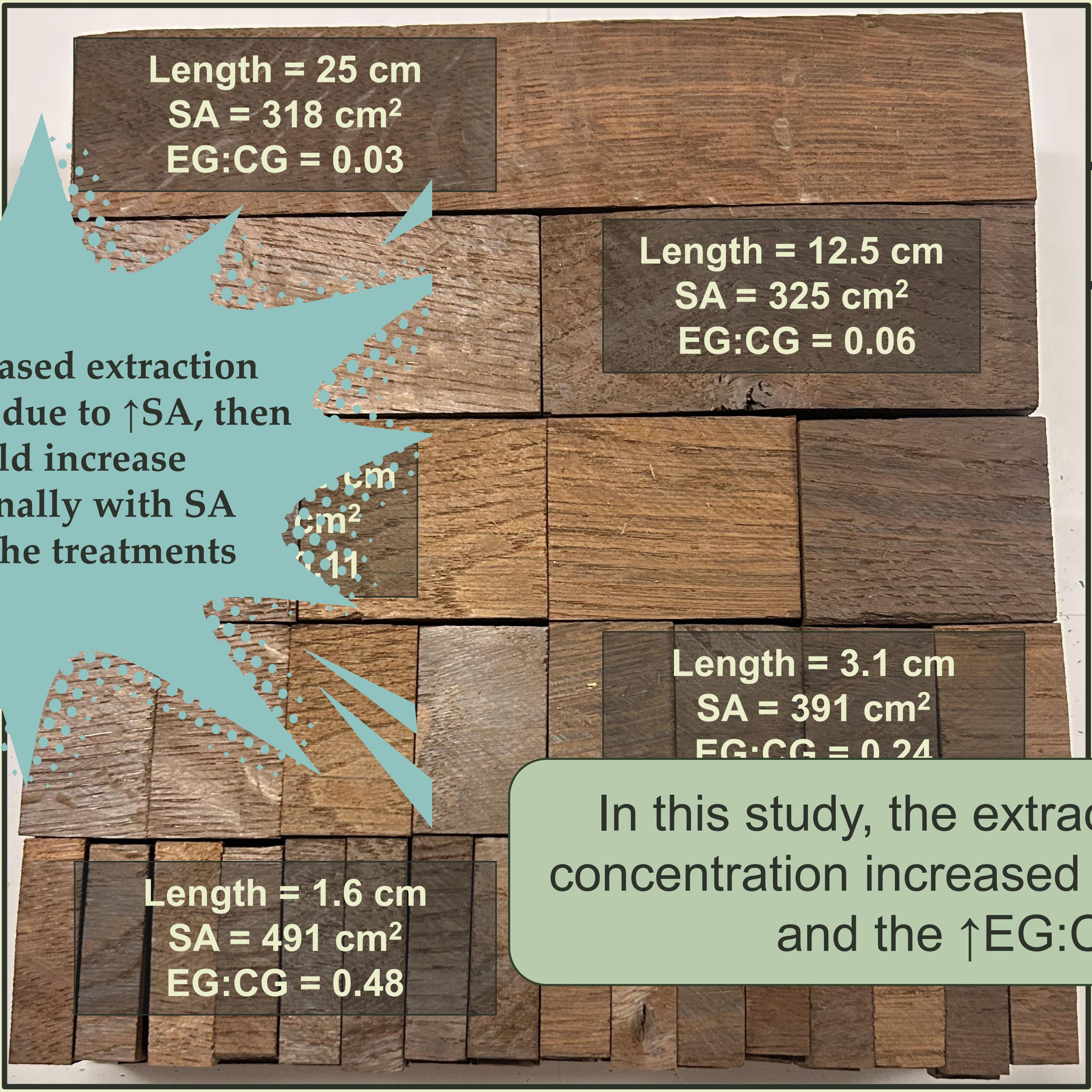
Stave Segments



2% ↑ SA
50% ↑ EG:CG

5% ↑ SA
49% ↑ EG:CG

12% ↑ SA
53% ↑ EG:CG

If the increased extraction rate is solely due to ↑SA, then it should increase proportionally with SA between the treatments

In this study, the extraction rate and concentration increased as both the SA and the ↑EG:CG…

One-Dimensional Kinetic Modeling

- A first-order kinetic model fitted using a multi-objective differential evolution (DE) parameter estimation routine
  - Simultaneously solving for two variables using 5 differential equations
- Model outputs
  - Theoretical maximum extraction concentrations
  - Extraction rate

- Ordinary differential equation:

$$\frac{dc_{(t)}}{dt} = \frac{SA_{total}}{V_l} \times k_{total\_SA}\left(c_{eq} - c_{(t)}\right)$$

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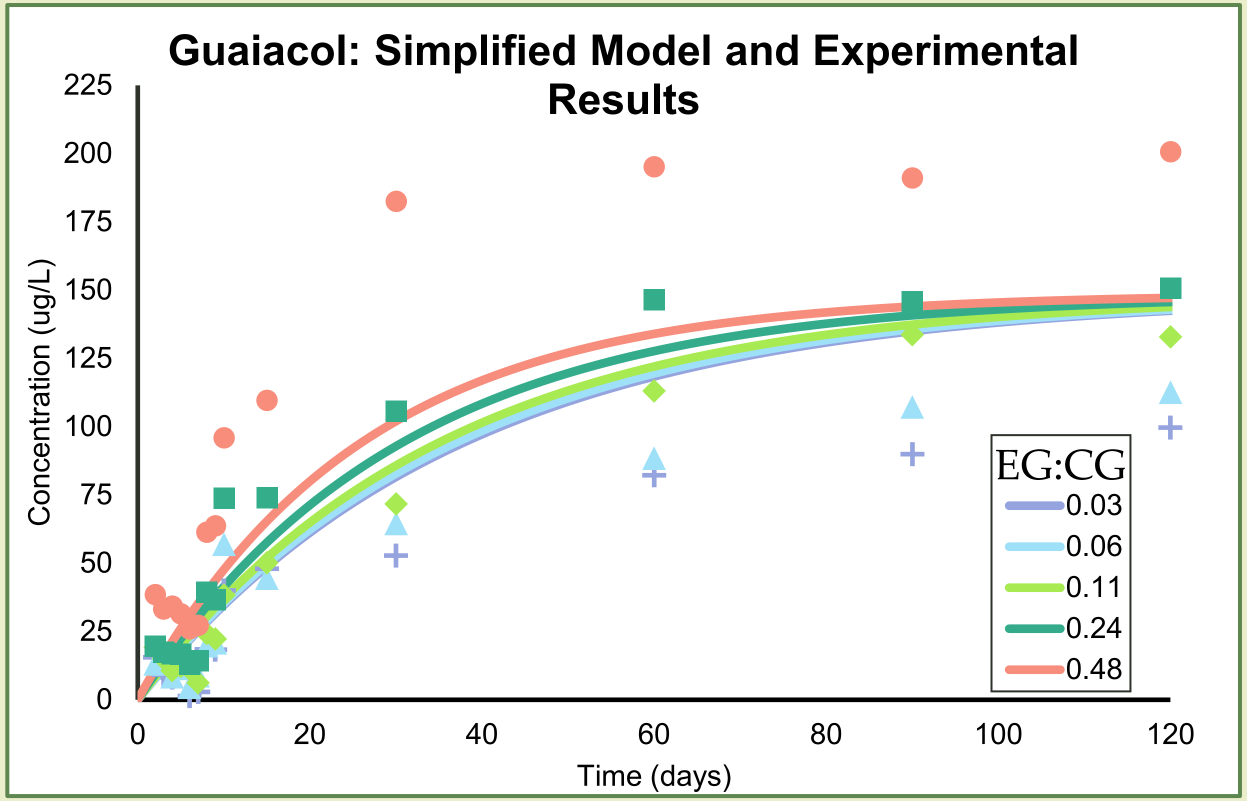
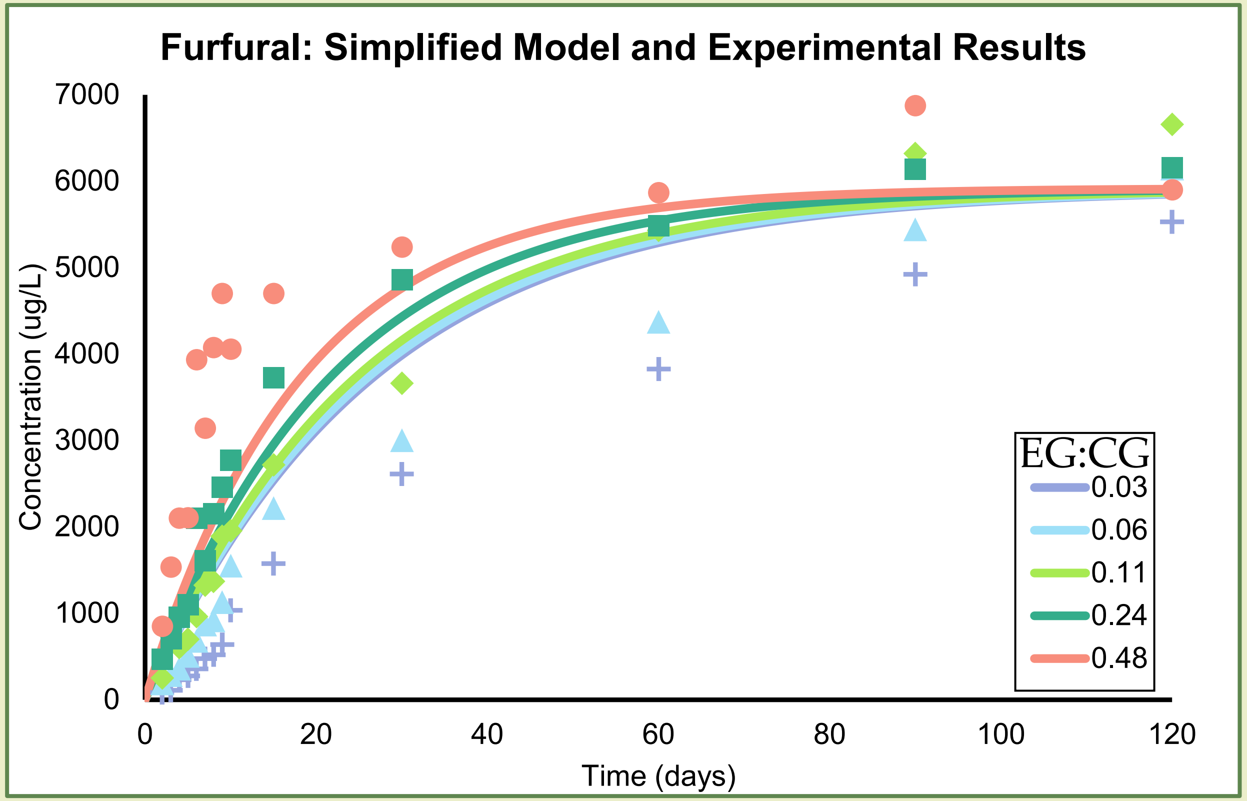
One-Dimensional Kinetic Modeling





- Experimental results compared to a one-dimensional model using total SA_{total}/Volume
- Data exhibits different extraction patterns than what the model shows

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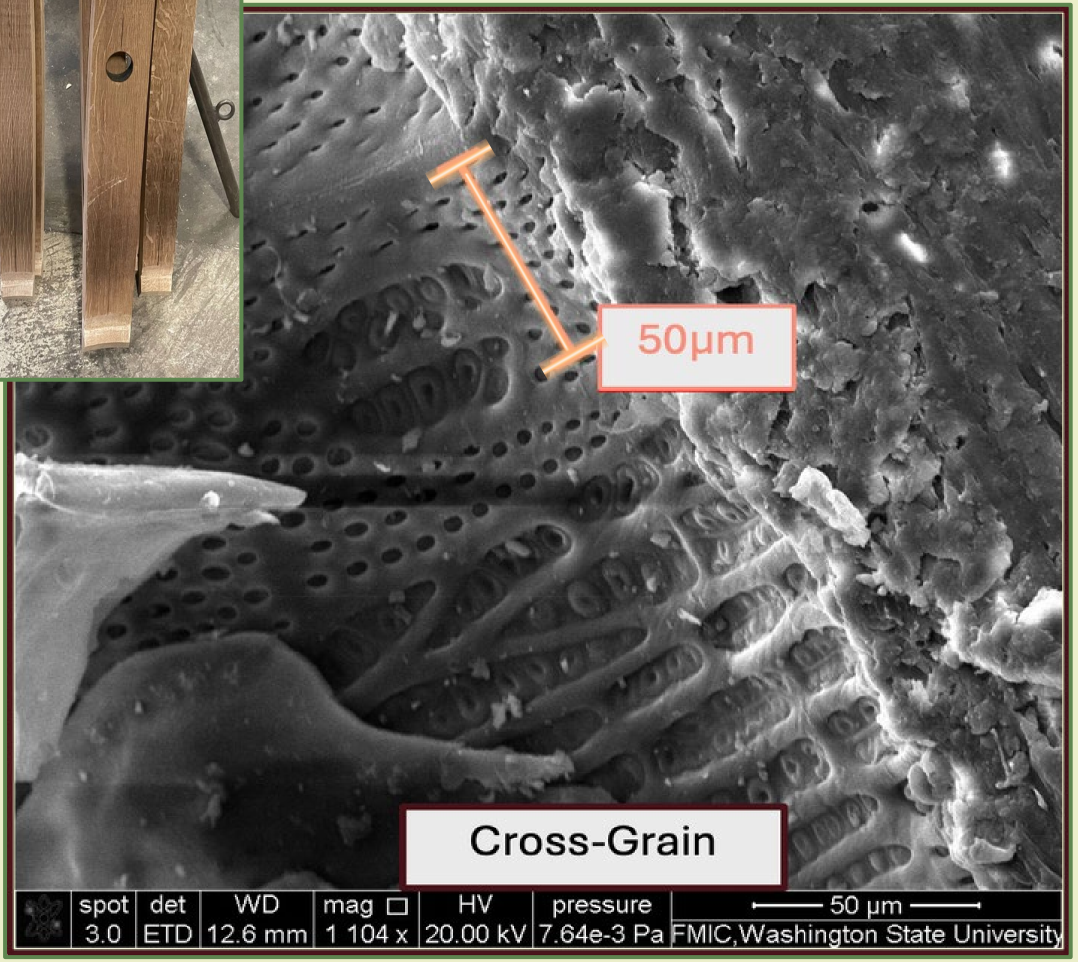
Grain Structure

Cross-Grain of a stave used for a barrel.



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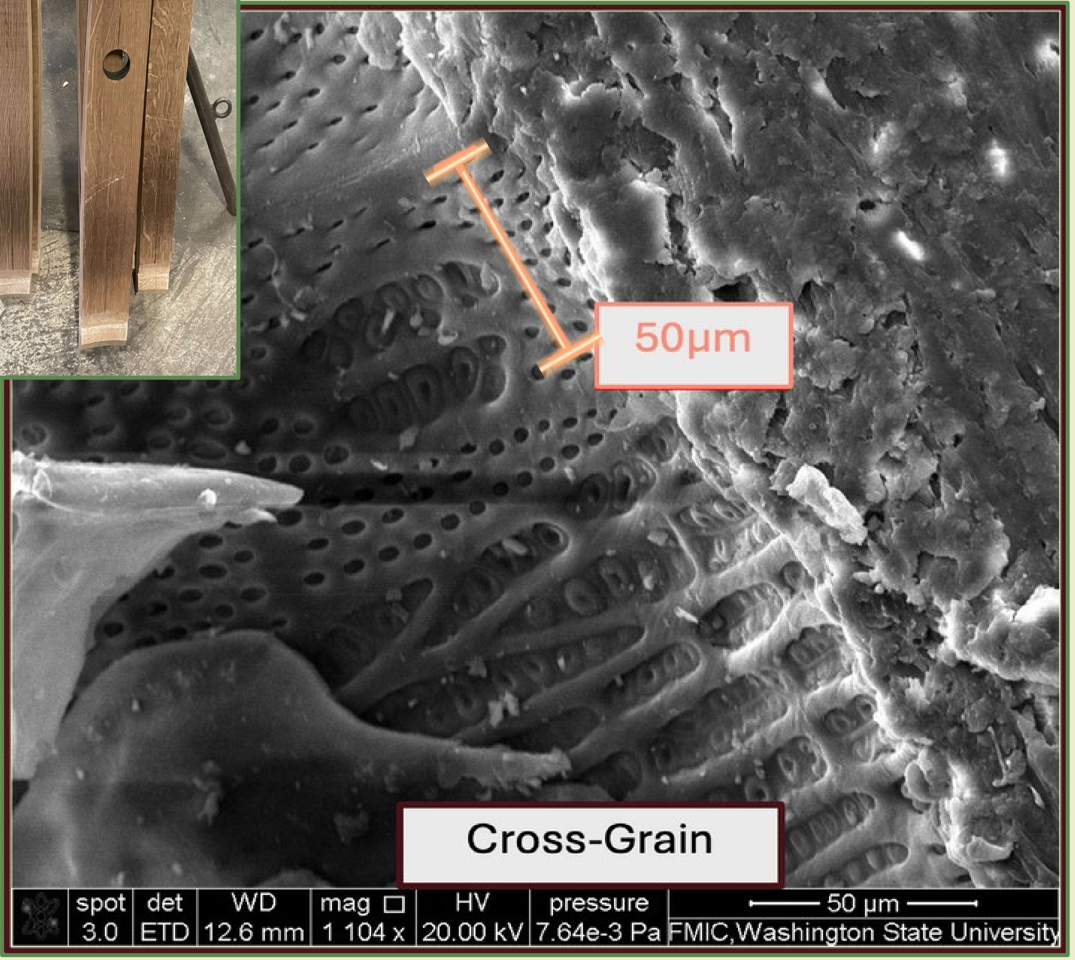
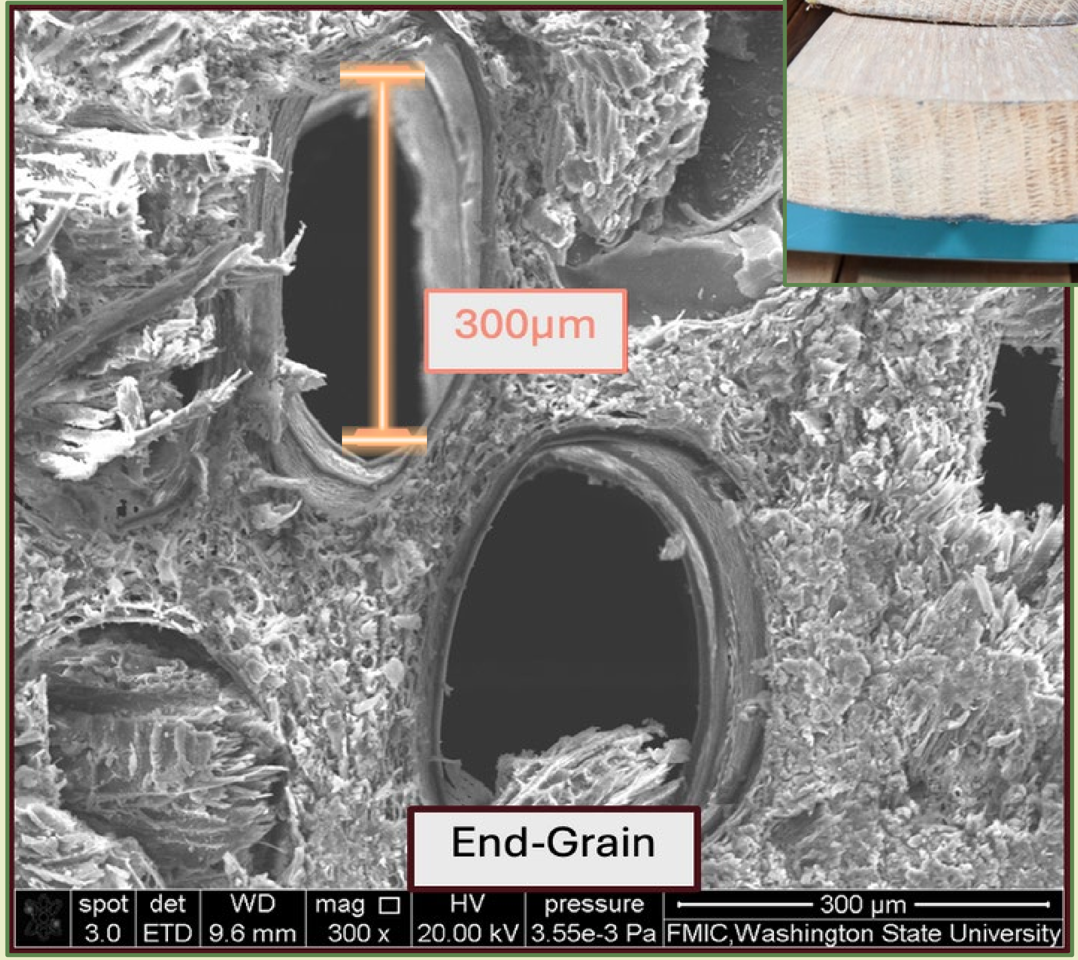


End-Grain of a stave used for a barrel.

Photo taken by Dr. Thomas Collins



Two-Dimensional Kinetic Modeling

- First-order kinetic models were fitted to the ordinary differential equation.
  - Simultaneously solving for four variables using 5 differential equations
- Model outputs
  - Theoretical maximum extraction concentrations for both end grain ($C_{solid\ eg}$) and cross grain ($C_{solid\ cg}$)
  - Extraction rate for both end grain (k_{eg}) and cross grain (k_{cg})

- Ordinary differential equation:

$$\frac{dc_{(t)}}{dt} = \frac{SA_{eg}}{V_l} \times k_{eg}\left(c_{s(eq)} - c_{l(t)}\right) + \frac{SA_{cg}}{V_l} \times k_{cg}\left(c_{s(cq)} - c_{l(t)}\right)$$

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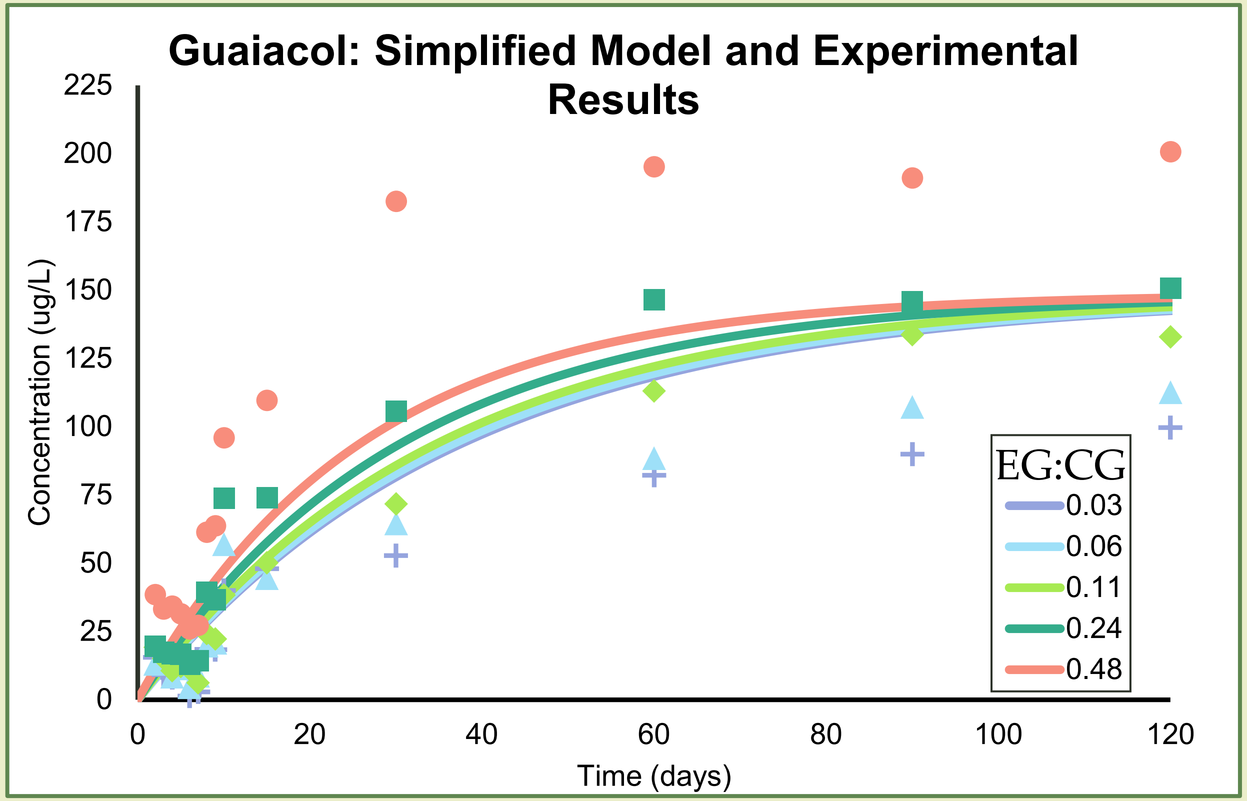
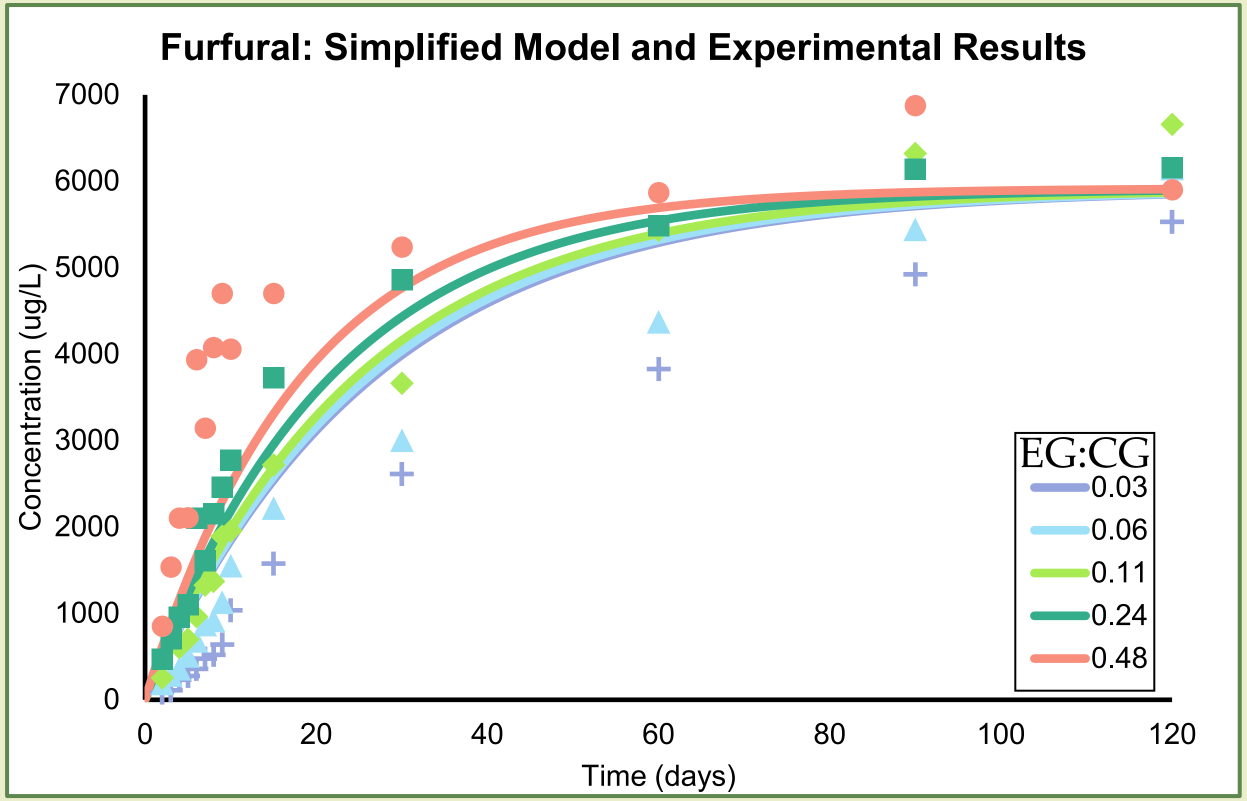
One-Dimensional Kinetic Modeling





- Experimental results compared to a one-dimensional model using total SA/Volume
- Data exhibits different extraction patterns than what the model shows

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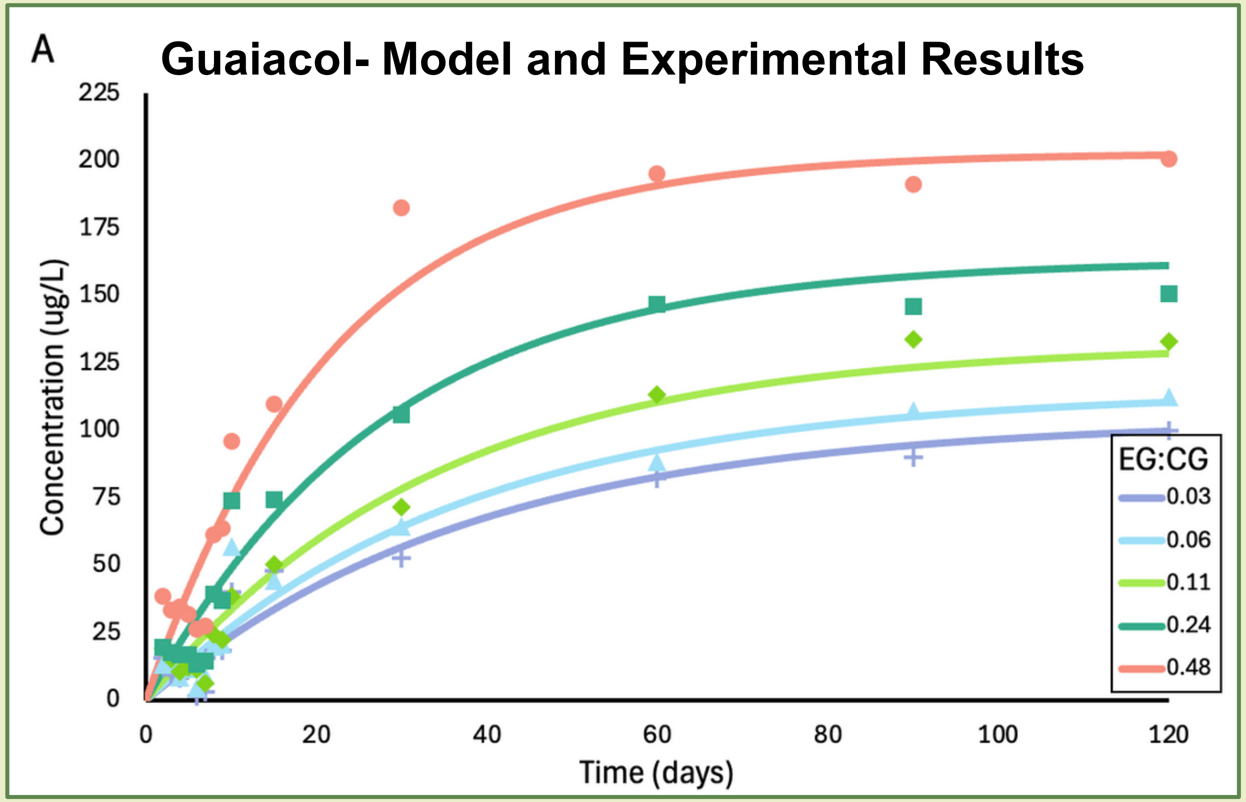
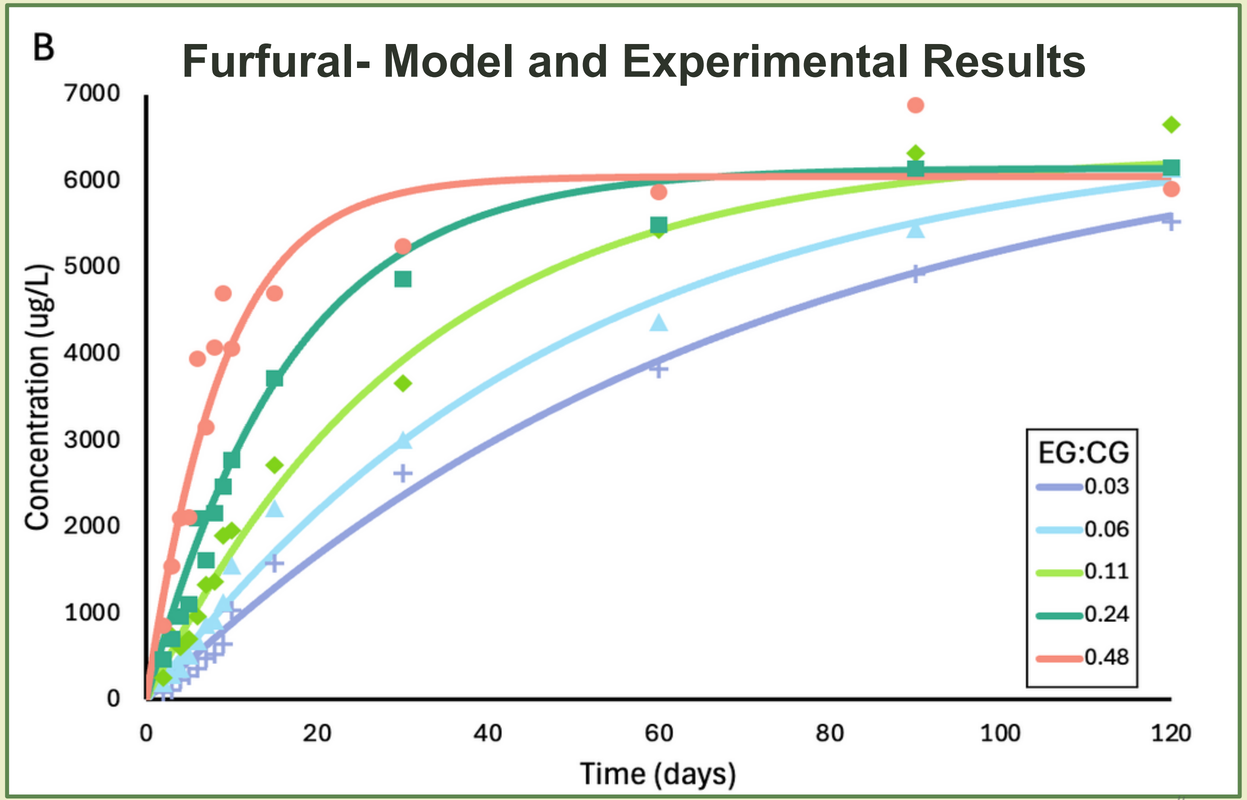
Two-Dimensional Kinetic Modeling

- A model that fits the data allows for the evaluation of trends in extraction.
- All compounds, except furfural, increased not only the extraction rate but also the concentration.





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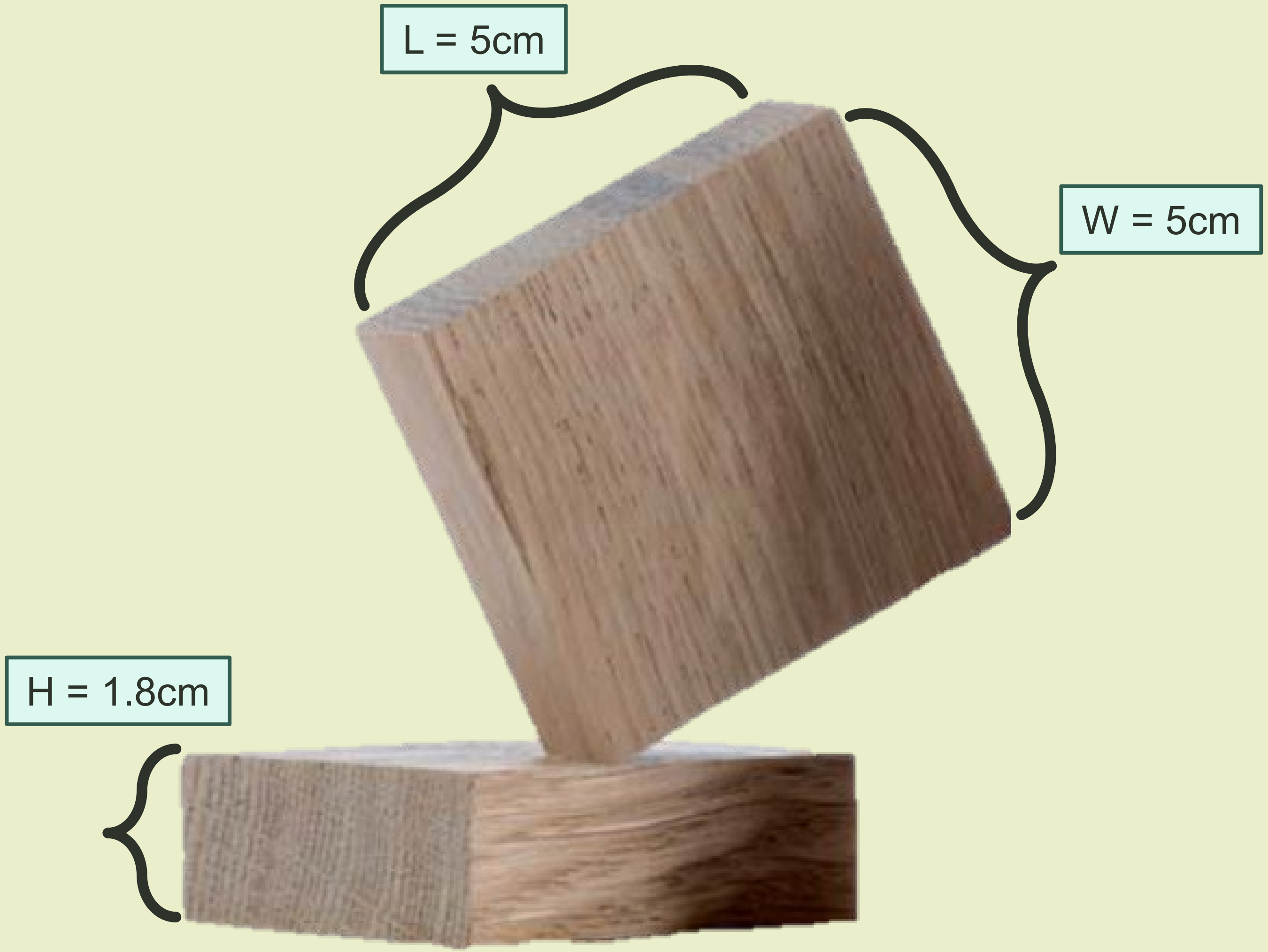
Modeling of Oak Extraction Kinetics



- A predictive oak extraction model was developed using the current extraction kinetics of both grain types.
  - Specific kinetic constants will vary
  - The model was made using a model wine
    - Additional modification to account for outside reactions in the process.

$$SA_{eg\ per\ block} = (2 \times L \times \mathrm{H})$$

$$SA_{eg\ per\ block} = (2 \times 1.8 \times 5)$$

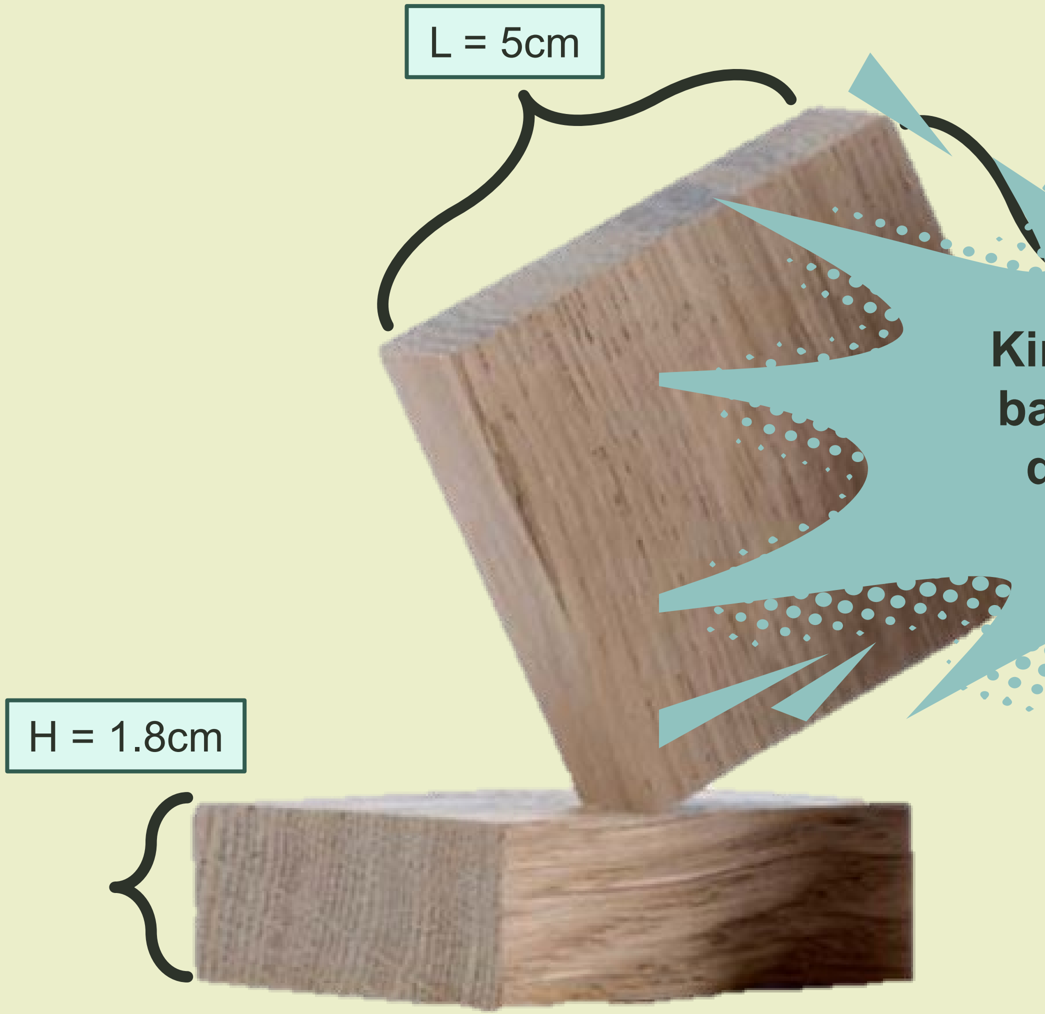
$$SA_{eg\ total\ dose} = (18) \times (275 \times 12) = 59400\ cm^2$$

$$SA_{cg\ per\ block} = ((2 \times L \times H) + (2 \times W \times H))$$

$$SA_{cg\ per\ block} = ((2 \times 1.8 \times 5) + (2 \times 5 \times 5))$$

$$SA_{eg\ total\ dose} = (68 \times (12 \times 275)) = 224400\ cm^2$$

Modeling of Oak Extraction Kinetics



Kinetic values used are based on experimental data from a different product.

- A predictive oak extraction model was developed using the current extraction kinetics of both grain types.
- ecific ki tic constants will vary
- el was made using a model
- onal modification to account for outside s in the process.

$$SA_{eg\ per\ block} = (2 \times L \times H)$$

$$SA_{eg\ per\ block} = (2 \times 1.8 \times 5)$$

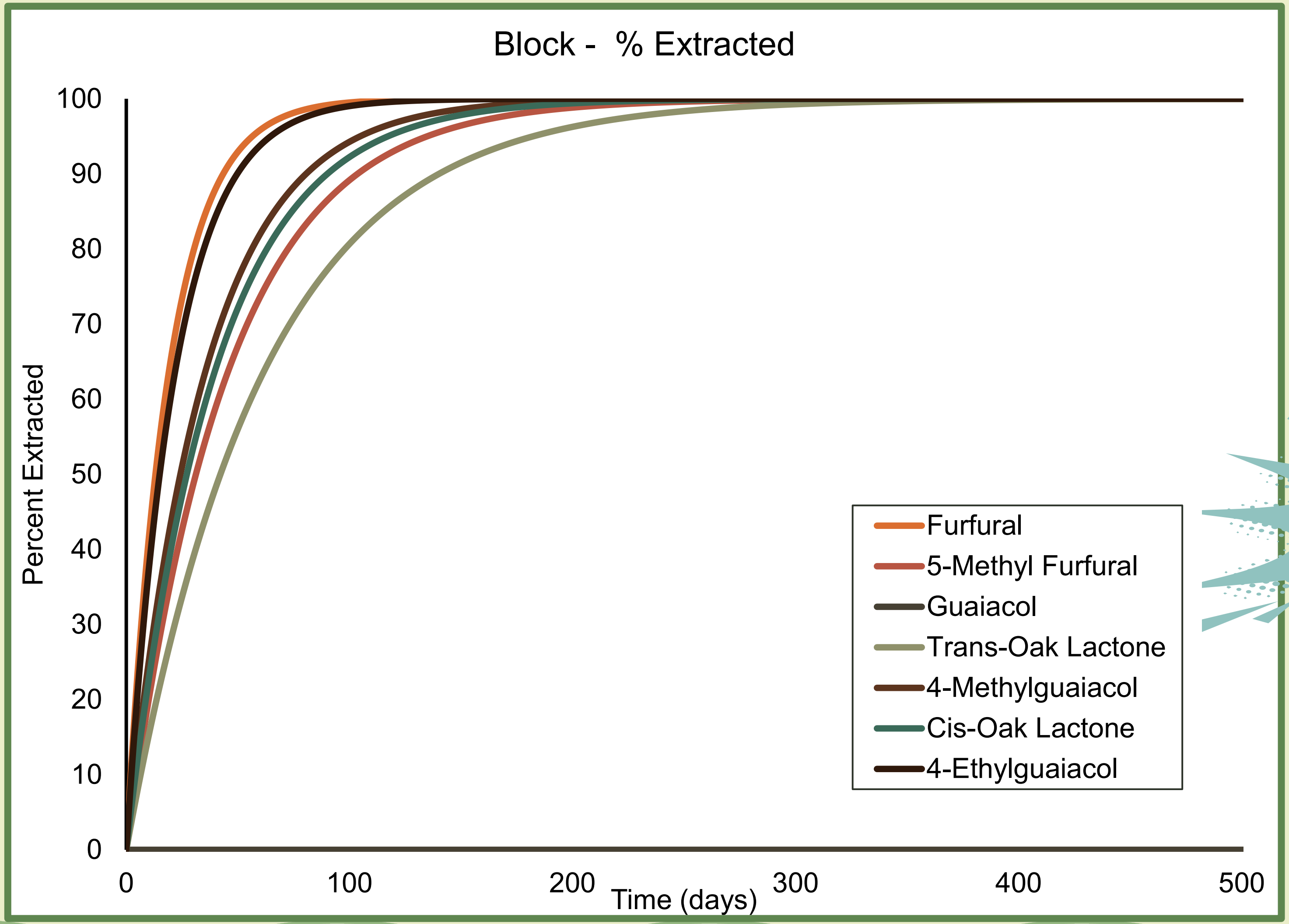
$$SA_{eg\ total\ dose} = (18) \times (275 \times 12) = 59400\ cm^2$$

$$SA_{cg\ per\ block} = ((2 \times L \times H) + (2 \times W \times H))$$

$$SA_{cg\ per\ block} = ((2 \times 1.8 \times 5) + (2 \times 5 \times 5))$$

$$SA_{eg\ total\ dose} = (68 \times (12 \times 275)) = 224400\ cm^2$$

How Much Has Been Extracted



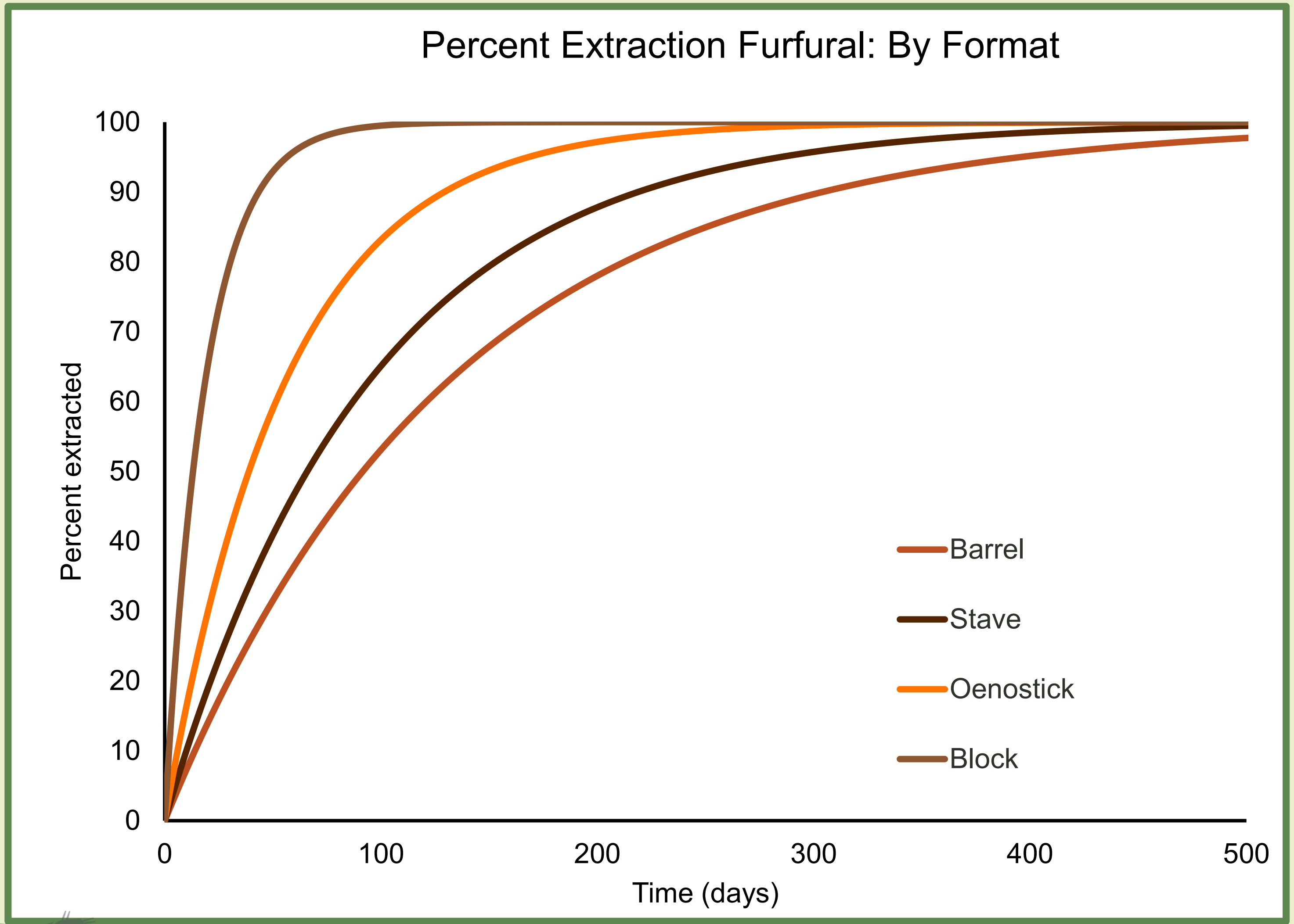
- Results from the Two-Dimensional model allow for normalization
  - Same scale

How Much Has Been Extracted

- A predictive oak extraction model was developed using the current extraction kinetics of both grain types.
  - Based on the kinetic values of a different product

Compound	Amount Extracted at 90 days (% of total)
Furfural	99.2
4-Ethylguaiacol	86.5
Guaiacol	91.0
4-Methylguaiacol	77.2
Cis-Oak Lactone	92.4
Trans-Oak Lactone	90.0
5-Methyl Furfural	98.5

Across Different Formats: Furfural

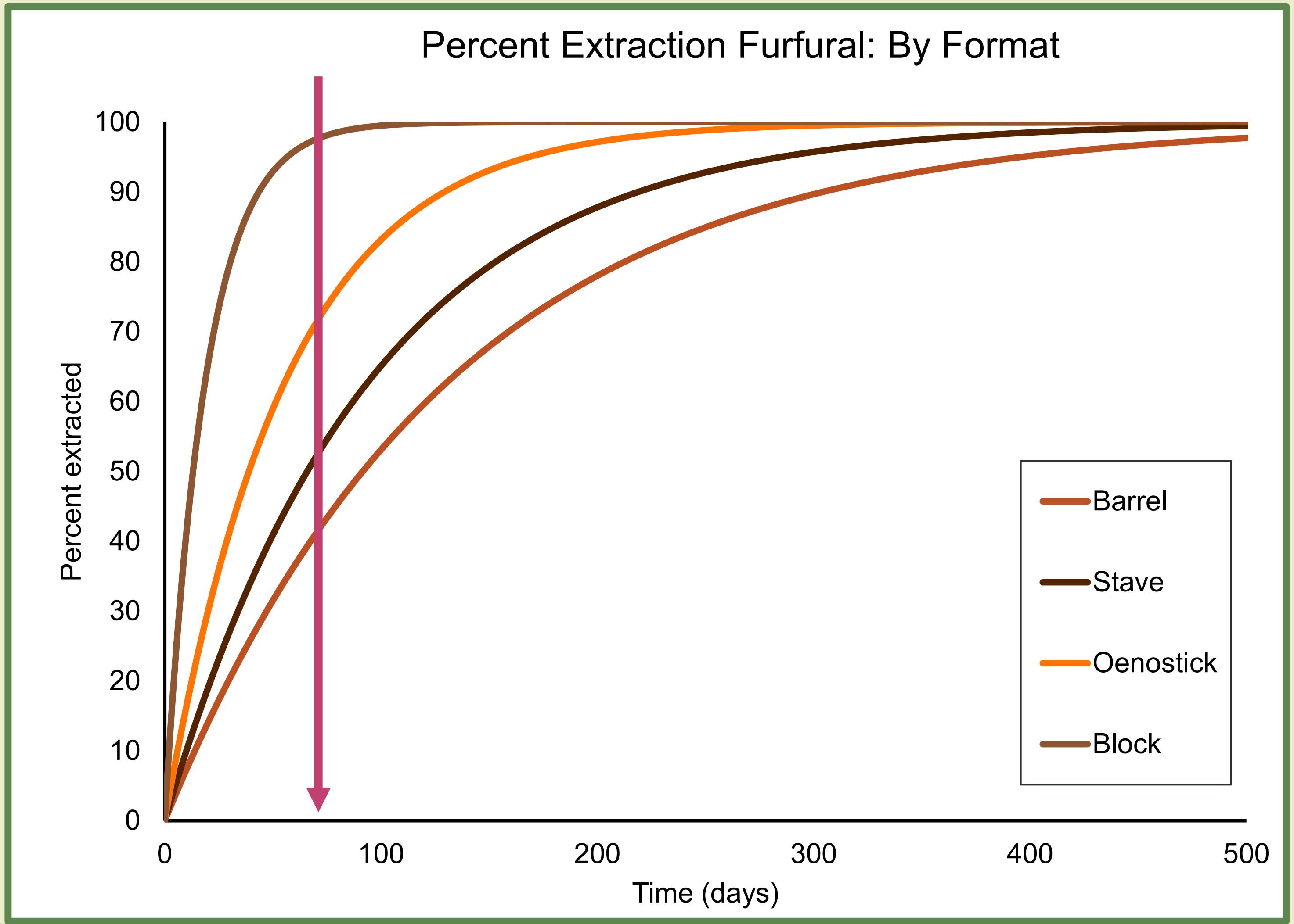


- The format and dose rate can be adjusted for this model.
  - A single-barrel equivalent dose rate is modeled.
  - Same dose rate

Oenostick

Stave Adjunct Format

Across Different Formats: Furfural



- The model can be used to compare extraction rates across formats.
  - Solely based on medium toast; additional toasts will be added to the model.

Format	EG:CG	90 days (% of total)
Barrel	0.000	49.42
Stave	0.014	61.22
Oenostick	0.050	79.88
Block	0.265	99.15

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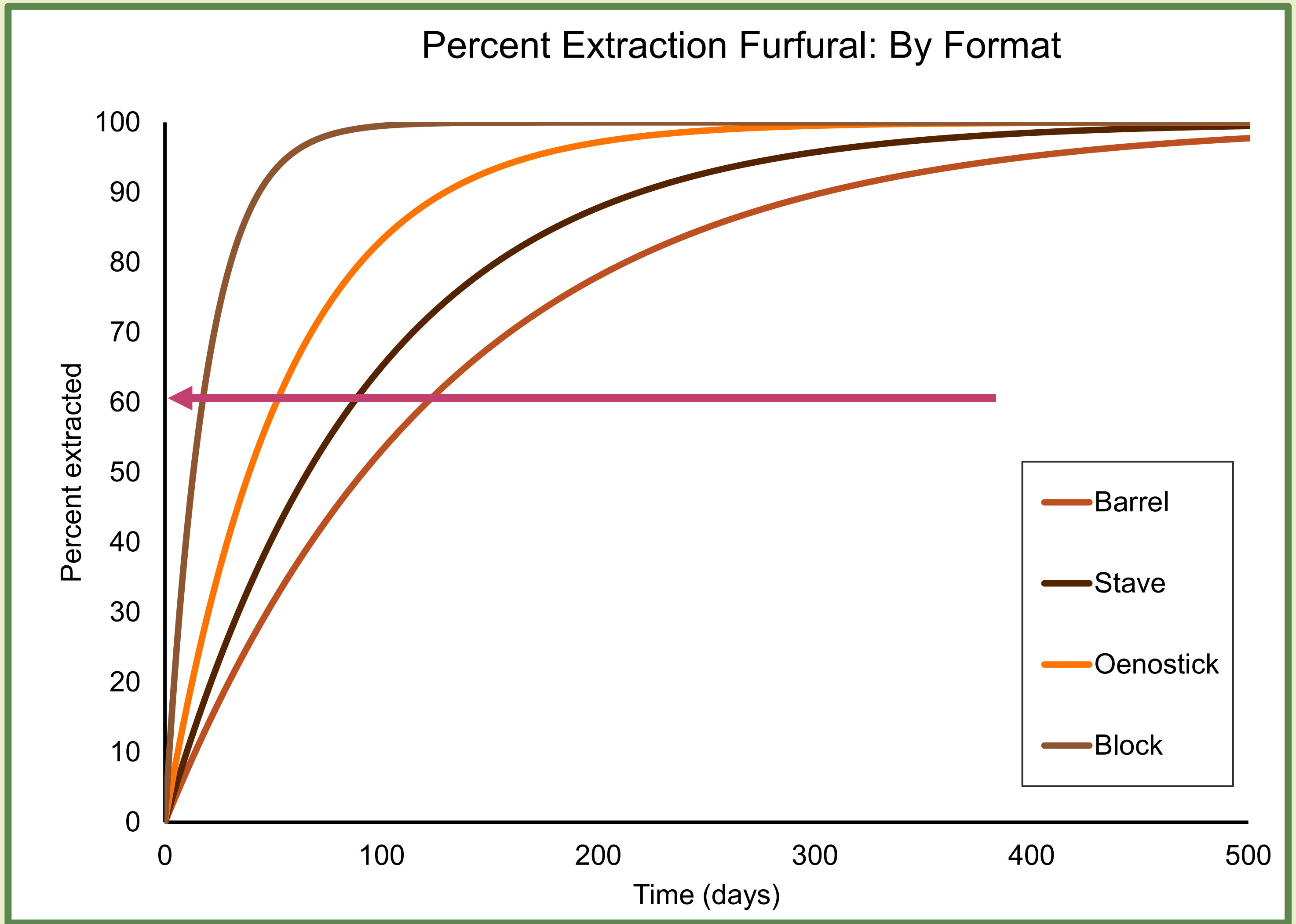
Across Different Formats: Furfural



- The model can be used to compare extraction rates across formats.
  - Solely based on medium toast; additional toasts will be added to the model.

Format	Time Required To Extract (days)
	60%
Barrel	121
Stave	87.5
Oenostick	51.5
Block	17.5

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Thank You!
Questions?

- Thank you to Dr. Tom Collins, Dr. Bob Coleman, and Dr. Roger Boulton for the guidance and support!
- Special thanks to all members of the Collins and Harbertson lab!
- This project is sponsored by Scott Laboratories
  - Thank you, Cynthia Coleman, for trusting us with this project!!
- Microscopy images taken at WSU Franceschi Microscopy & Imaging Center

WHY, WHEN & HOW CAN YOU USE OAK ADJUNCTS

WHY → economic & logistic

WHEN → try early and learn what you like

HOW → small tank size vs lab bench

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SUMMARY

- Blind tasting of a 2025 Willamette Valley Pinot noir aged with different Seguin Moreau oak products at equivalent doses approximating 20% new oak
- Explored details of trial oak products and various formats and applications
- Considered toasting methods and repeatability among products and toast levels
- Considered kinetics and 2D modelling of oak volatile extraction
- Takeaway: Be open to experimentation in your winery, regardless of size!
- Questions?

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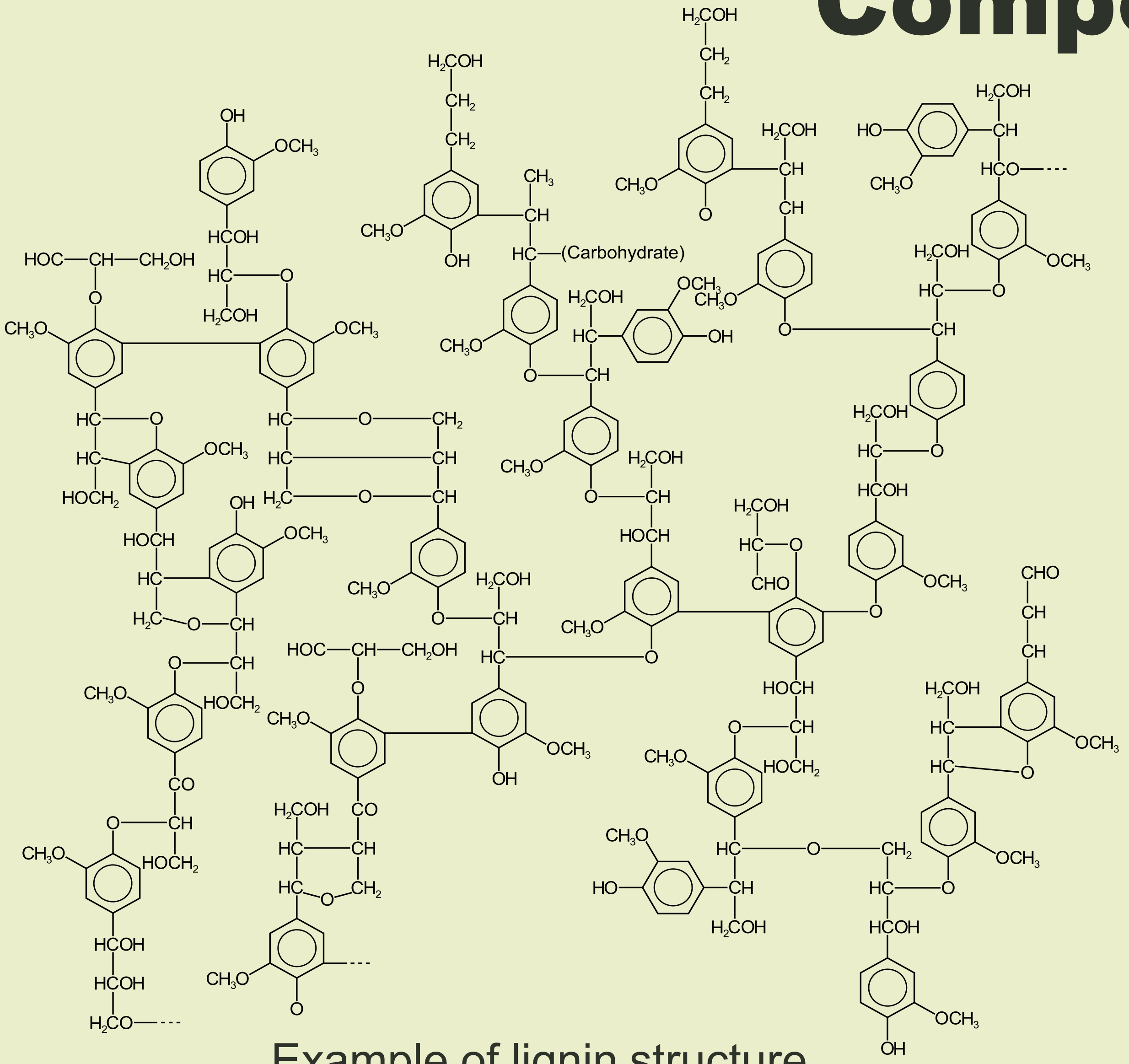
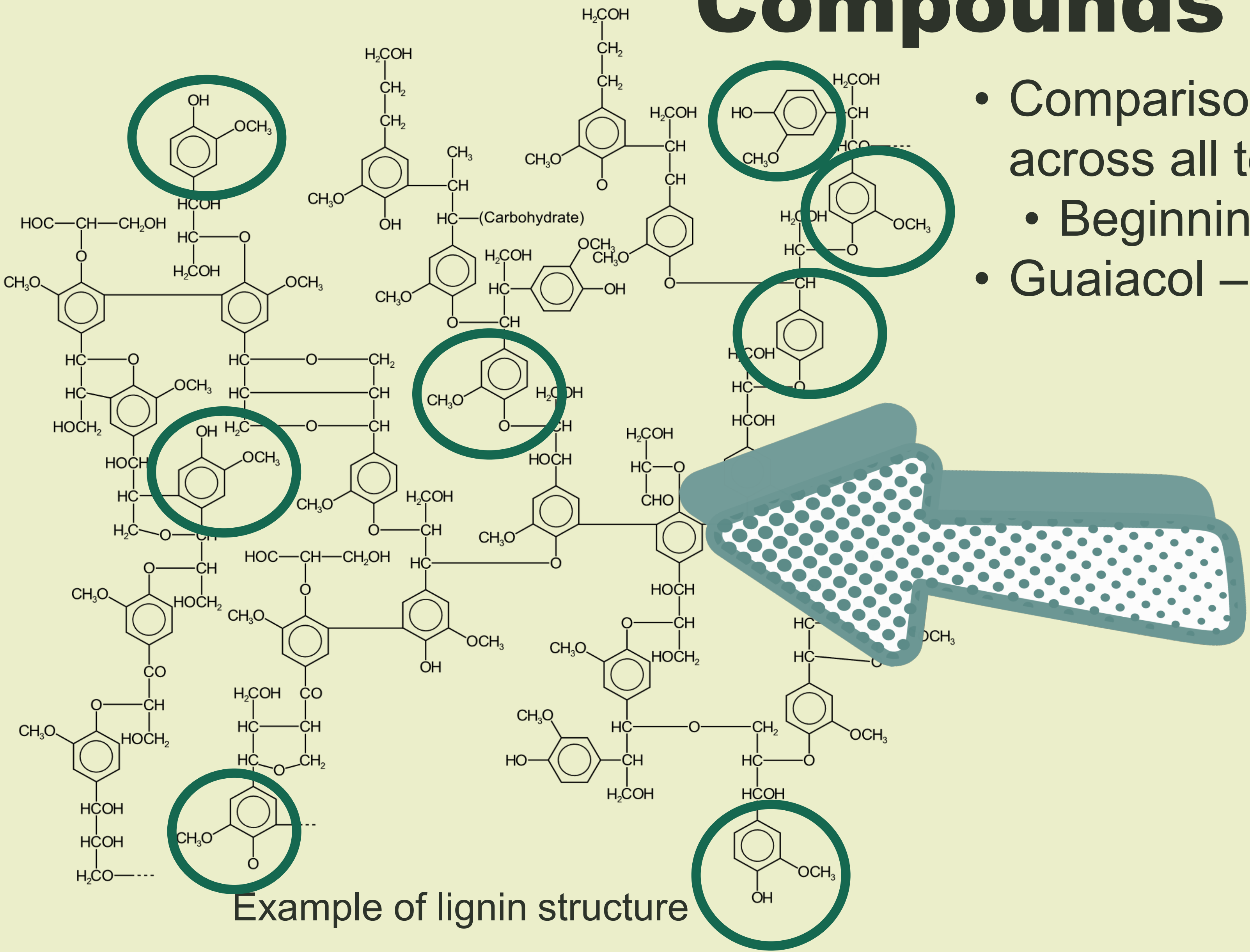
Toasting Effects on Volatile Compounds



Example of lignin structure

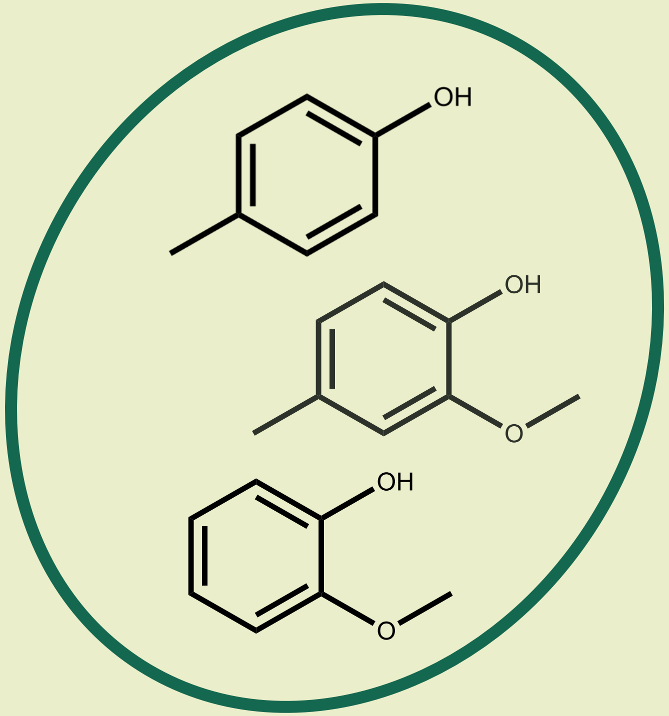
- During toasting, each compound of interest reacts differently when heat is applied.
- Comparison of guaiacol and furfural across all toast levels.
  - Beginning with guaiacol
- Guaiacol – Lignin degradation product

Toasting Effects on Volatile Compounds



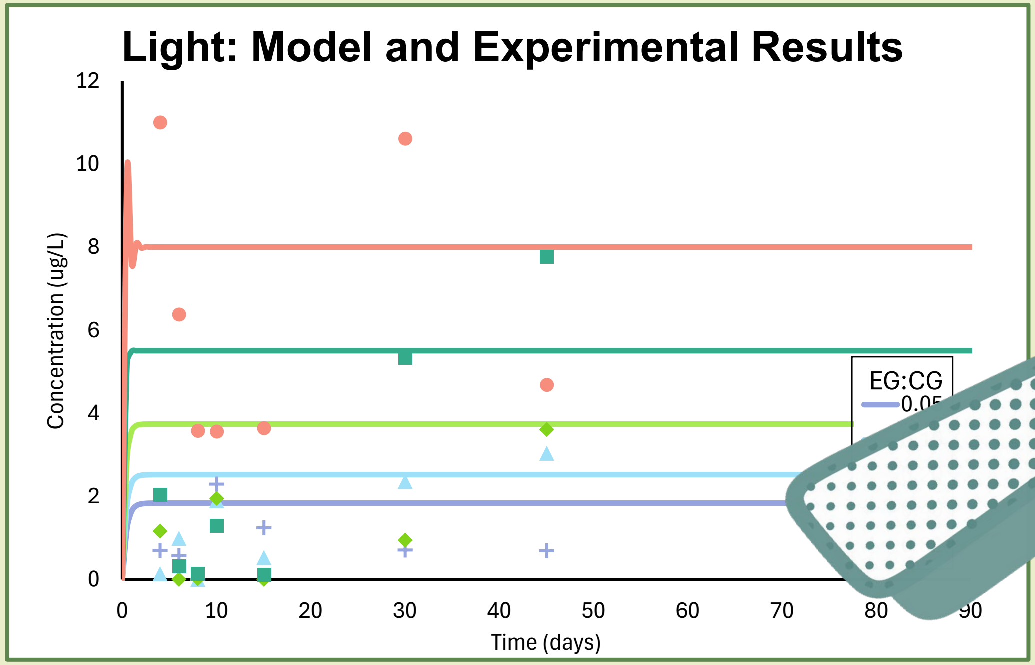
Example of lignin structure

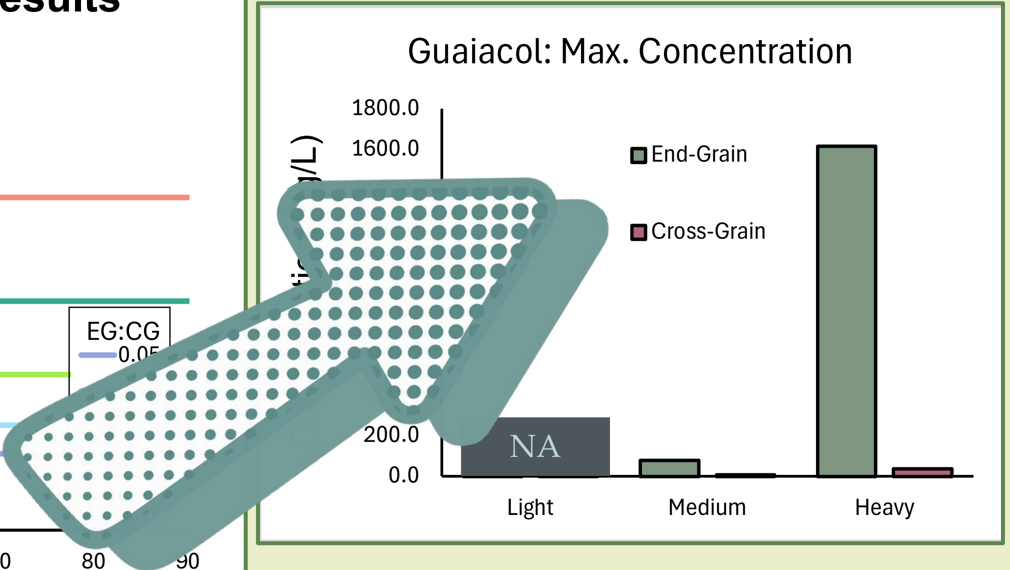
- Comparison of guaiacol and furfural across all toast levels.
  - Beginning with guaiacol
- Guaiacol – Lignin degradation product

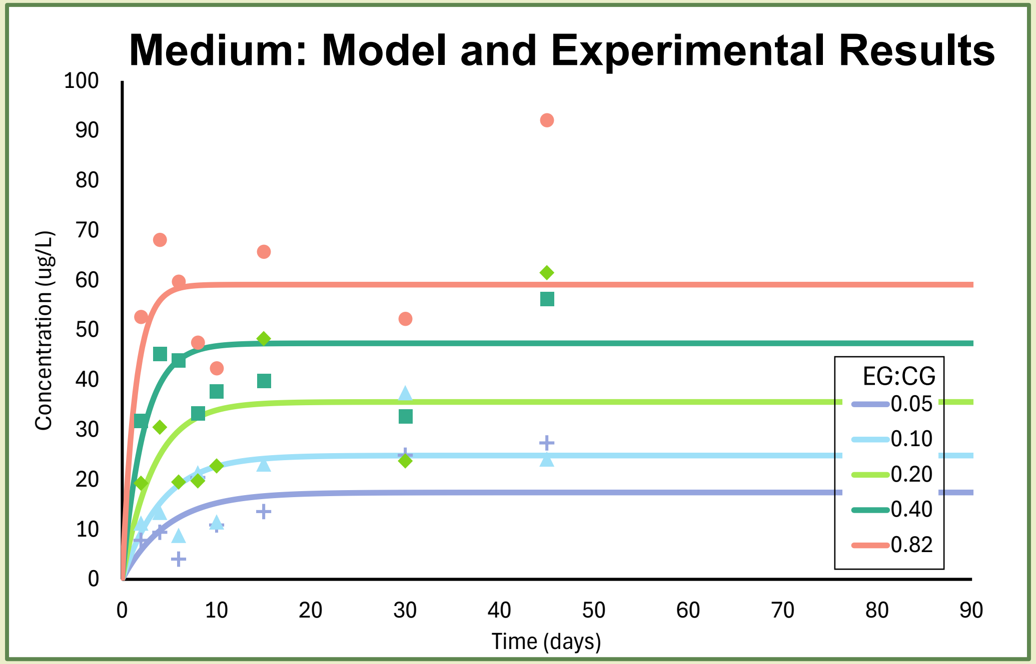


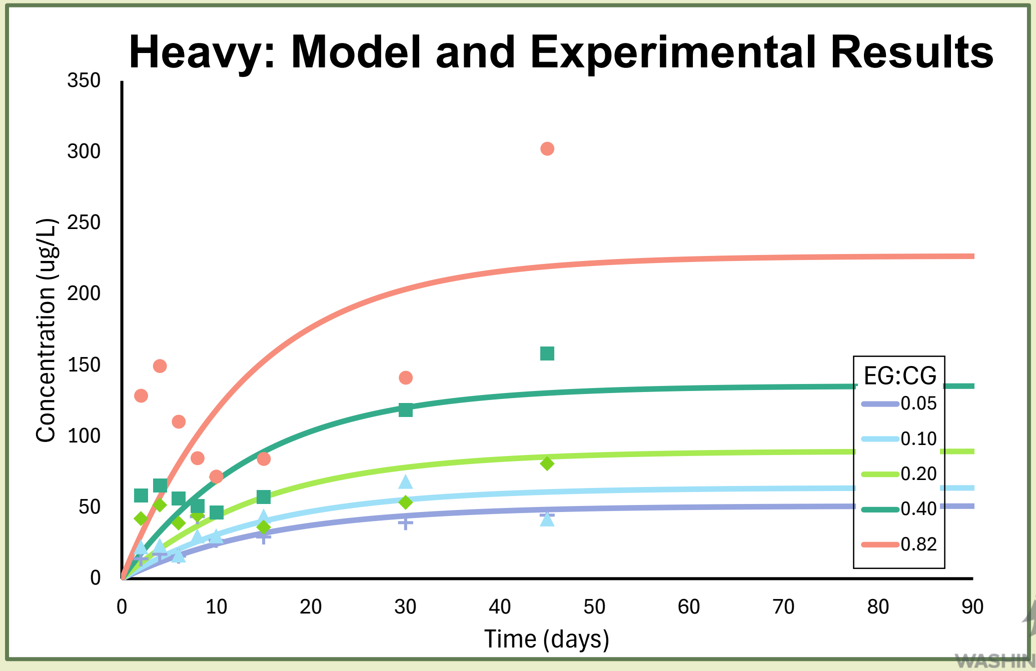
Multi-Toast Kinetic Evaluation: Guaiacol

Compound Class: Lignin degradation product









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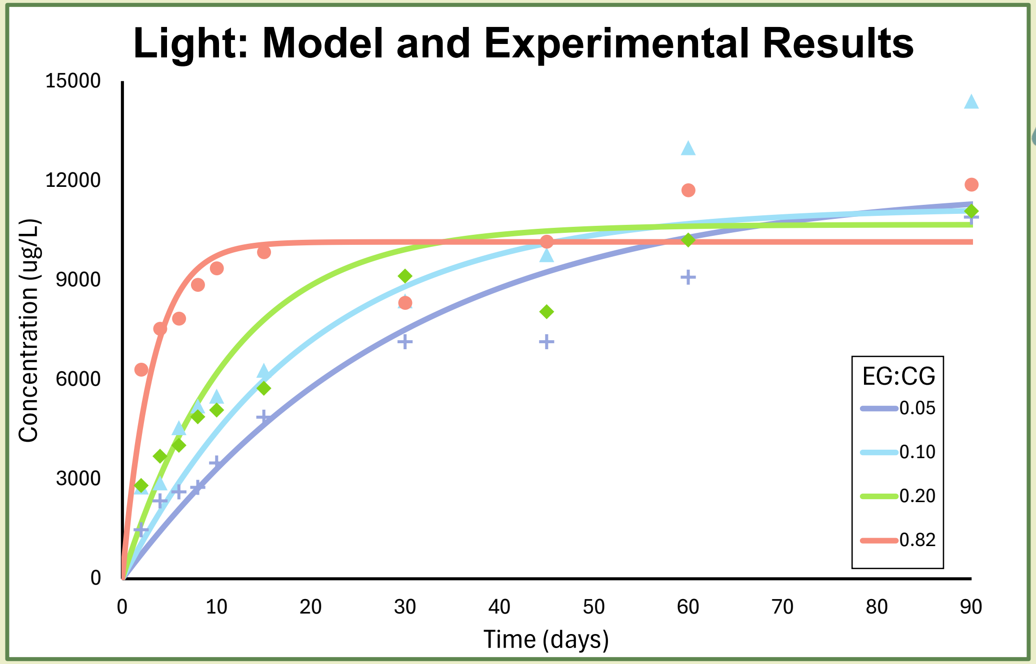
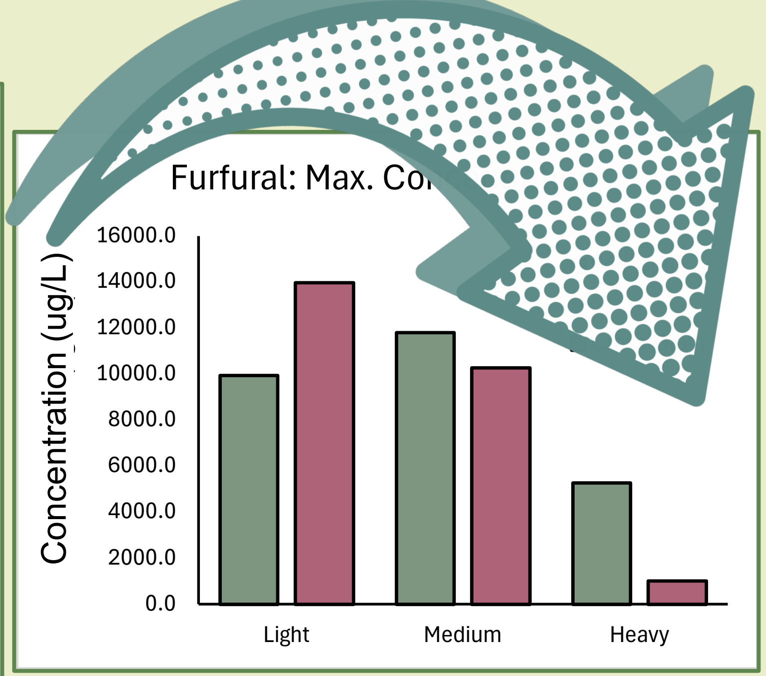
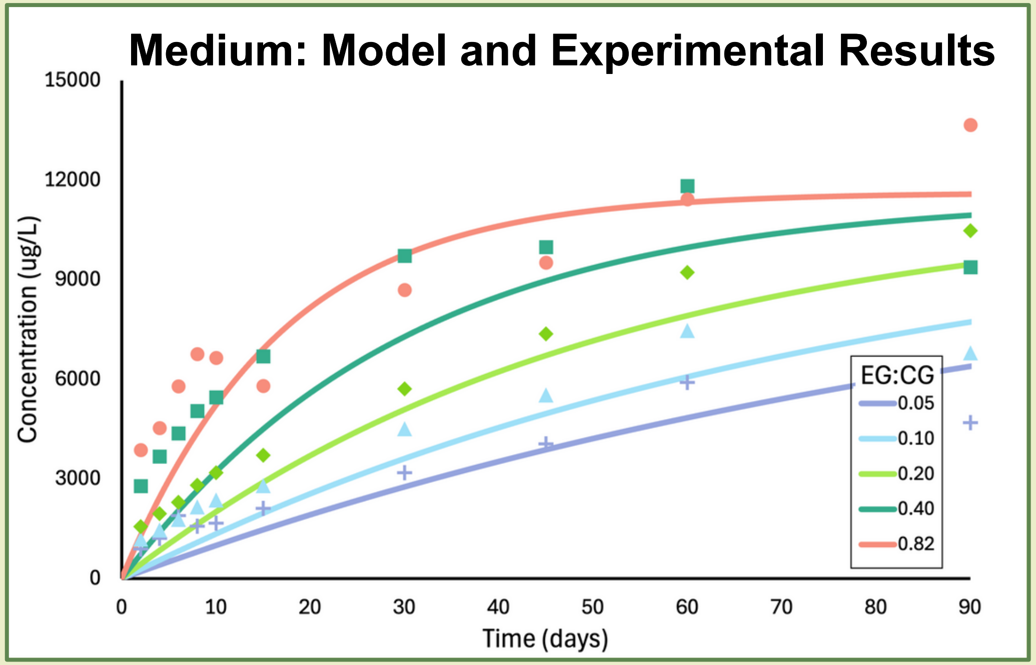
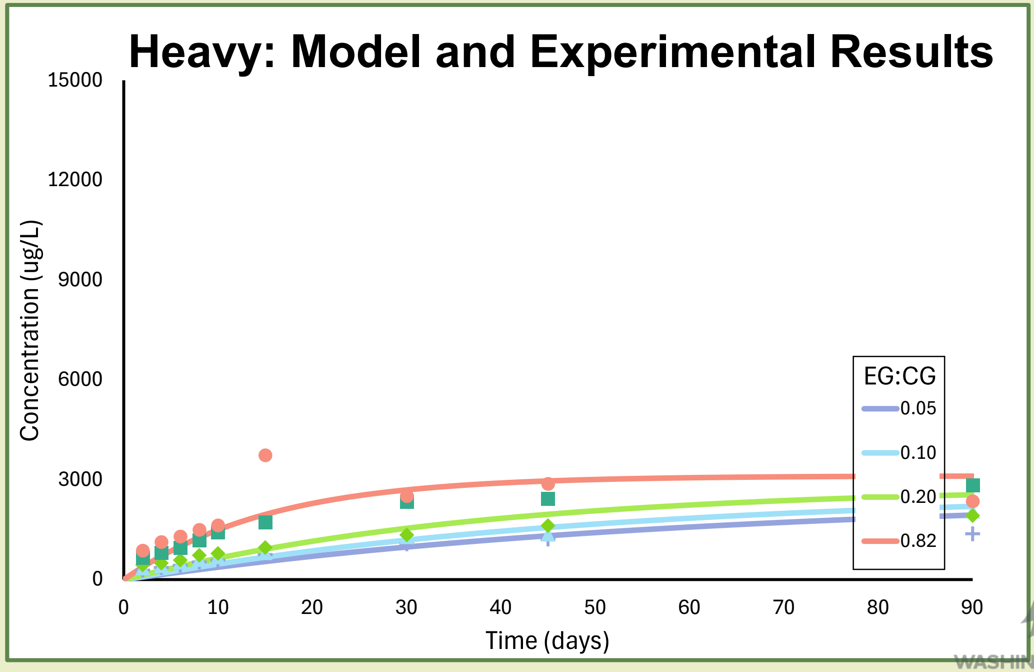
Multi-Toast Kinetic Evaluation: Furfural

Compound Class: Cellulose/Hemicellulose degradation product









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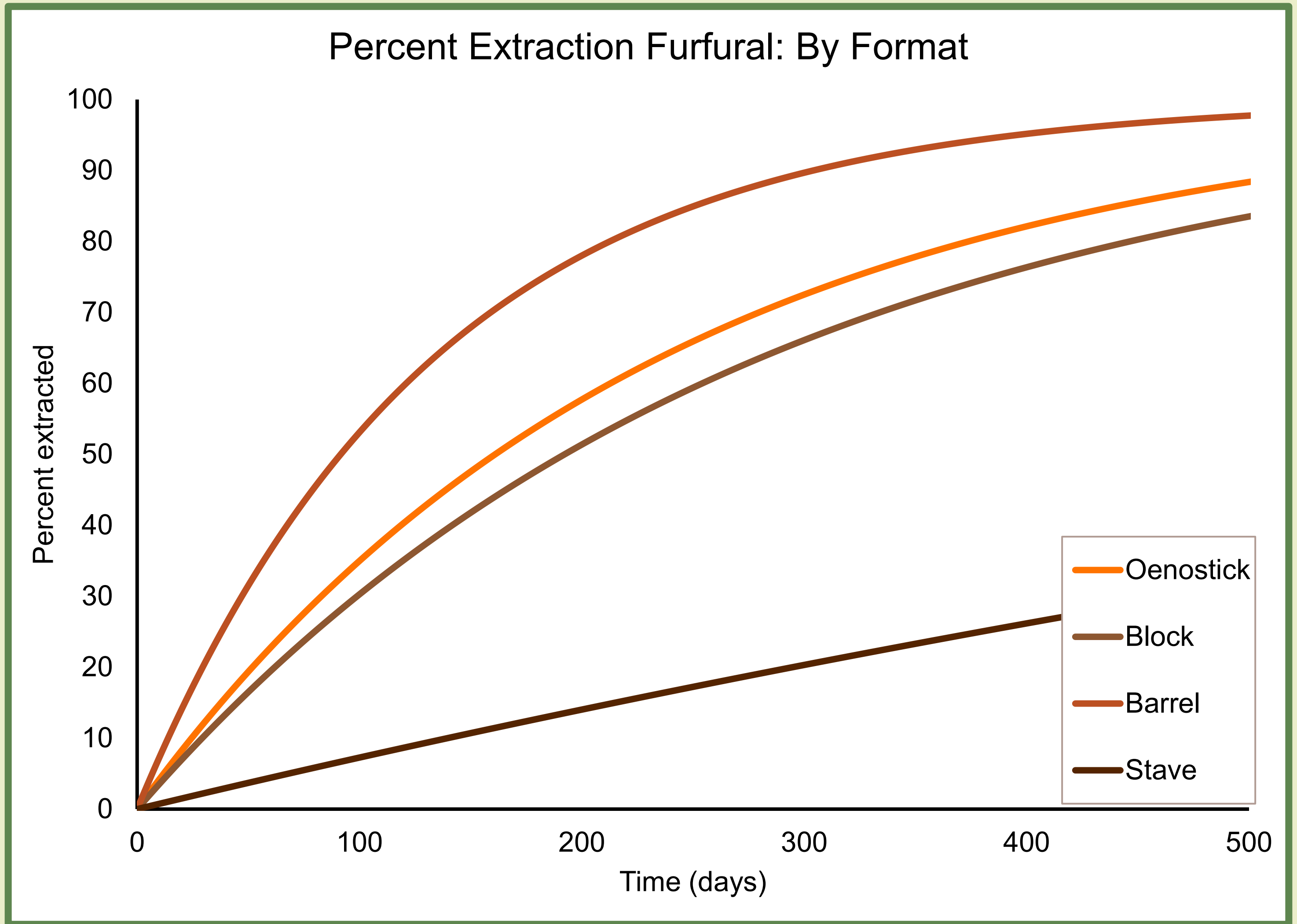
Two-Dimensional Kinetic Modeling

- First-order kinetic models were fitted using a multi-objective differential evolution (DE) parameter estimation routine
  - Simultaneously solving for four variables using 5 differential equations
- Model outputs
  - Theoretical maximum extraction concentrations for both end grain ($C_{solid\ eg}$) and cross grain ($C_{solid\ cg}$)
  - Extraction rate for both end grain (k_{eg}) and cross grain (k_{cg})
- Ordinary differential equation:

$$\frac{dc_{l(t)}}{dt} = \frac{SA_{eg}}{V_l} \times k_{eg}\left(c_{s(eg)} - c_{l(t)}\right) + \frac{SA_{sg}}{V_l} \times k_{sg}\left(c_{s(sg)} - c_{l(t)}\right)$$

Visualization of DE made by Pablo Rodrigues Mier.

Amount Extracted Across Different Formats: Furfural



- Model shown at volume
  - Extreme differences in volume result in more complex kinetic dynamics.
  - Difference in diffusional rate-limiting step
- ***LIMITATIONS:***
  - The model was first designed at the barrel equivalent
    - Dosage (5-35% NOE) needs to be further evaluated.
  - Study not till depletion

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