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Deep eutectic solvent pre-treatment of residual biomass streams – effects on anaerobic degradability –

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Biogas production within a circular economy

- Management of wastes and residues from
  - Agricultural production
  - Processing of agricultural goods
- Provision of renewable enegery
- Provision of organic fertilizer

- Treatment of lingnocellulosic biomass for
  - Production of value-added products
  - Improvement of anaerobic degradability

Deep eutectic solvent pre-treatment of residual biomass streams

Essentials on DES

- Mix of hydrogen bond donor and hydrogen bond dacceptor
- Melting point of mixture < melting point of individual substances
- Good solvation properties

- Advantages over conventional solvents
  - Biodegradability, biocompartibility
  - Low toxicity
  - High thermal stability
  - Low volatility
  - Non-flammability

Abbott et al. 2003, Pandey et al. 2017, Qin et al. 2020, Gorke et al. 2008

Deep eutectic solvent pre-treatment of residual biomass streams

Materials and methods

Cork dust | Olive pruning | Common reed

Comminution

DES pre-treatment

- 1:10 solid : solvent ratio
- 1:2 Choline chloride : formic acid
- 90 °C / 110 °C / 130 °C
- 20 min / 40 min / 60 min

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Comminution

↓

DES pre-treatment

↓

Solid/liquid separation → Valorization of liquid fraction

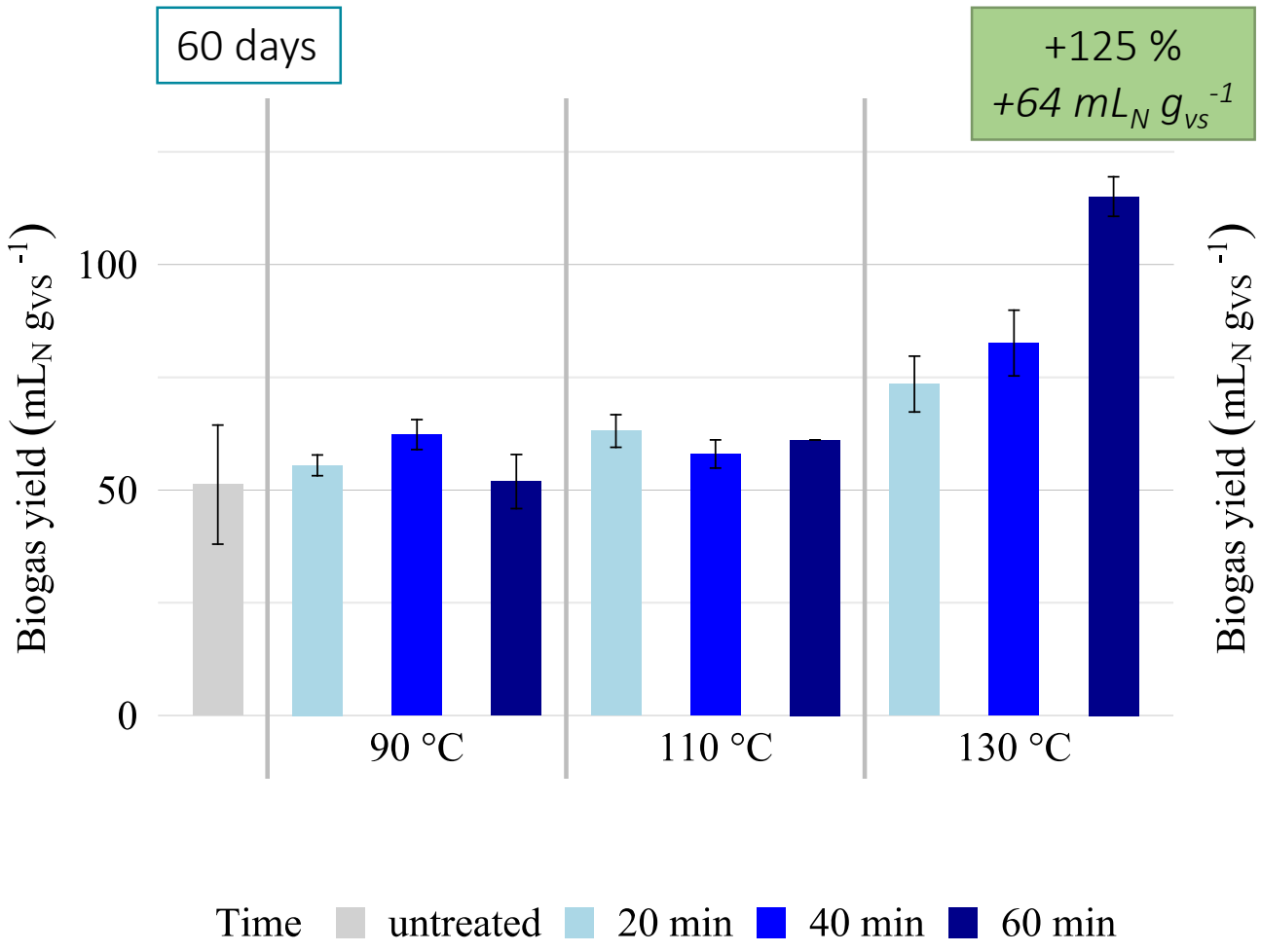
↓

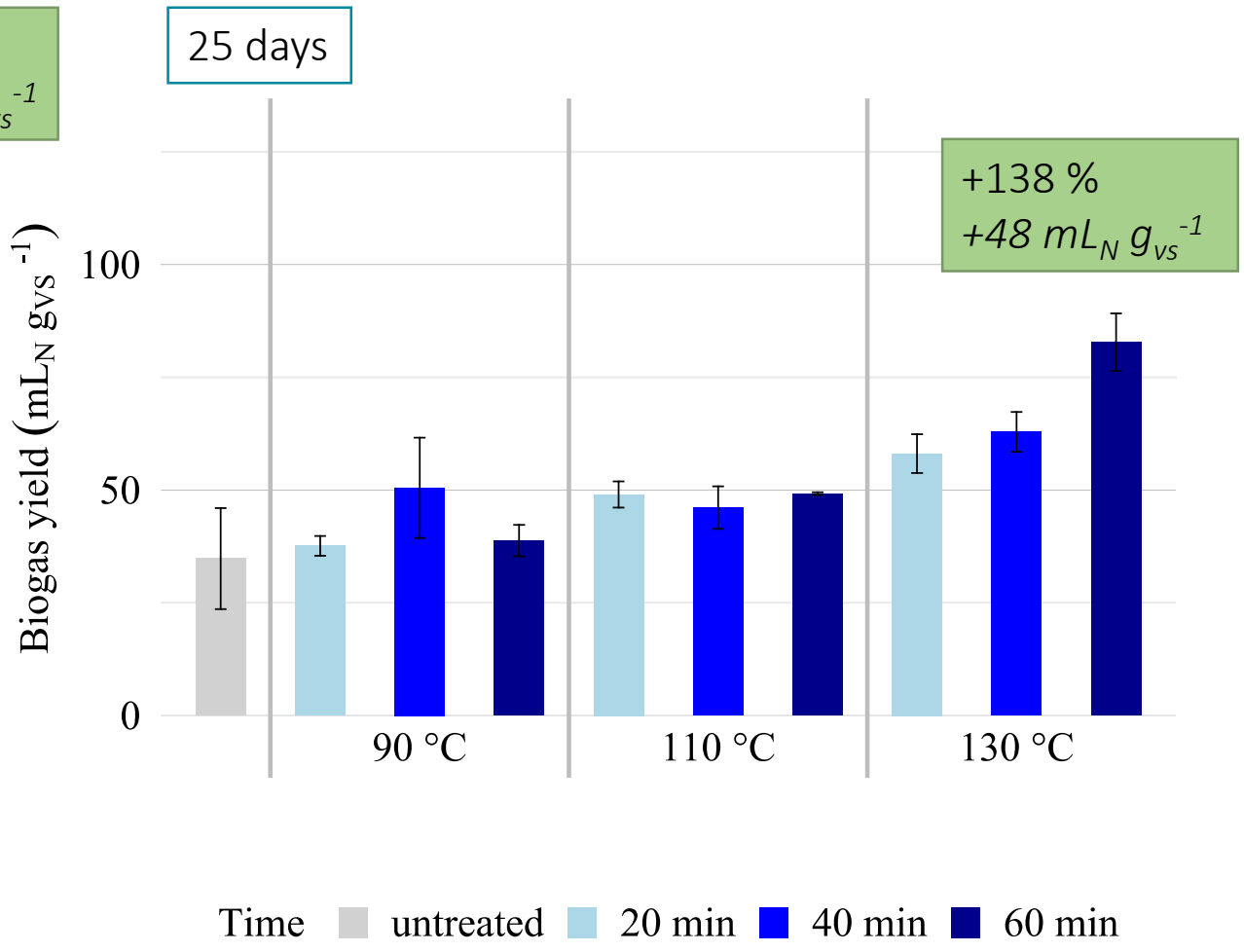
Anaerobic digestion of solid residuals

- 37 ± 1 °C
- 60 days
- Gas compositional analysis

Anaerobic degradability of DES pre-treated biomass

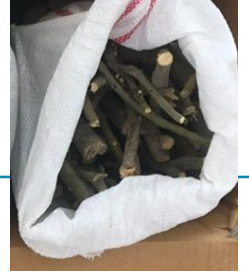
Results - Cork dust

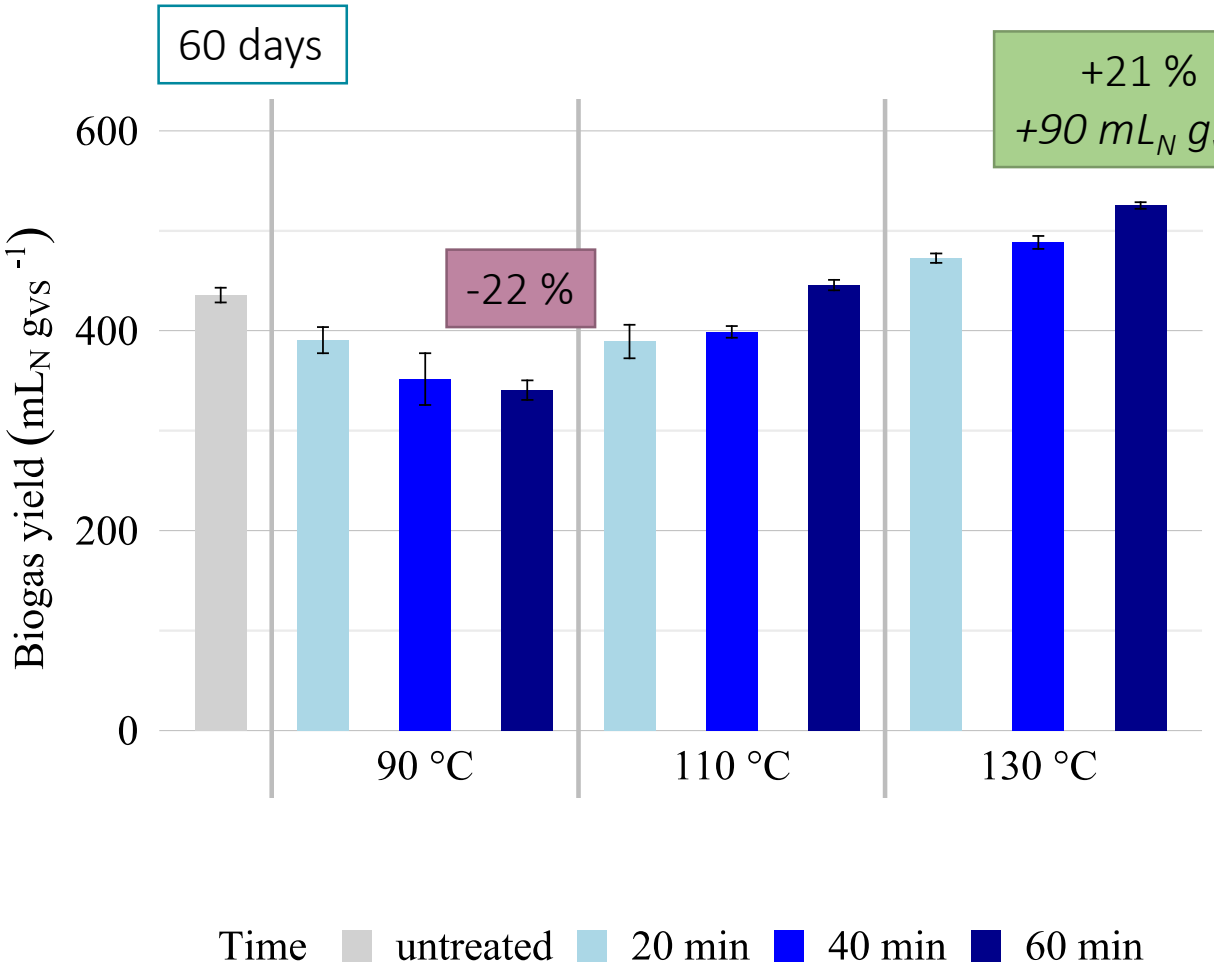


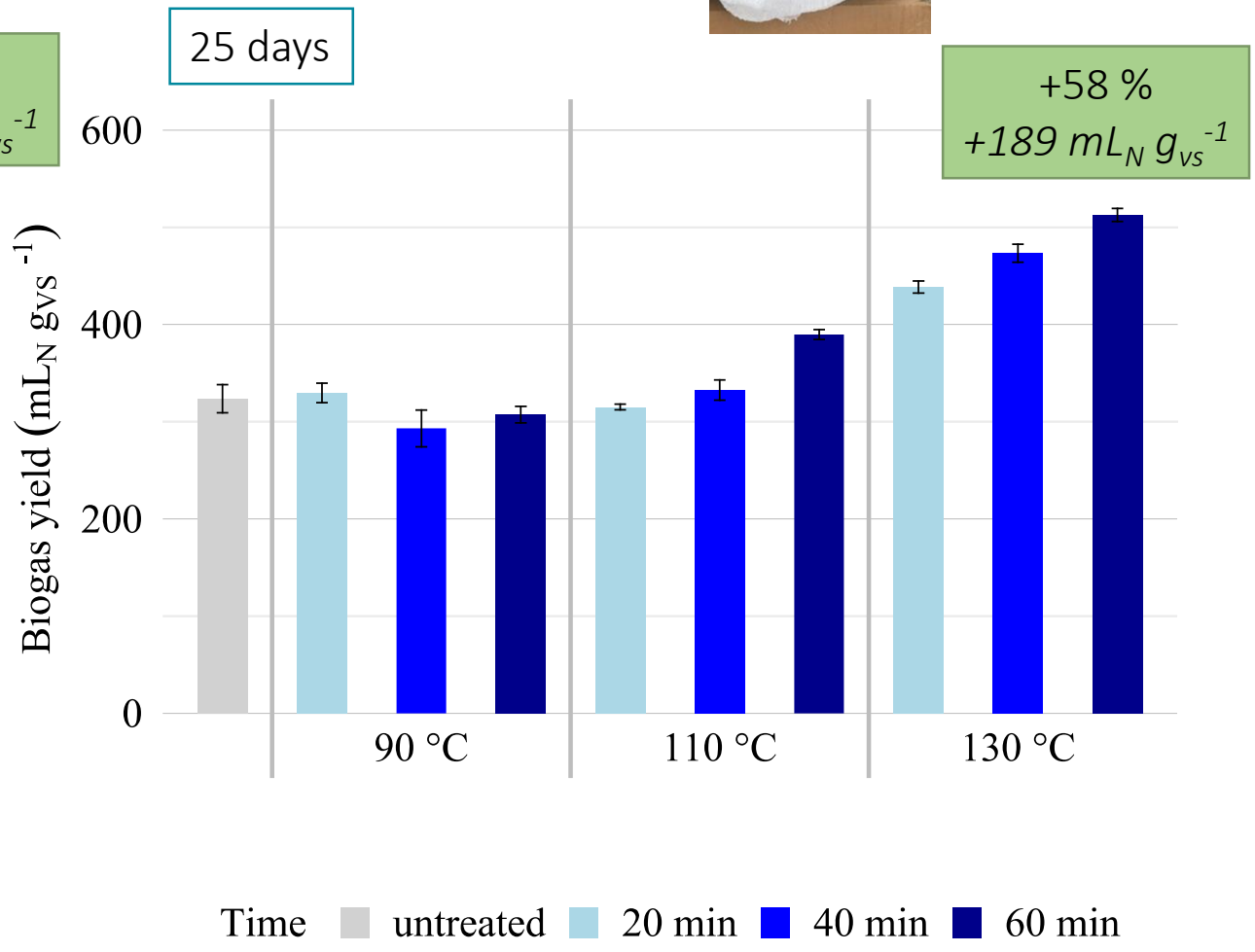


Anaerobic degradability of DES pre-treated biomass

Results - Olive tree pruning

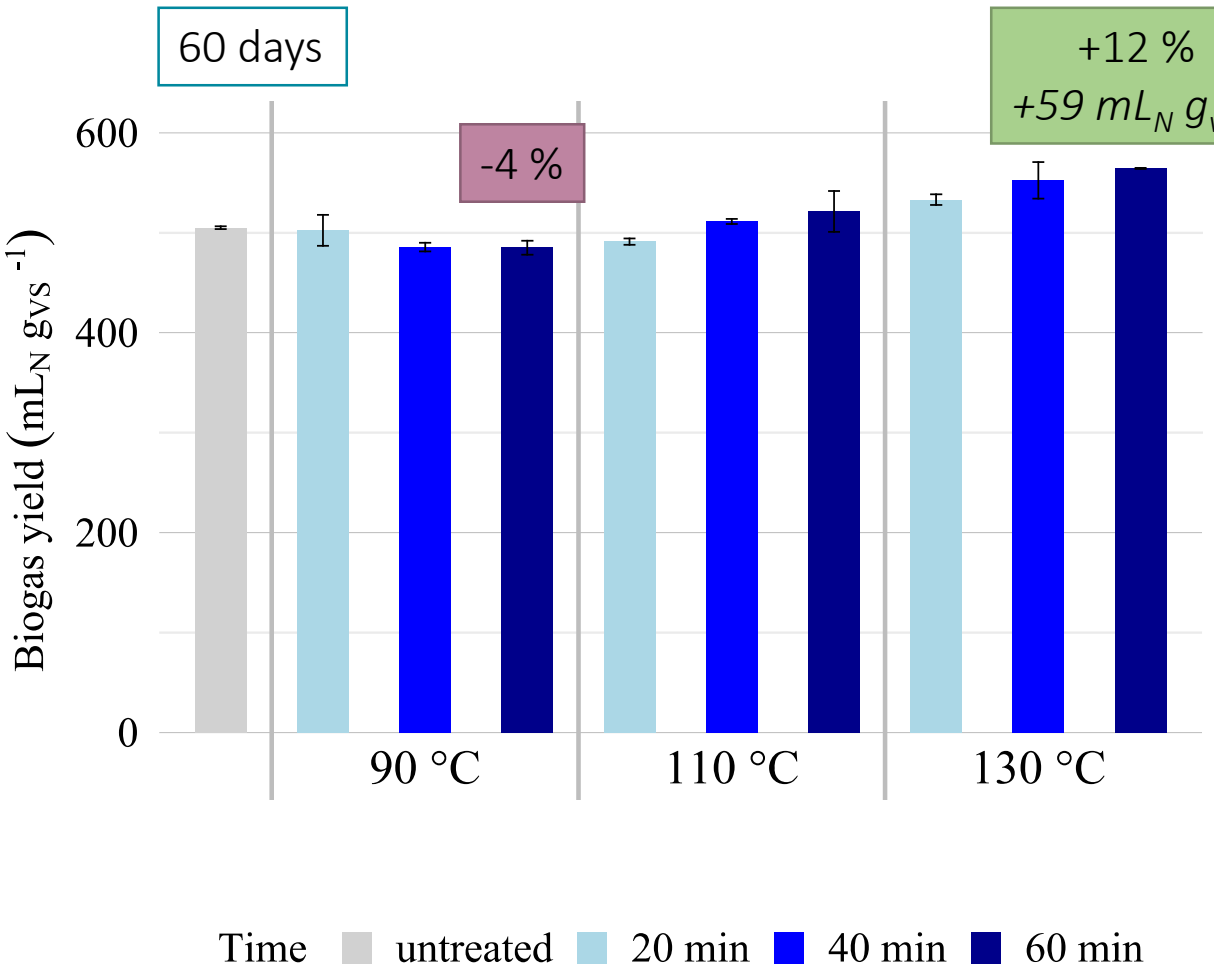


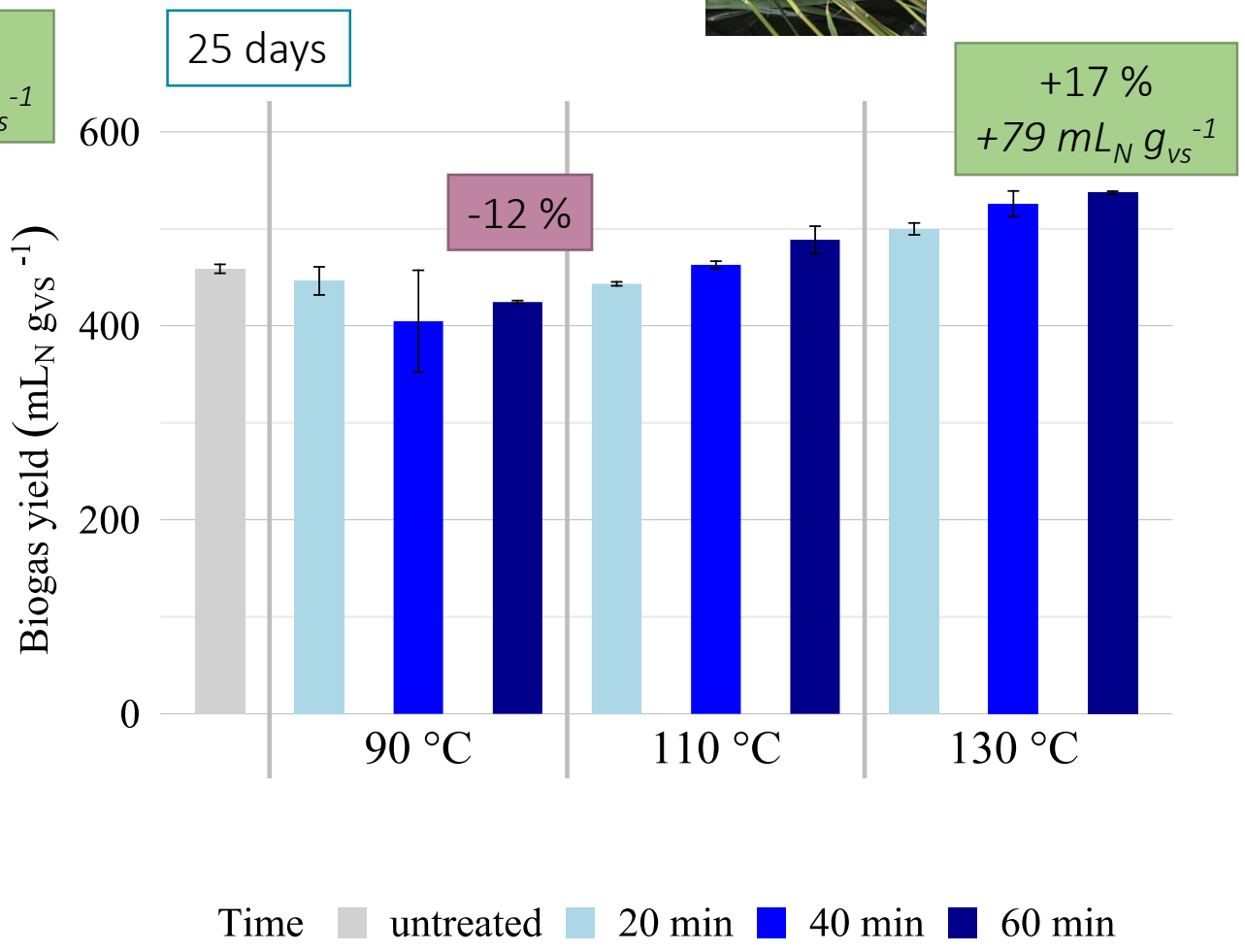




Anaerobic degradability of DES pre-treated biomass

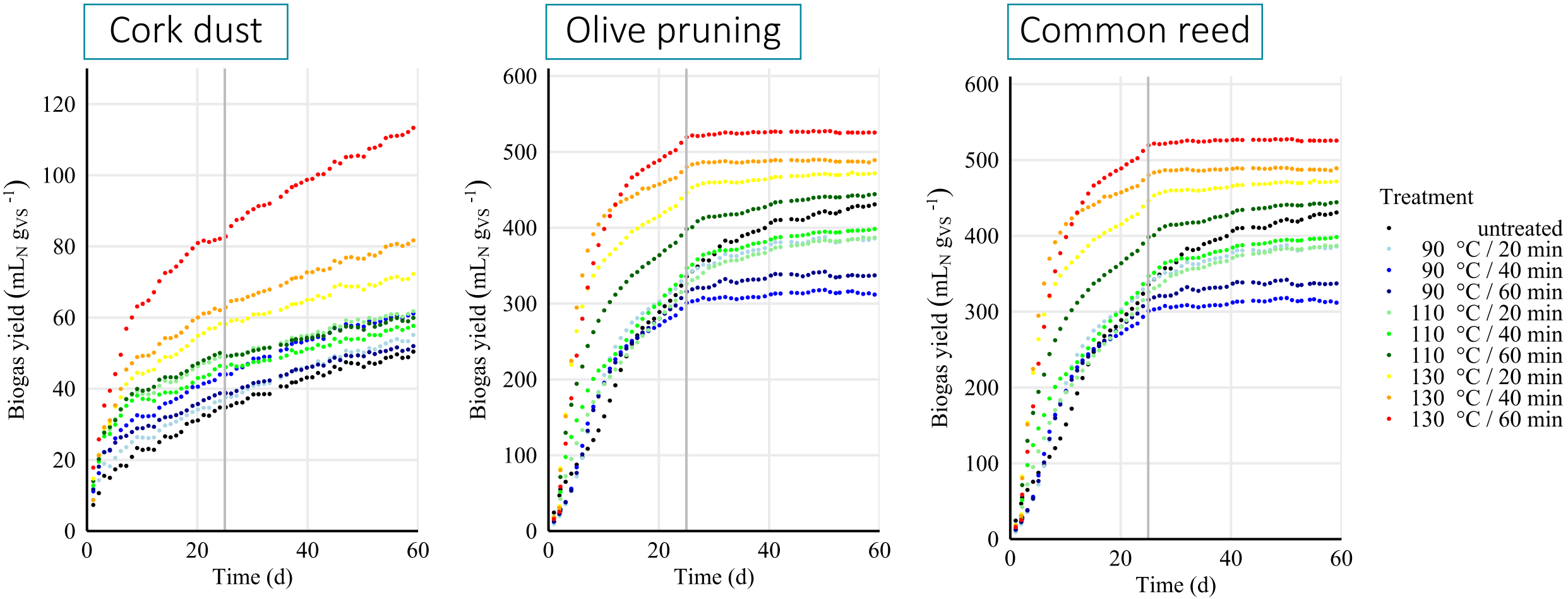
Results - Common reed





Anaerobic degradability of DES pre-treated biomass

Results - Changes in degradation kinetics

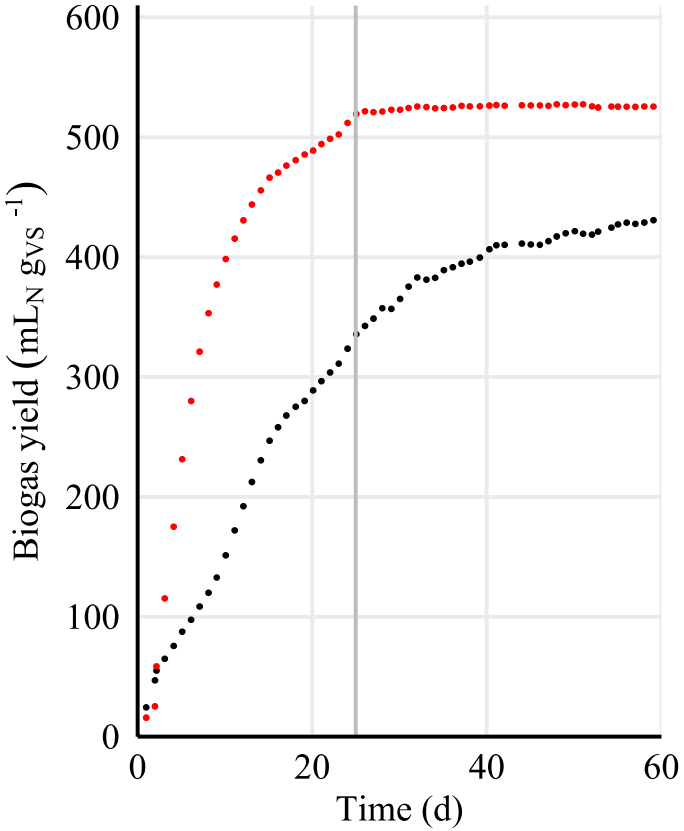


Anaerobic degradability of DES pre-treated biomass

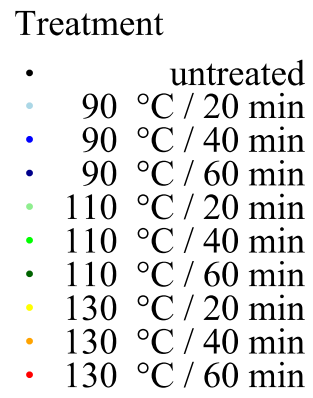
Results - Changes in degradation kinetics

Cork dust

Olive pruning



Common reed

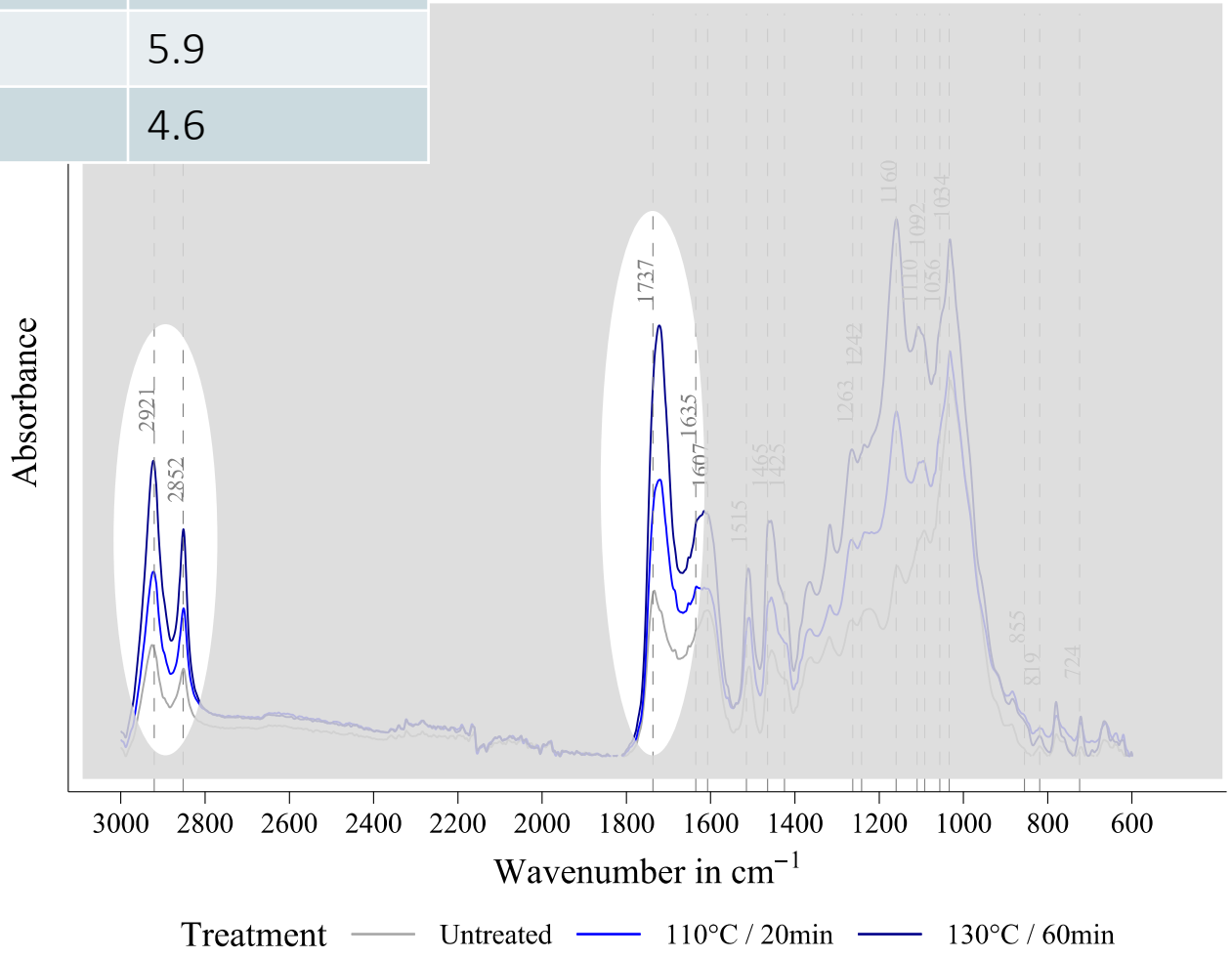


Anaerobic degradability of DES pre-treated biomass

Results - Cork dust

	Glucose (%)	Lignin (+ suberin %)	Ash (%)
Untreated	9.0	52.0	2.1
110 °C – 20 min	12.6	53.5	5.9
130 °C – 60 min	17.2	56.7	4.6

- Increase in suberin



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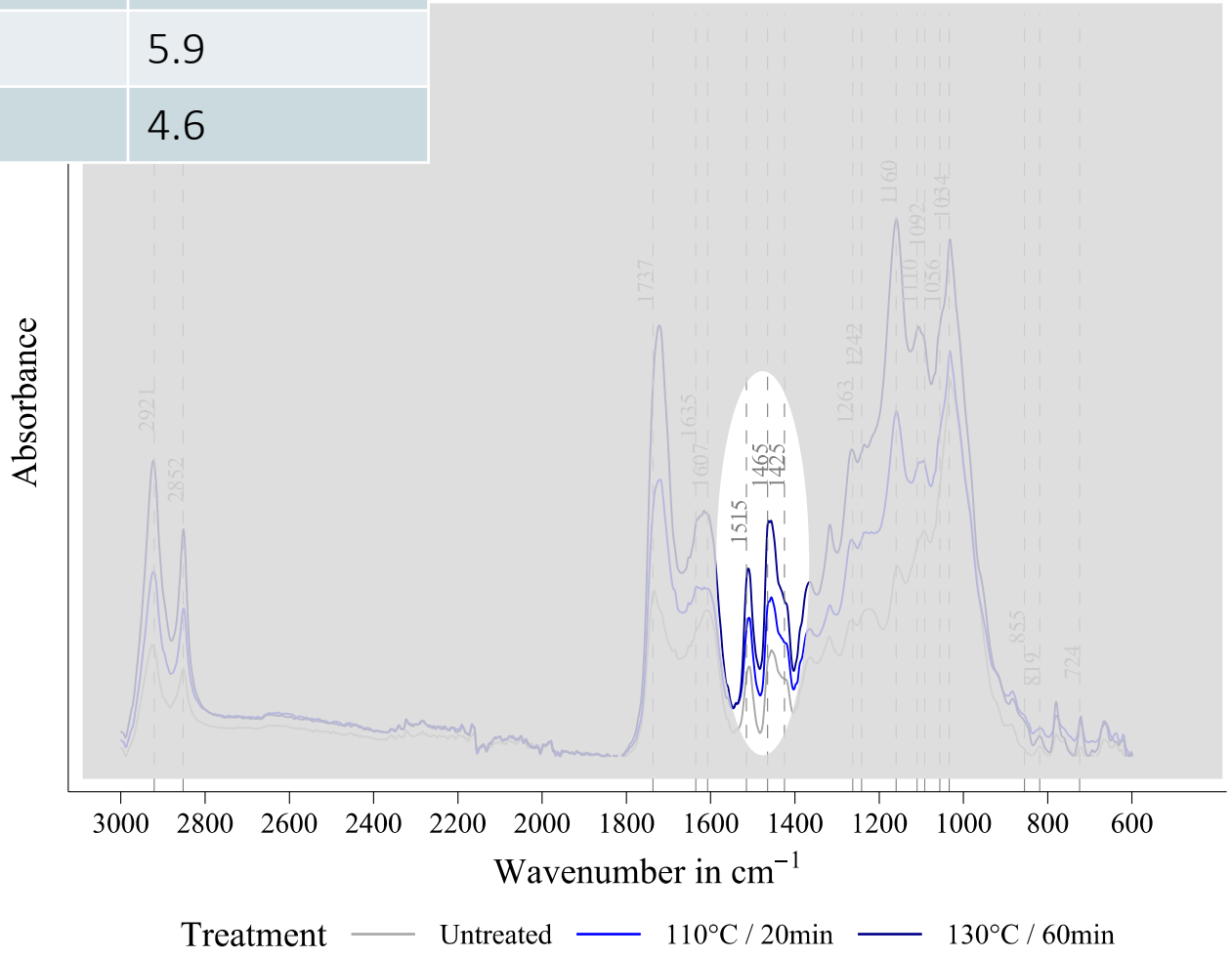
- Increase in suberin and lignin



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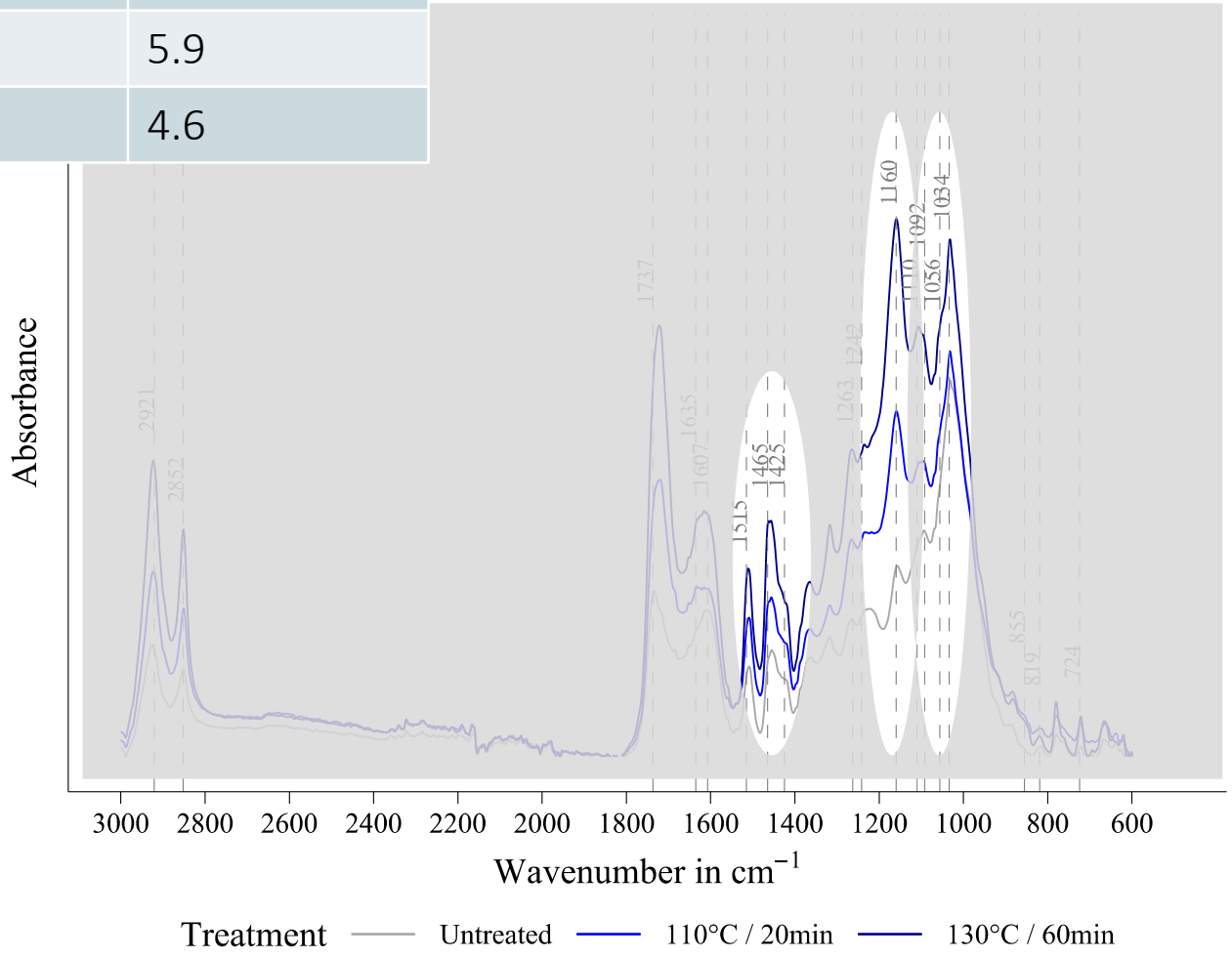
- Increase in glucose



Lynam et al. 2017, Garcia et al., 2010, Rocha et al., 2001, Lopes et al., 2000, Lopes et al., 2001, Neto et al.,1995

Anaerobic degradability of DES pre-treated biomass

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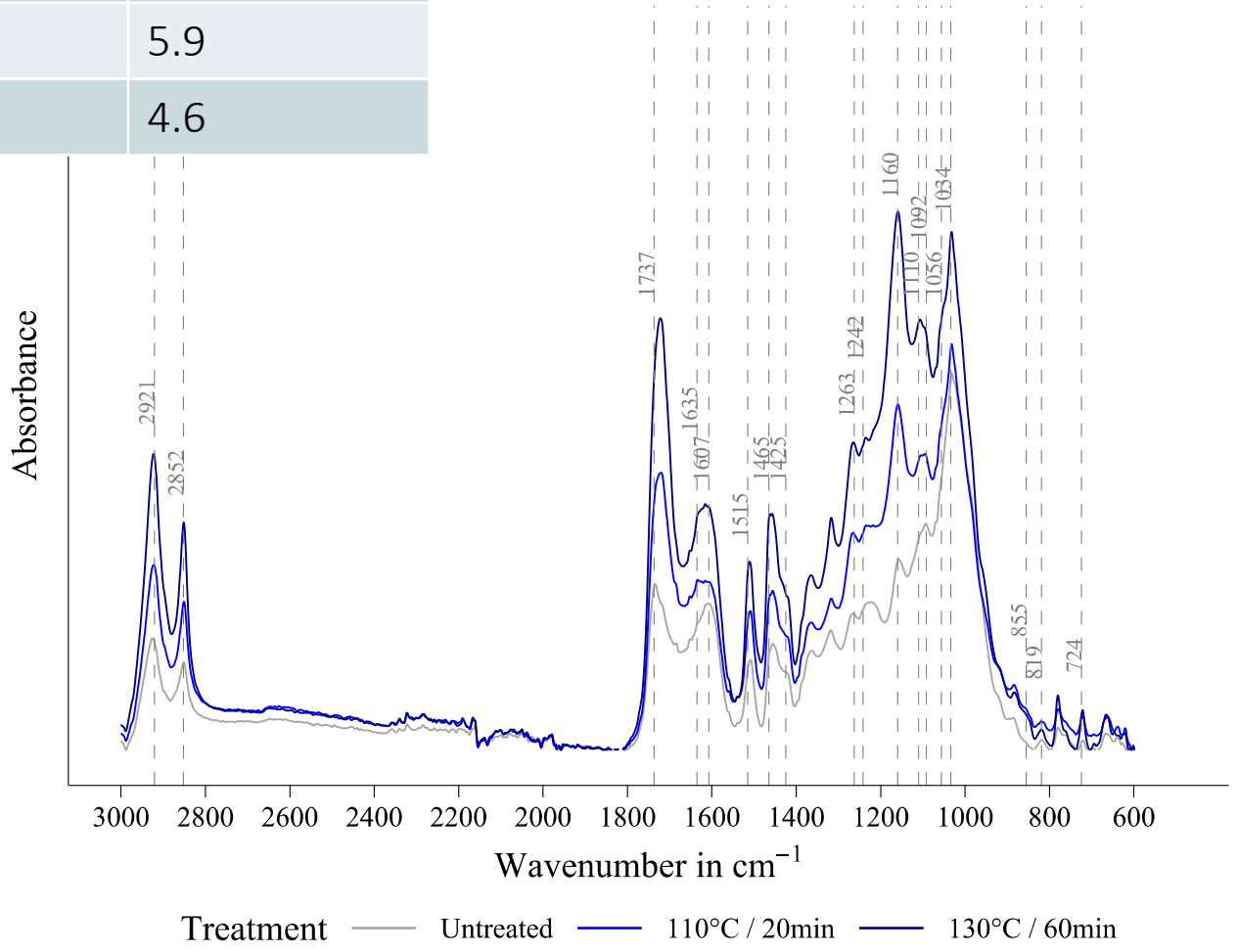
- Increase in suberin and lignin
- Increase in glucose
- Realtive increase of cellulose to lignin ratio



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Anaerobic degradability of DES pre-treated biomass

Conclusion

- Huge differences among investigated biomass streams
- Two major effects on biogas formation
  - Increase of biogas yield
  - Change of degradation kinetics
- Increase associated with increased cellulose:lignin ratio

Thank you for your attention!

Questions?

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Thank you for your attention!

Questions?

Anaerobic degradability of DES pre-treated biomass

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