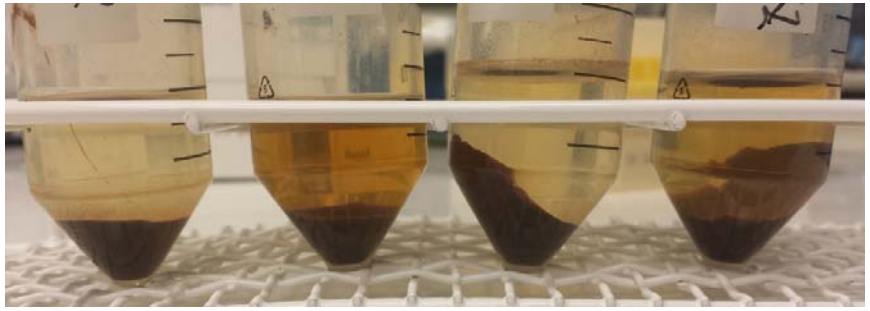
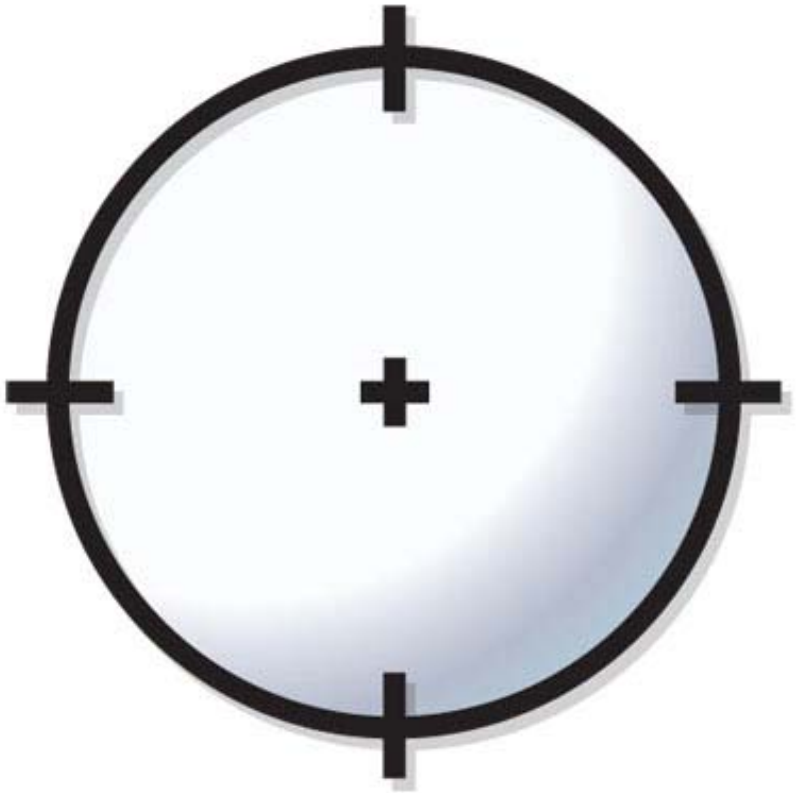


In vitro oxidative and enzymatic degradation of modified wood

Rebecka Ringman, Annica Pilgård, Klaus Richter

SP Technical Research Institute of Sweden



AIM

Examine:

…whether fungal cellulases are inhibited by wood acetylation and furfurylation

…if Fenton derived hydroxyl radicals (·OH) are able to depolymerise polysaccharides in acetylated and furfurylated wood

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KEY MESSAGE

- Fungal cellulases were not inhibited by wood acetylation, but efficacy was reduced
- Cellulase efficacy in acetylated wood was increased by oxidative pre-treatment (but not to the same extent as in untreated wood), indicating that ·OH depolymerised acetylated wood
- Poly(FA) may be degraded by hydroxyl radicals

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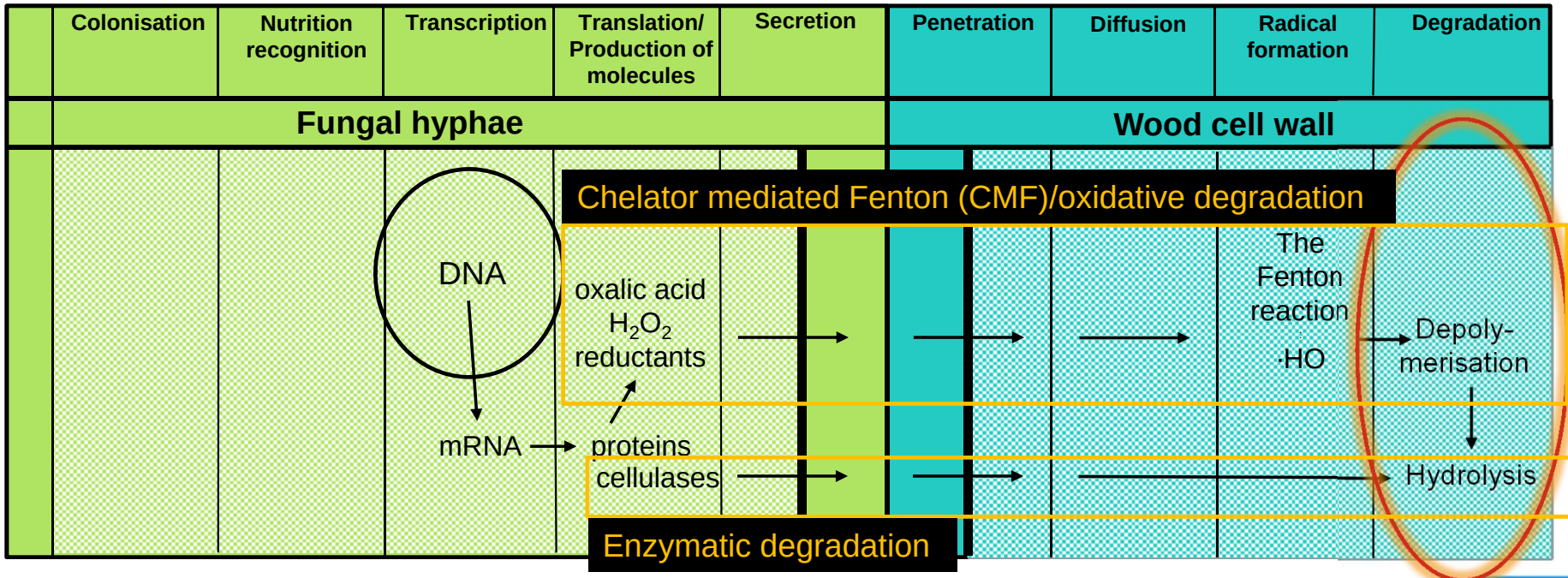
BACKGROUND: BROWN ROT WOOD DEGRADATION

Which step is inhibited by wood modification?



This study focuses on depolymeri-sation and hydrolysis

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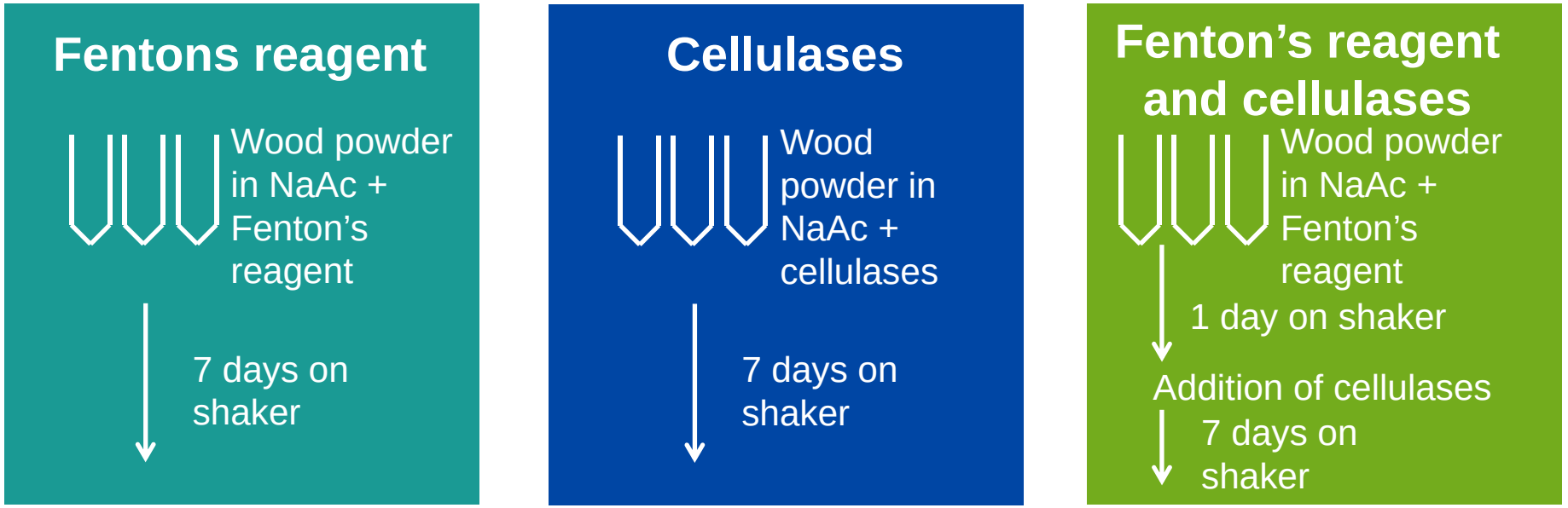
EXPERIMENTAL SET-UP

***In vitro* treatment with Fenton's reagent, cellulases and both (Verma and Mai 2010)**



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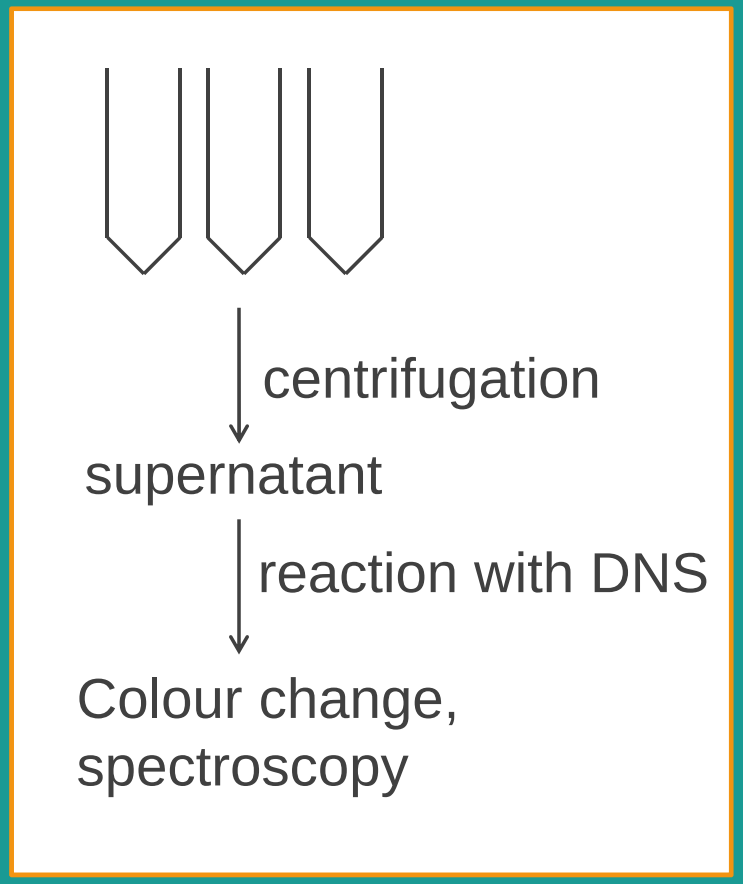


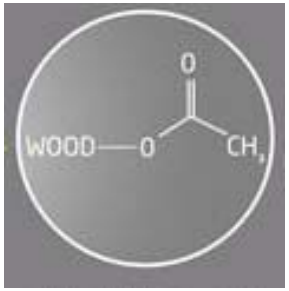
EXPERIMENTAL SET-UP

Analysis of reducing sugars released into supernatant

- Reducing sugar = end sugar
  - Number of reducing sugars = number of cleavages
- Dinitrosalicylic acid (DNS) – reacts with reducing sugars => colour change

ACETYLATED WOOD

Production and characteristics



- Acetic anhydride replaces water and bind to OH-groups
- Decreased EMC, increased durability

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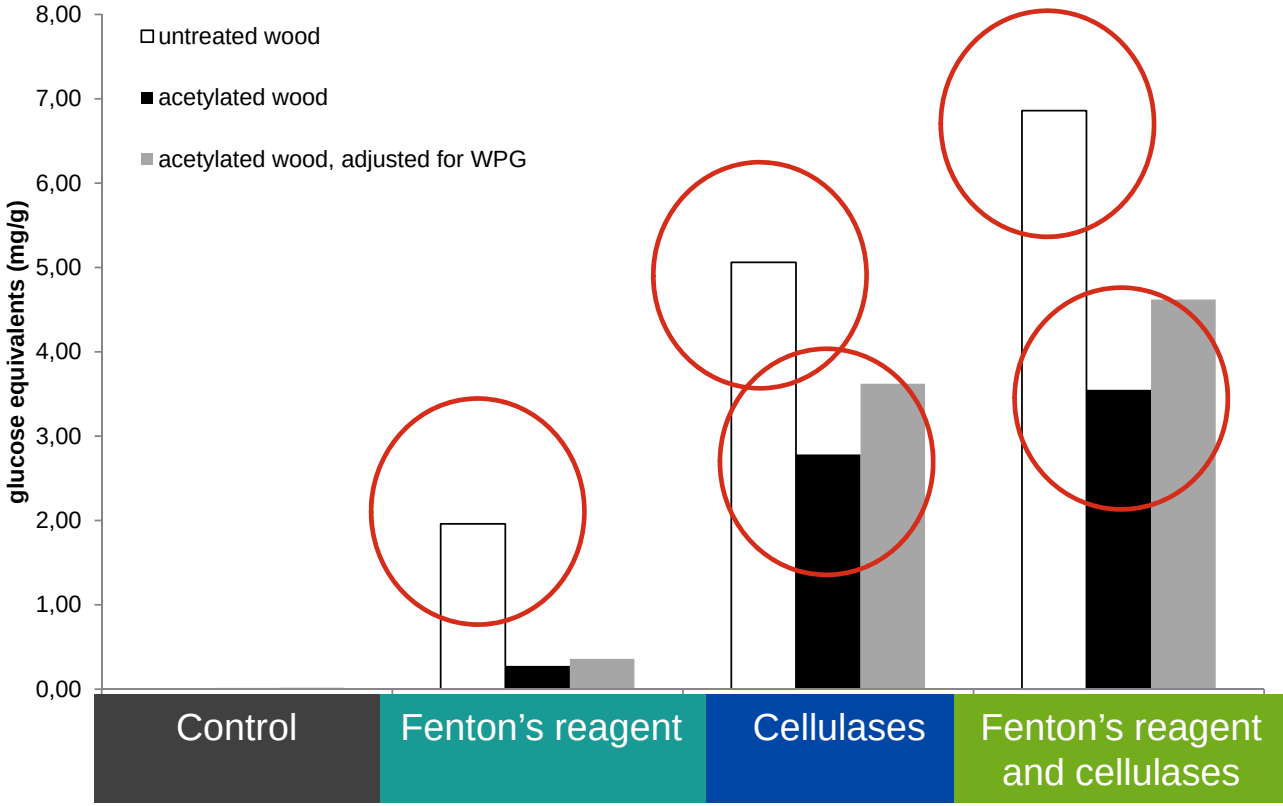
ACETYLATED WOOD

Results (representative values)

- Brown rot cellulases were able to hydrolyse acetylated wood
- Oxidative pre-treatment increased hydrolysis efficacy in acetylated wood
- Lower levels than in untreated wood



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ACETYLATED WOOD

Discussion

- Possible reasons for lower efficacy:
  - Fenton's reagent: ·OH may also be reacting with the acetyl groups
  - Cellulases: acetyl groups may be physically hindering the cellulases

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ACETYLATED WOOD

Discussion

- Increased efficacy of cellulases after pre-treatment with Fenton's reagent due to:
  - ·OH may have cleaved off the acetyl groups
  - ·OH depolymerises crystalline regions of cellulose (not as well acetylated) => release of non-acetylated cellulose (more effectively degraded)?

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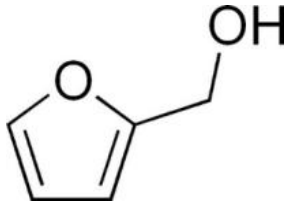
FURFURYLATED WOOD

Production and characteristics

- Impregnation with furufuryl alcohol, which polymerises inside the wood
- Decreased EMC, increased durability



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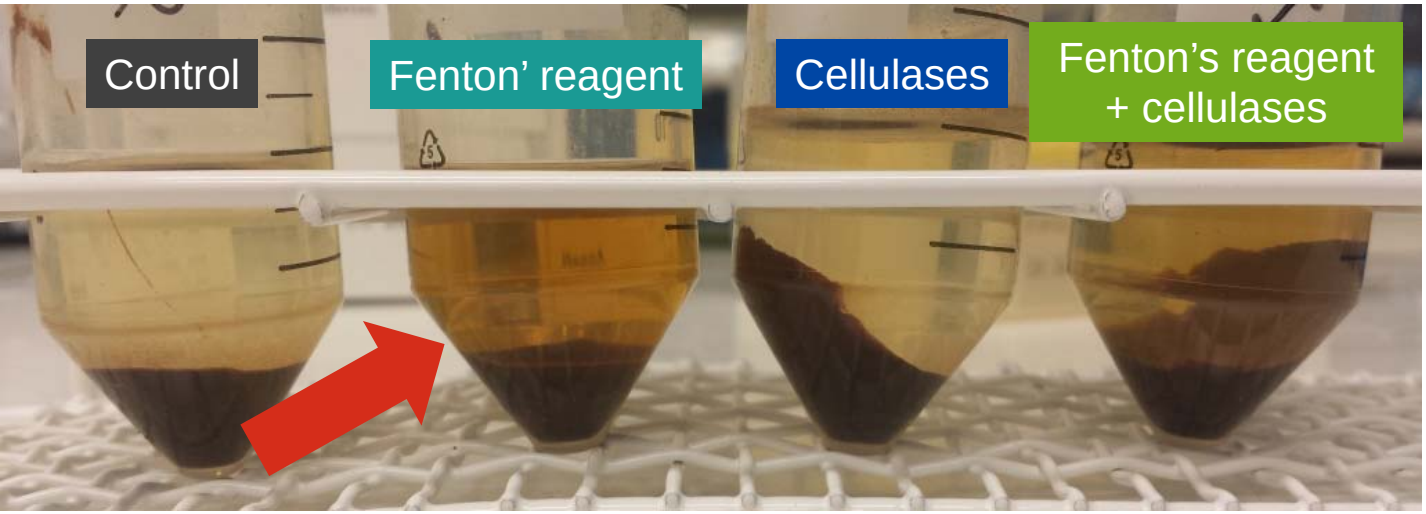

FURFURYLATED WOOD

Results

- Fenton's reagent turned supernatant brown
- Extremely high values after DNS analysis
  - DNS reacts with aldehydes
- Poly(FA) degraded to furfurals?

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FURFURYLATED WOOD

Discussion

- Could not measure reducing sugars released with DNS after treatment with Fenton's reagent
  - Alternative method is needed
- Fungal cellulases hydrolysed polysaccharides in furfurylated wood (Venås 2008)

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CONCLUSIONS

- Acetylated wood was hydrolysed by fungal cellulases
  - Enzyme non-recognition not main mode of action
- Hydrolysis of acetylated wood was more effective after oxidative pre-treatment
  - Indicates that hydroxyl radicals depolymerised polysaccharides in acetylated wood
- Poly(FA) may have been degraded by hydroxyl radicals

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ALTERNATIVE METHODS

- FT-IR
  - Planning to go to Stockholm in April
- Other biochemical method?
  - Will talk to people at SP Chemistry if we don't get the answers we want from FT-IR
- Other?