Pretreatment/fractionation and conversion of lignocellulosic biomass towards enhanced furanics production

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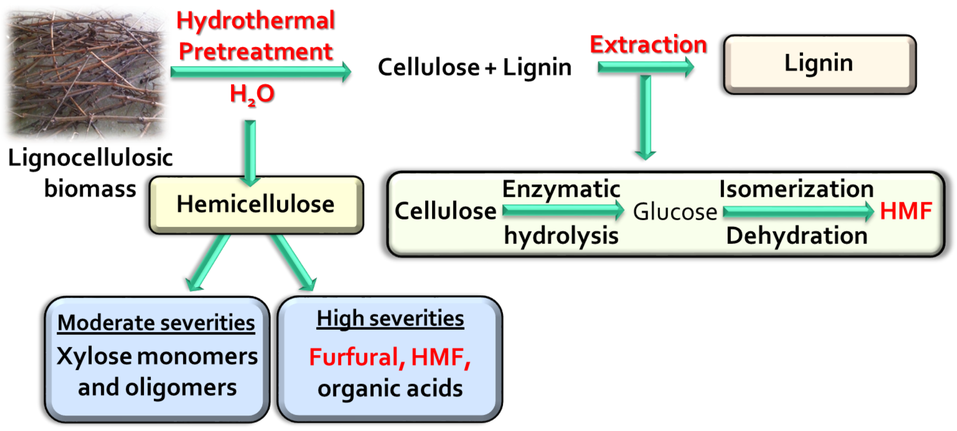
Objectives

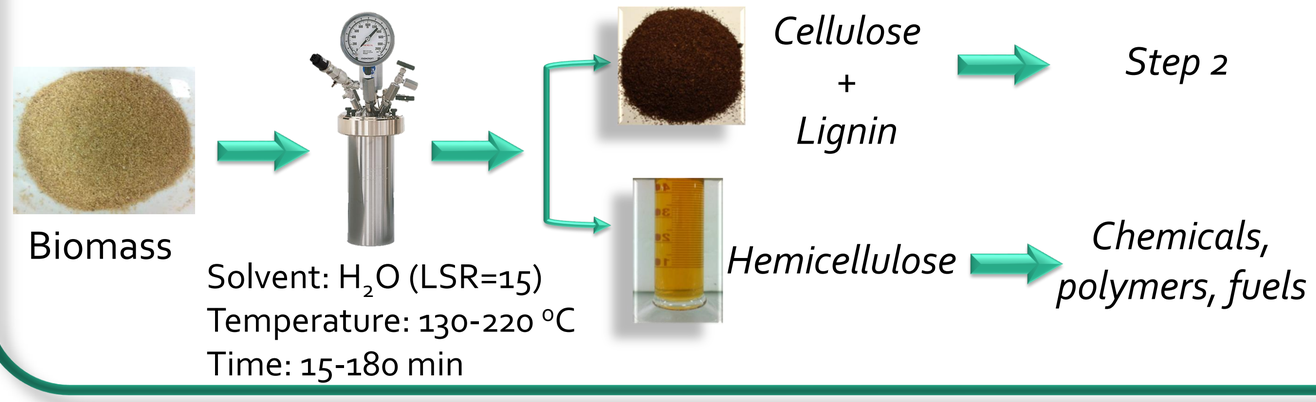
- Valorization of lignocellulosic biomass towards value added chemicals and fuels.
- A "whole biomass" biorefinery process, based on the combination of hydrothermal pretreatment in neat H_2O and "green" extraction of lignin.



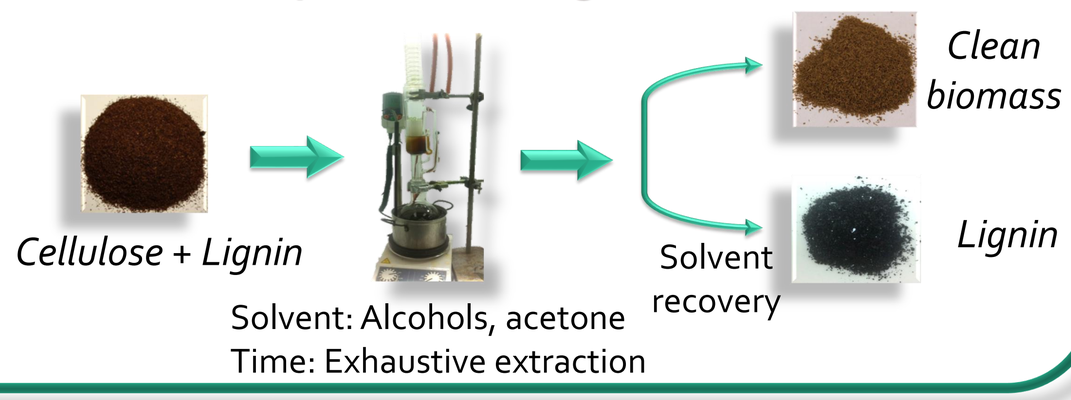
- Optimization of process conditions towards furanics production.
- Further valorization of furanics to polymers, fuel additives and platform chemicals production.

Process

Step 1: Hydrothermal Pretreatment

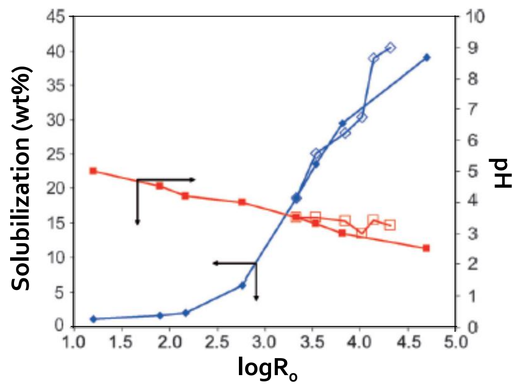


Step 2: "Green" lignin extraction



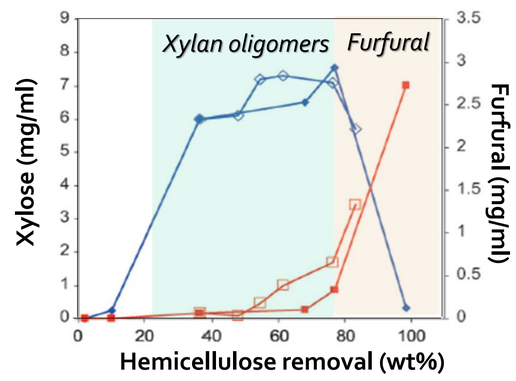
Production of furanics

Biomass solubilization



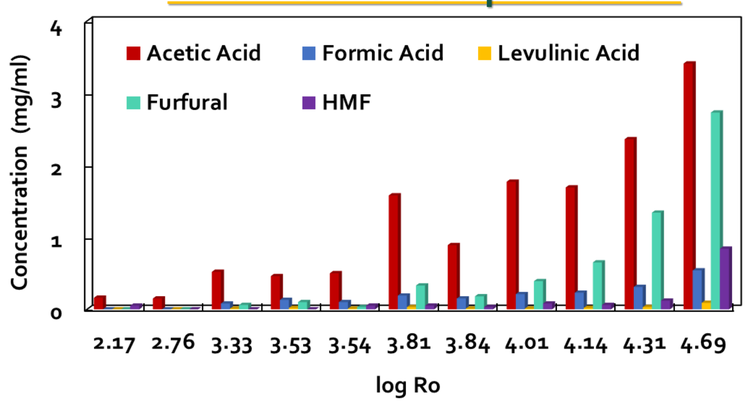
✓ *Increase of severity, increase the solubilization and decrease the pH due to CH_3COOH release.*

Hemicellulose removal



✓ *At low severities, hemicellulose is removed as xylose while at higher severities, as furfural.*

Furanics and acid production

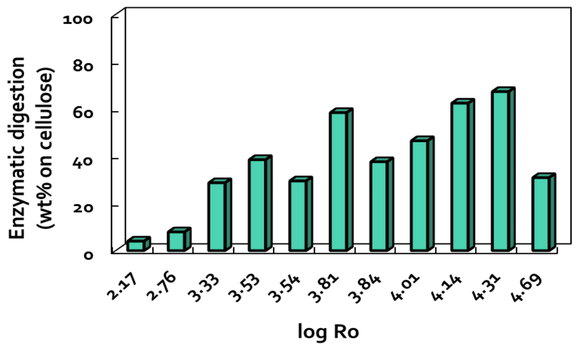


✓ *Increase of severity resulted in increase of furanics and acids production.*

Valorization of other streams

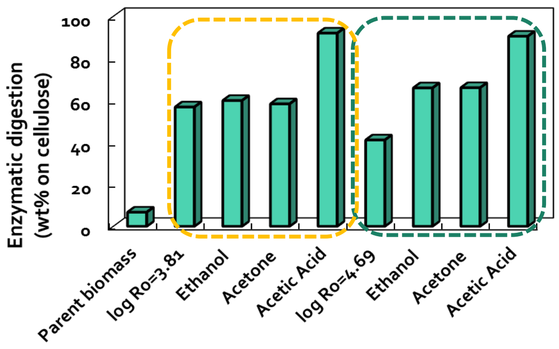
Enzymatic digestion of cellulose to glucose

Before lignin extraction



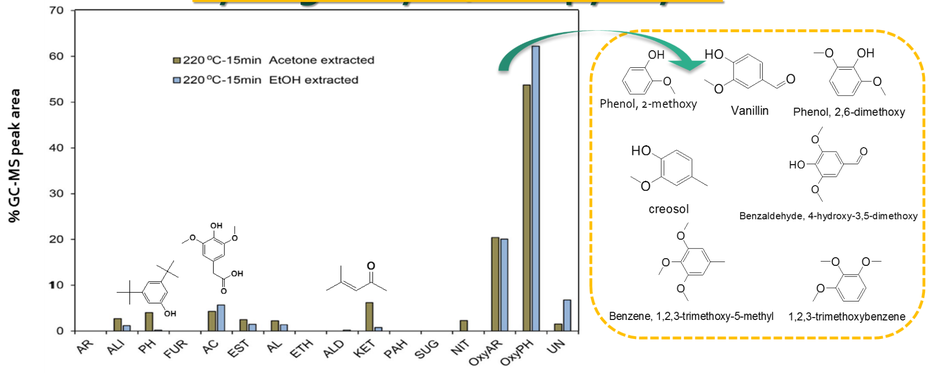
✓ *Increase of severity led to decrease in enzymatic digestion due to surface lignin formation.*

After lignin extraction with various solvents



✓ *Extraction of lignin significantly enhanced the enzymatic digestion.*

Potential lignin valorization via catalytic hydrogenolysis/ fast pyrolysis



✓ *Lignin can be converted to a "pool" of chemicals.*

Conclusions

- Hydrothermal pretreatment in neat H_2O can be successfully used towards the conversion of biomass sugars to furanic compounds.
- Hemicellulose stream rich in furanics and organic acids can be a primary feedstocks for a variety of processes.
- According to the proposed pretreatment methods, all the biomass components can be converted to value added chemicals.

References

[1] C.K. Nitsos, K.A. Matis, K.S. Triantafyllidis, *ChemSusChem*, **2013**, *6*, 110-122.

[2] C.K. Nitsos, T. Choli-Papadopoulou, K.A. Matis, K.S. Triantafyllidis, *ACS Sustainable Chem. Eng.*, **2016**, *4*, 4529−4544.

[3] C.K. Nitsos, P.A. Lazaridis, A. Mach-Aigner, K.A. Matis and K.S. Triantafyllidis, *ChemSusChem*, **2019**, *12*, 1179-1195

[4] A.A. Marianou, C.M. Michailof, A. Pineda, E.F. Iliopoulou, K.S. Triantafyllidis, A.A. Lappas, *App. Catal. A*, **2018**, *555*, 75-87