Biorefinery model based on co-production of Furfuryl Alcohol and Cellulosic Ethanol

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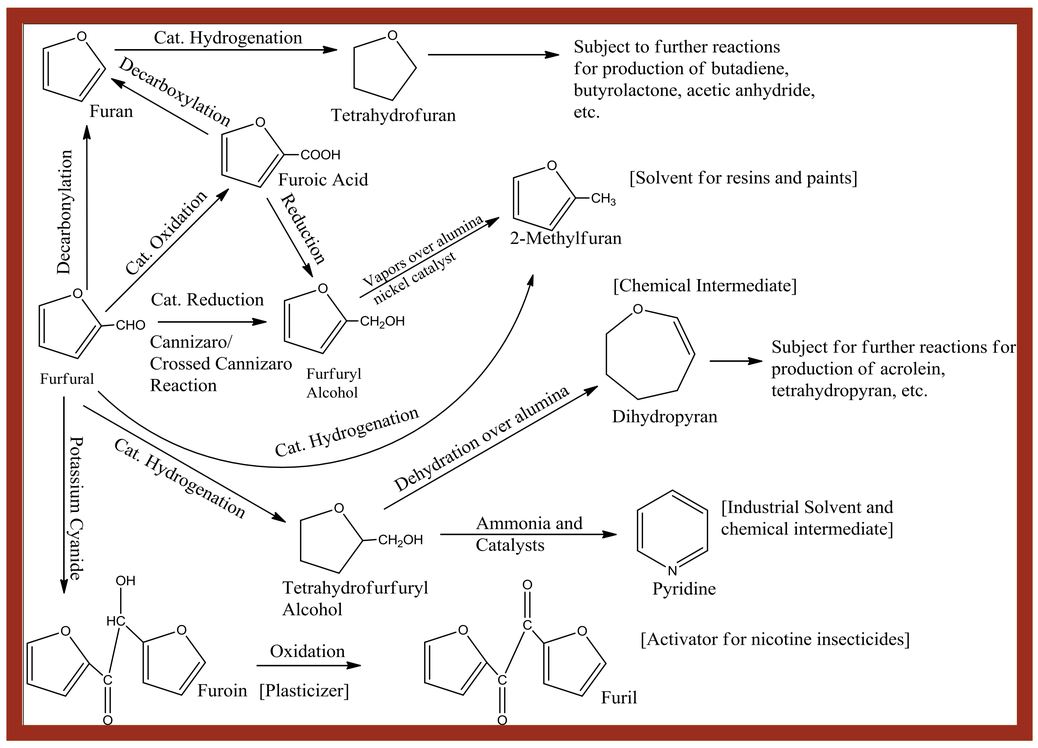
Background:

- Substitutes for fossil-origin materials
- Chemistry of furfural and byproducts- 100 year science
- Many applications: plastics, solvents, resins, etc.
- Over 60% furfural converted to furfuryl alcohol

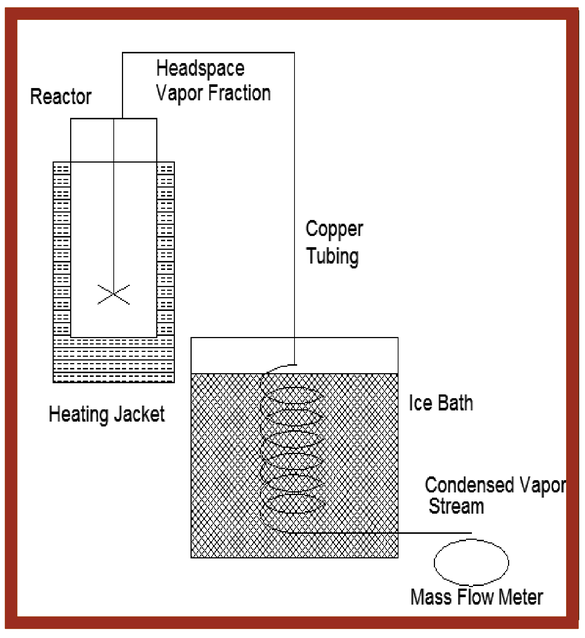


Objectives

- Biorefineries for fuels, chemicals and materials
- ***Improve furfural yield***
- ***Alternative methods to produce furfuryl alcohol***
- ***Construct integrated furfuryl alcohol biorefinery***
- Aqueous process and green chemistry
- Benign chemical and biological processes
- Reduce environmental impact

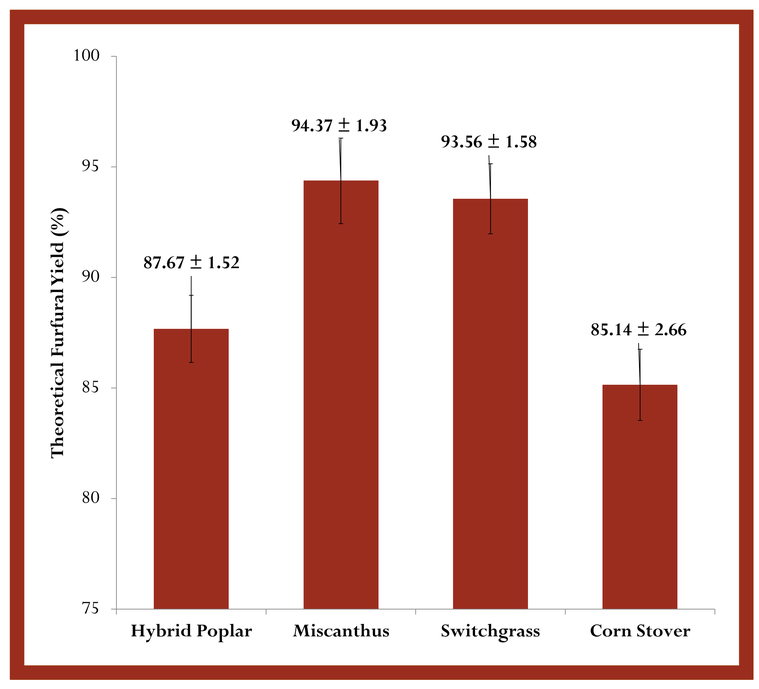
Introduction*:*

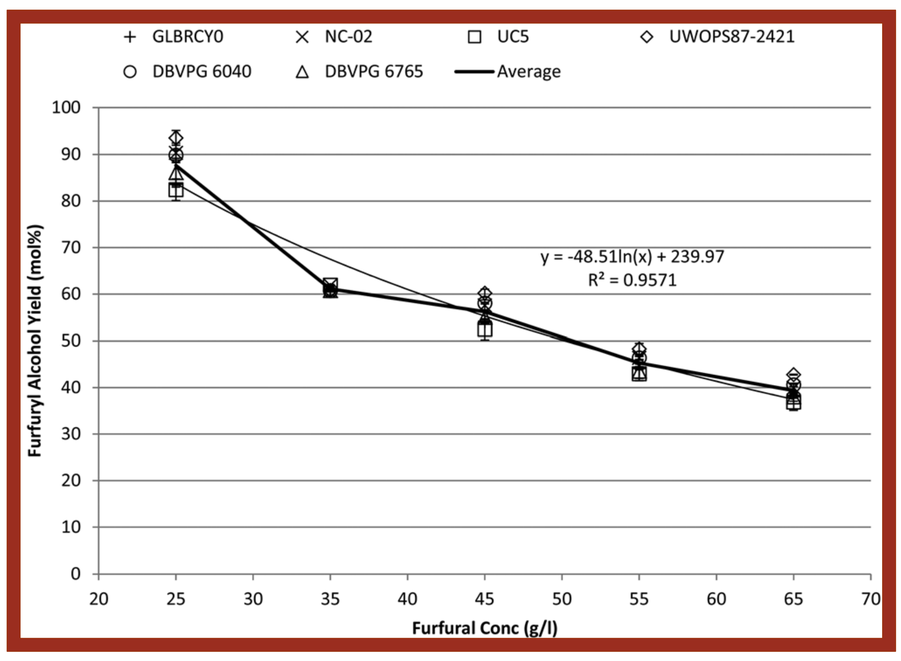
- Fractionation of pentosans to convert to furfural using BRD process
- Use of Baker's yeast to convert furfural (FF) into furfuryl alcohol (FA)
- Screening of *S. cerevisiae* strains for furfural toxicity
- Fermentation
- Avoids use of high pressure hydrogenation
- Constructed a hypothetical biorefinery model
- Dilute concentrations- economics

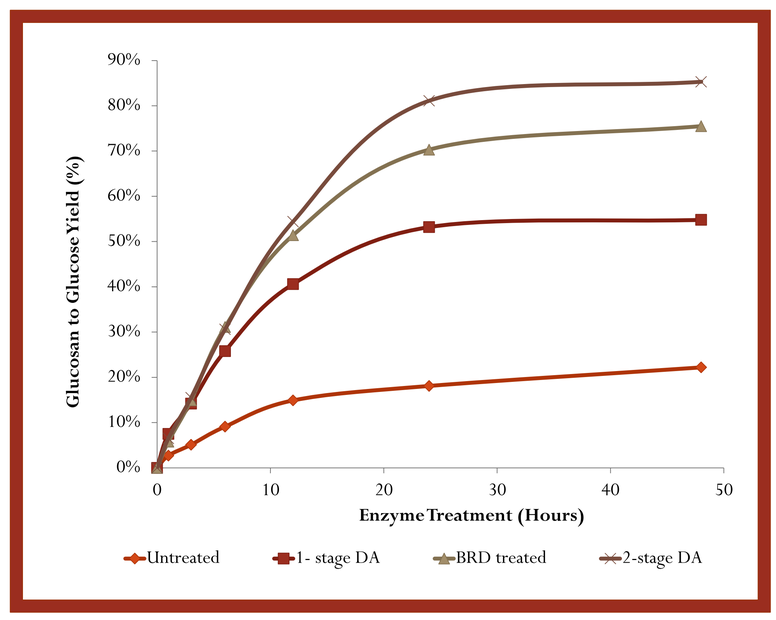


Batch Reactive Distillation (BRD):

- Produced furfural in high yield using hybrid poplar, switchgrass, miscanthus and corn stover
- Liquid hot water treatment to fractionate pentosans in high yield
- Yields between 85-95% (mol basis) compared to <50% industrial
- Prevented formation of humins and loss of furfural
- Solid fraction available for other applications
- Dilute concentrations!
  (Mandalika and Runge, Green Chem., 2012, 14, 3175)







Microbial Transformation:

- *S. cerevisiae* utilized to convert furfural into furfuryl alcohol
- 57 strains screened for furfural toxicity to select 6 that performed the best
- FFconversion achieved from 25 to 65 g/l
- FA yield of 93% achieved at 25 g/l
- Dilute concetrations!
  (Mandalika, et al., Green Chem, 2014, 16, 2480)

Research Questions:

- Increase concentration of FF and FA
- Investigate applicability of solid residues for cellulosic ethanol
- Evaluate feasibility of using spent viable yeast and tie loops
- Model and economize the furfural biorefinery