Second Generation Ethanol Production Using Subcritical Water Hydrolysis on Sugarcane Bagasse and Straw

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Background

- **Using high-temperature, high-pressure water to achieve subcritical conditions, lignocellulose may be hydrolyzed into simple sugars for use in fuel ethanol production. Enabling a green economy.**
- Ethanol is a fuel additive and used around the world, and may be considered a green fuel due to low carbon emissions during production and use.
- Brazil produces 20% of the world's sugar and 25% of the world's ethanol from sugarcane (610 MMT 2018).
- Bagasse and Straw from the sugarcane plant, which are mostly discarded, may now potentially contribute to the waste-to-energy economy.
- Current methods for 2nd generation ethanol production via fermentation require acid- or enzyme- catalyzed hydrolysis, both of which are taxing on the environment and expensive for global acceptance.

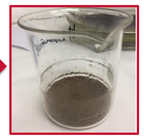
Methodology

Feedstock, Knifed

297 µm sifted

DH2O
20 mL/min
15 MPa
200 C

Reactor



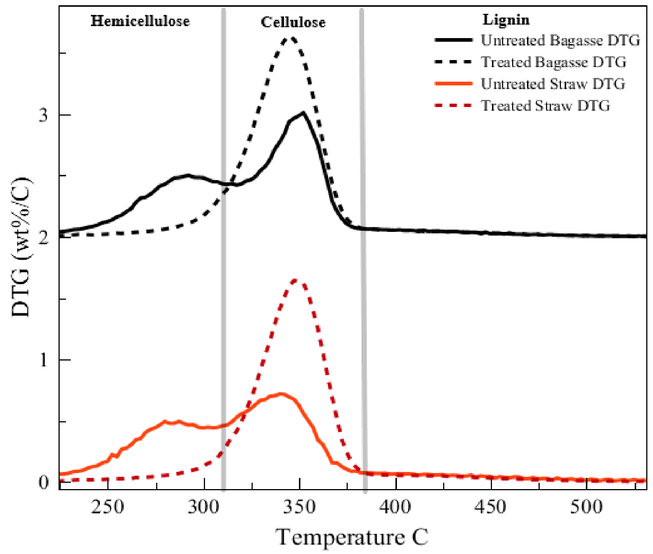
Char Residue

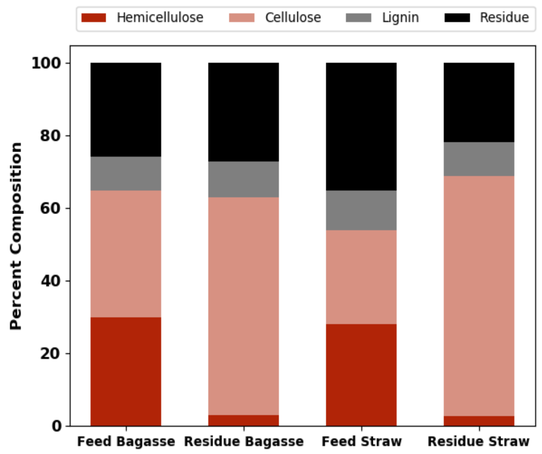
Hydrolyzate

Fermentation

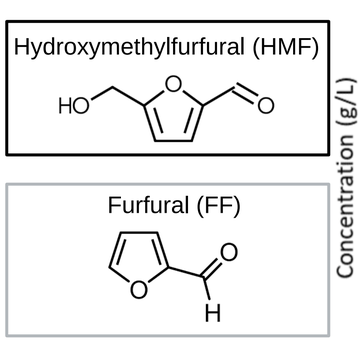
- Each feedstock was processed identically towards fermentation.
- Half of each hydrolyzate solution was enzymatically hydrolyzed for comparison, to break down complex sugars, and to aid in yeast growth.

Results & Discussion
Hydrolysis





Figures 1 & 2:
Thermogravimetric analysis (TGA) determined the compositions of the feed char residue. This is corroborated by FTIR analysis.



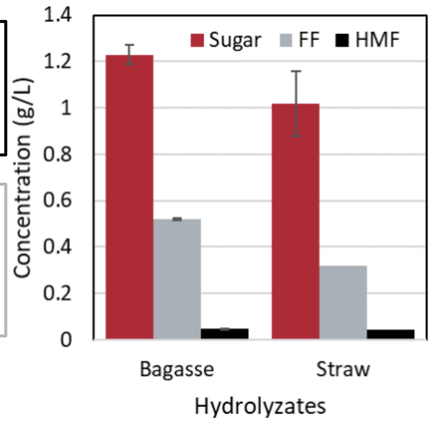


Figure 3:
UV-Vis spectroscopy and high-performance liquid chromatography (HPLC) determined sugar and inhibitor concentrations.

Results & Discussion
Fermentation

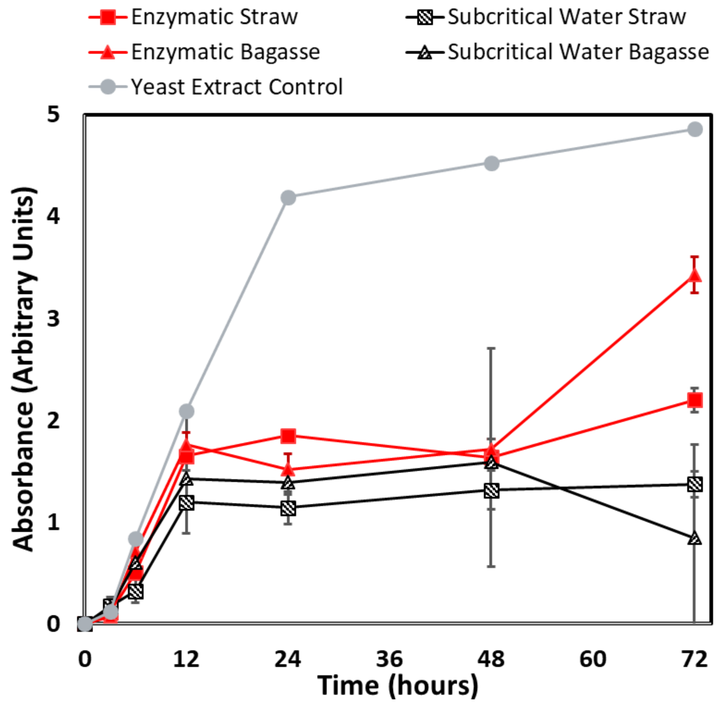


Figure 4:
- Hydrolyzate offered similar initial growth rates to Yeast Extract.
- Yeast extract was used as both inoculum and control.

Conclusion

Ethanol (Et.)
H_3C—OH

- Subcritical water hydrolyzes the majority of hemicellulose in bagasse and straw.
- The hydrolyzate solutions compare well against the Yeast Extract, and therefor this is a viable substitute for 2G hydrolysis.
- Yields could be improved by either using higher temperature and pressure water to degrade the cellulose, or use feedstock with greater hemicellulose concentrations.

Acknowledgements

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