A Co-production of Sugars, Lignosulphonate, Cellulose and Cellulose Nano-crystals from Ball-milled Wood

Lanxing Du\textsuperscript{a}, Jinwu Wang\textsuperscript{b}, Michael P. Wolcott\textsuperscript{b}

\textsuperscript{a} Beijing Forestry University, \textsuperscript{b} Washington State University

Introduction

Lignocellulose biomass can be converted to high-value products by separation and transformation of its three components. However, various reported methods usually use one of the components, getting rid of the others. They cannot utilize the all components (cellulose, hemicellulose and lignin) with low cost and high efficiency. Valorization of all components have become clearly important in developing cost-effective biorefineries. Ball milling acted as a potential pretreatment for the production of cellulosic sugars. It is deemed as a potential pretreatment for the production of cellulosic sugars. The saccharification residual solids from hydrolyzing the milled wood contains the most recalcitrant cellulose and high percentage of lignin. Harvesting these components for cellulose and value-added lignin products will bring additional revenues to help a sustainable biocconversion.

Objectives

- Demonstrate the feasibility of utilizing major components of ball milled wood and hydrolysis residual solids,
- Evaluate the effects of ball milling on 4 co-products: sugars, lignosulphonate, cellulose and cellulose nanocrystal, and the role in facilitating preparations of alpha cellulose and cellulose nanocrystals.

Materials and Method

- Wood chips
- Hammer milled wood
- Ball milled wood
- Holocellulose
- Cellulose
- Lignosulphonate
- Nanocrystal
- Enzymatic hydrolysis
- Hydrolysis residues
- Neutrot sulfite
- Deagglomeration
- Acid hydrolysis

Results

Sugar Yields and Lignosulphonate Content

![Fig. 1 Sugar yields, and lignosulphonate content of ball milled wood](image)

Morphology

![Fig. 2 Morphology of hammer milled wood, ball milled wood, hydrolysis residues, and cellulose nanocrystal](image)

Aspect Ratio

![Fig. 3 Cumulative aspect ratio distribution of the ball milled wood, hydrolysis residues and cellulose nanocrystal](image)

Conclusions

- Lignosulphonate, cellulose, and cellulose nanocrystal are successfully prepared by using ball milled wood and enzymatic hydrolysis residues.
- Sufficient ball mill not only improve the sugar yield, but also shortens the hydrolysis time for milled wood and enzymatic hydrolysis residues.
- BMWs present an intuitive view of particle size reduction with prolonging milling time. Ball milling decreases the aspect ratio of wood fibers, while the lignin, hemicellulose removal shapes the cellulose, increasing its aspect ratio gradually.
- Ball milling hardly affects the resulted lignosulphonate content. Enzymatic hydrolysis has a great contribution to fractionation of lignin.

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References: