Original Paper

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Statistical modelling and optimization of alkaline peroxide oxidation pretreatment process on rice husk cellulosic biomass to enhance enzymatic convertibility and fermentation to ethanol

Augustine Omoniyi Ayeni, Michael Olawale Daramola, Patrick T. Sekoai, Opeyemi Adeeyo, Musa Joel Garba & Ayotunde A. Awosusi

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Abstract

The complex and ordered arrangements of the lignocellulosic materials make them recalcitrant for their conversions to ethanol. Pretreatment is a crucial step in overcoming these hindrances. In this study, a 23-full factorial design of experiments optimization technique was applied on the alkaline peroxide oxidation pretreatments of rice husks biomass. The low–high levels of the influencing variables on pretreatments were; temperature (100–120 °C), time (1–2 h), % (v/v)H2O2 concentration (1–3%). Under the prevailing pretreatments, the optimum conditions were predicted and validated to be 109 °C, 2 h, and 1.38% H2O2 which yielded 56% (w/w) cellulose content, 55% (w/w) hemicellulose solubilization, and 48% (w/w) lignin removal. At the established optimum pretreatment conditions, and considering variations in biomass and enzymes loadings, maximum reducing sugars production was 205 mg/g dry biomass at different enzymatic hydrolysis conditions of 3% biomass loading, hydrolysis temperature of 45 °C, hydrolysis time of 24 h, and 35 FPU/g cellulose enzyme loading. The highest cellulose conversion of 33% yielded 24 g/L ethanol at the end of the first day of saccharification and fermentation. Physical, structural, and morphological investigations on raw and treated materials using tools such as stereomicroscopy, scanning electron microscopy, and fourier transform infrared spectroscopy further revealed the effectiveness of chosen method on rice husks biomass.

References

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