

Influence of high-pressure steam pretreatment on the structure of rice husk and enzymatic saccharification in a two-step system

ABSTRACT

This study aimed at developing an operational high-pressure steam pretreatment (HPSP) to effectively modify rice husk for enzymatic saccharification. The HPSP was performed at 160 to 200 °C under 0.3 to 2.8 MPa for 2 to 10 min. The efficiency of this method was based on the chemical composition, scanning electron microscopy (SEM), Fourier transform infrared (FTIR), and X-ray diffraction (XRD) analyses. Optimum pretreatment conditions (200 °C, 1.85 MPa for 7 min), enzyme concentration at 30 FPU/g and temperature at 60 °C for 48 h of continuous saccharification effectively produced sugar (21.1 g/L = 0.422 g/g dry substrate) at a saccharification degree of 53.87%. Conducting a second-step enzymatic saccharification resulted in additional sugar production (7.9 g/L = 0.158 g/g substrate) and a 20.44% saccharification degree. In contrast, the two-step saccharification process (48 and 24 h) achieved optimal sugar yield of 0.581 g/g substrate and saccharification degree of 73.5%. Additionally, the process improved the yield of monomeric sugars of glucose (0.465 g/g), xylose (0.010 g/g), and cellobiose (0.063 g/g). Therefore, the combination of the high-pressure steam pretreatment with thermostable cellulase from *Bacillus licheniformis* 2D55 in a two-step enzymatic saccharification process is an economically viable method in rice husk bioprocessing for sugar production.

Keyword: High-pressure steam pretreatment; Rice husk; Structural characterisation; *Bacillus licheniformis* 2D55 thermostable cellulase; Two-stage enzymatic saccharification