Improving Cellulose Nanofibrillation of Waste Wheat Straw Using the Combined Methods of Prewashing, *p*-Toluenesulfonic Acid Hydrolysis, Disk Grinding, and Endoglucanase Post-treatment

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Abstract

Here we established a new approach for improving the cellulose nanofibrillation of high ash content waste wheat straw (WWS). The results were comprehensively elucidated from the ash removal, delignification, mechanical fibrillation and endoglucanase post-treatment. When water dosage was increased from 50 to 500 times of the WWS weight, the ash content gradually decreased during prewashing process, which facilitated lignin solubilization in subsequent *p*-toluenesulfonic acid (*p*-TsOH) hydrolysis. Approximately 80% of lignin in prewashed WWS could be dissolved during acid hydrolysis to result in a relatively higher crystallinity of 59.1%. Compared with the lignocellulosic nanofibrils (LCNF) directly obtained using acid hydrolysis and disk grinding, prewashing-assisted acid hydrolyzed WWS was fibrillated into LCNF with smaller height of 57.0 nm. Mild endoglucanase post-treatment could further produce less entangled LCNF with thinner diameters. In short, this study presented a promising and green pathway to achieve an efficient utilization of agricultural residue wastes to cellulose nanomaterials.

Keywords: Waste wheat straw; Prewashing; *p*-Toluenesulfonic acid hydrolysis; Delignification; Endoglucanase post-treatment; Cellulose nanofibrillation

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