

Supporting Information

An efficient method for cellulose nanofibrils length shearing via environmentally friendly mixed cellulase pretreatment

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Supplementary Figure Legends:



Figure S1: The morphology of original eucalyptus pulp fibers. The fiber dimensions were $\geq 10 \mu\text{m}$ in diameter and $\geq 200 \mu\text{m}$ in length.

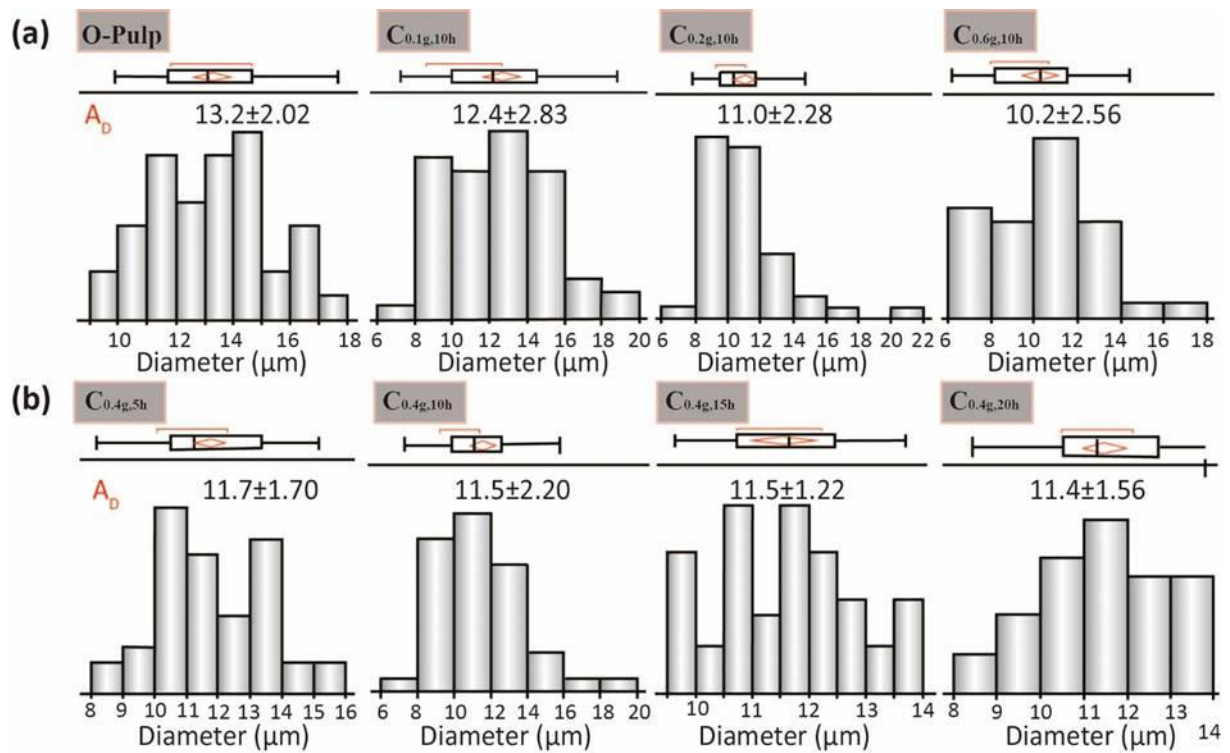


Figure S2: A large amount of data statistics further showed the average diameter of original pulp fiber and enzymatic hydrolysis cellulose fiber with the condition as the same as Fig. 2a. The average diameter had an obvious decreasing after using enzyme hydrolysis, which illustrated the cellulase hydrolysis process via layer-up-layer.

| Wavelength (cm ⁻¹) | 3400 | 2900 | 1641 | 1433 | 1370 | 1165 | 1113 | 1059 | 898 |
|-----------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| O-pulp | 1.600 | 0.624 | 0.186 | 0.616 | 0.705 | 1.291 | 1.593 | 2.000 | 0.288 |
| C _{0.1g, 10h} | 1.530 | 0.518 | 0.173 | 0.470 | 0.571 | 0.991 | 1.304 | 1.607 | 0.206 |
| C _{0.2g, 10h} | 1.834 | 0.564 | 0.205 | 0.514 | 0.627 | 1.139 | 1.505 | 1.914 | 0.217 |
| C _{0.6g, 10h} | 2.023 | 0.588 | 0.232 | 0.527 | 0.641 | 1.221 | 1.501 | 1.911 | 0.224 |
| C _{0.4g, 5h} | 1.712 | 0.572 | 0.204 | 0.514 | 0.628 | 1.118 | 1.491 | 1.894 | 0.222 |
| C _{0.4g, 10h} | 1.638 | 0.471 | 0.167 | 0.419 | 0.509 | 0.896 | 1.198 | 1.633 | 0.179 |
| C _{0.4g, 15h} | 1.524 | 0.495 | 0.169 | 0.447 | 0.546 | 0.954 | 1.243 | 1.481 | 0.195 |
| C _{0.4g, 20h} | 1.548 | 0.451 | 0.156 | 0.401 | 0.491 | 0.875 | 1.180 | 1.535 | 0.178 |
| Standard Deviation | 0.063 | 0.061 | 0.025 | 0.069 | 0.073 | 0.154 | 0.164 | 0.194 | 0.035 |

Table 1: All absorbance peak intensities of characteristic peaks and standard deviation were counted. Based on the standard deviation, the absorbance peak at 1641 cm⁻¹ was the least one and chose as the relative peak.

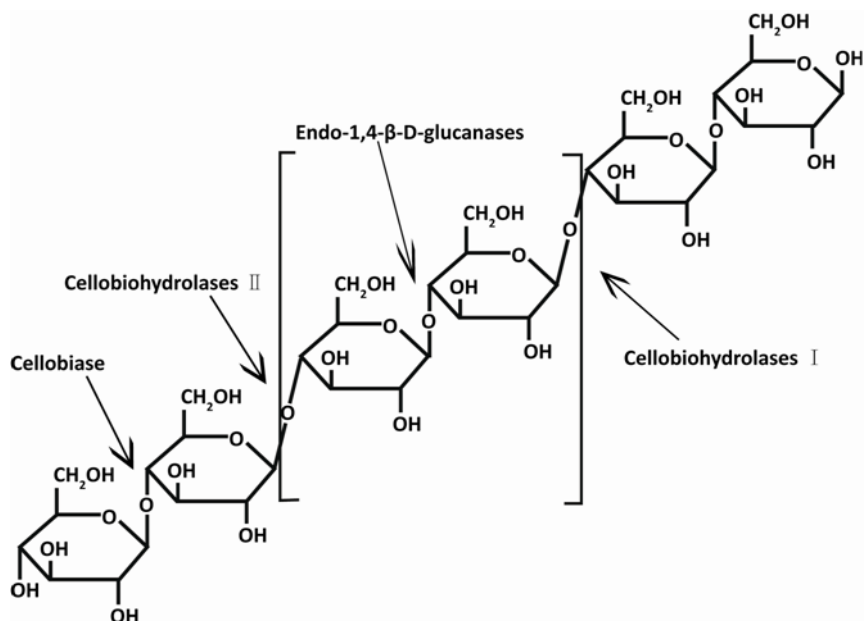


Figure S3: The reaction sites of molecular formula of cellulose. The endo-1,4-β-D-glucanases (EG), cellobiohydrolases I (CBH I), cellobiohydrolases II (CBH II) and cellobiase (CB) were respectively acted on different sites of cellulose molecular chain.