Supplementary Materials

Sustainable biorefinery for cascade fractionation of moso bamboo into furfural, glucan oligomers and less-condensed lignin

1. Toluene-ethanol extraction

a. Sample preparation: Weigh a known amount of dried sample and place it in the extraction bag. Insert the bag into the Soxhlet extractor, ensuring uniform distribution of the sample and preventing any leakage during extraction.

b. Extraction solvent preparation: Prepare a toluene-ethanol mixture with a 2:1 volume ratio and perform distillation to remove impurities, ensuring the solvent achieves analytical-grade purity.

c. Assembly of the extraction apparatus: Connect the round-bottom flask to the Soxhlet extractor, add 150 mL of the prepared toluene-ethanol solvent mixture to the round-bottom flask, attach the condenser, and ensure that the apparatus is securely sealed to prevent solvent evaporation during the extraction process.

d. Reflux extraction: Heat the round-bottom flask in a water bath maintained at 90±2 °C to initiate reflux extraction, with the extraction cycle frequency controlled at 6–8 cycles per hour over a total duration of 6 hours.

e. Post-extraction processing: Following extraction, the extraction bag was removed, and the residue was transferred onto a glass plate, then dried in a vacuum oven at 60 °C for 4 h to eliminate residual solvent.

f. Recovery and reuse: Collect the mixed solvent in the round-bottom flask and transfer it to a rotary evaporator. Ethanol and toluene are separately recovered by adjusting the vacuum levels and water bath temperatures accordingly. The recovered ethanol and toluene can be directly reused in subsequent biomass extraction processes.

This recovery process not only reduces solvent consumption and minimizes environmental pollution, but also simplifies operations through low energy input, thereby aligning with the principles of green and sustainable biorefineries.

2. Impact of pre-extraction conditions on the separation efficiency of hemicellulose

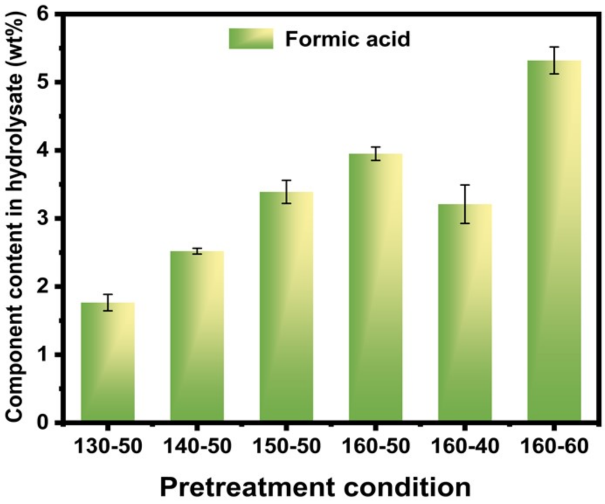

Fig. S1 The content of formic acid in the hydrolysate during p-TsOH pretreatment.

3. Preparation of furfural from biphasic system

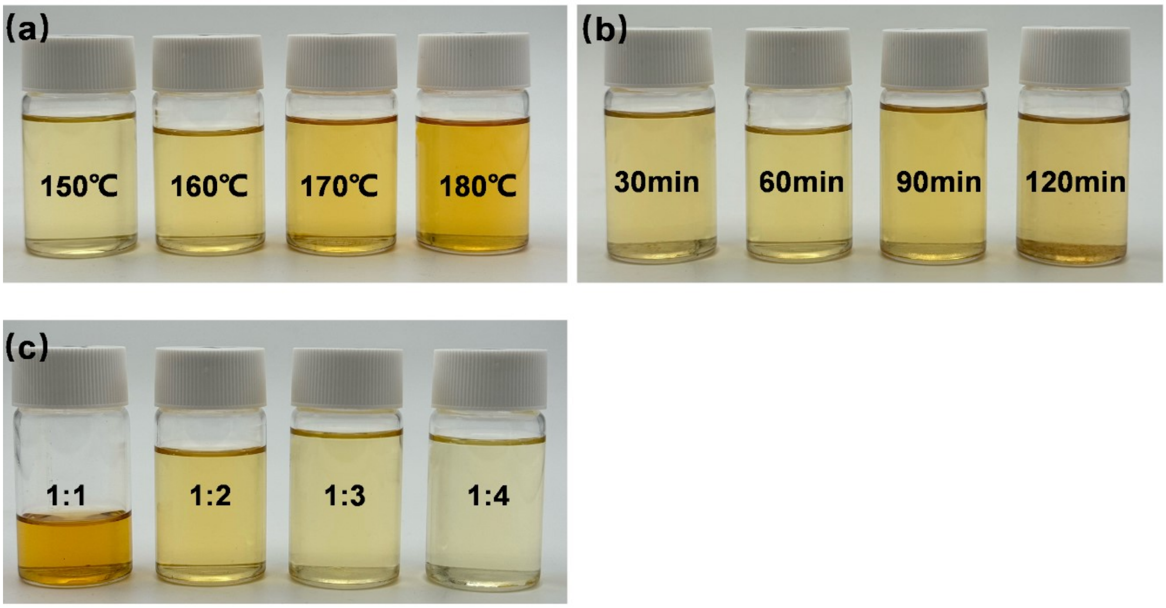

Fig. S2 The color and state of the organic phase under different reaction conditions (temperature, time and MIBK/filtrate ratios)

Table. S1 2D HSQC NMR data for the signal assignments in moso bamboo lignin samples in DMSO-d6

Label	δC/δH (ppm)	Assignments
A_α	71.8/4.86	C_α–H_α in β–O–4 unit (A) (Erythro)
OMe	56.63/3.72	C-H in Methoxy
A_β(S)	85.8/4.12	C_β–H_β in β–O–4 linked to S (A)
A_β(G)	83.4/4.38	C_β–H_β in β–O–4 linked to G (A)
A_γ	59.9/3.35-3.80	C_γ–H_γ in β–O–4 substructures (A)
A'_γ	63.0/4.36	C_γ–H_γ in γ-acylated β–O–4 (A′)
BD_α	76.0/4.81	Cα-Hα in benzodioxane substructures
HK_α	44.5/3.67	Cα-Hα in Hibbert ketone
HK_γ	67.1/4.19	Cγ-Hγ in Hibbert ketone
B_α	84.8/4.66	C_α–H_α in β-β resinol (B)
B_β	53.5/3.07	C_β–H_β in β-β (resinol) (B)
$S_{2,6}$	103.9/6.70	$C_{2,6}$–$H_{2,6}$ in syringyl units (S)
$S'_{2,6}$	106.3/7.32	$C_{2,6}$–$H_{2,6}$ in oxidized S units (S′)
G_2	110.8/6.97	C_2–H_2 in guaiacyl units (G)
G_5	114.5/6.70	C_5–H_5 in guaiacyl units (G)
G_6	119.0/6.78	C_6–H_6 in guaiacyl units (G)
$PCE_{2,6}$	130.2/7.48	$C_{2,6}$–$H_{2,6}$ in p-coumarate (p-CE)
PCE_7	144.8/7.51	C_7–H_7 in p-coumarate (p-CE)
PCE_8	113.7/6.24	C_8–H_8 in p-coumarate (p-CE)