Electronic Supplementary Information

For

Heterogeneous Catalytic Conversion of Solid Anaerobic Digestate Waste to Biofuels and Value-added Chemicals

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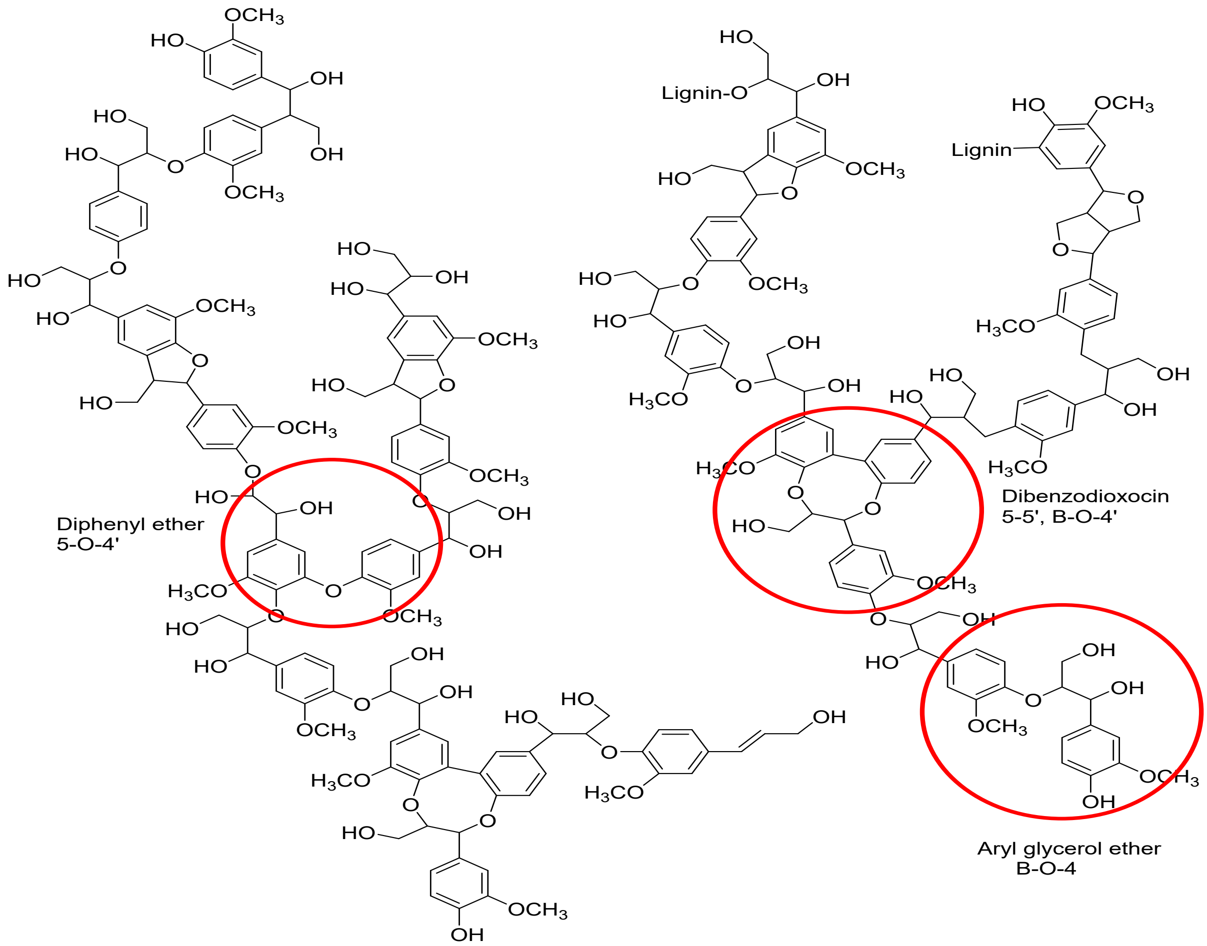


Fig. S1. Common chemical structure of lignin (adopted and drawn based on Wang [1]

Fig. S2. Biochar yield (%) using Rh/C

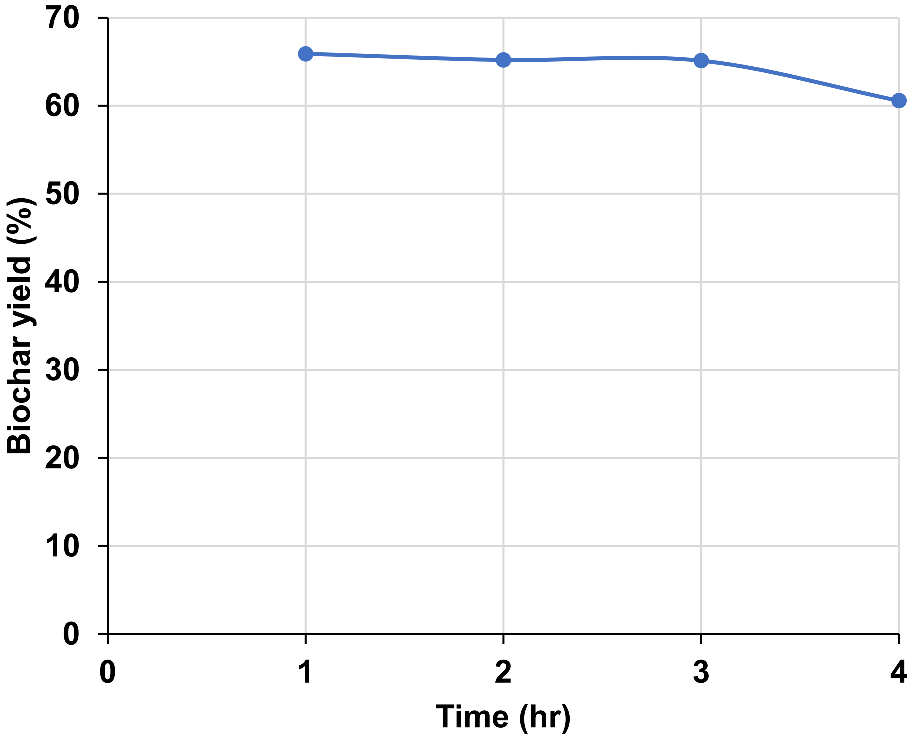


Fig. S3. Biochar yield (%) using Pd/C

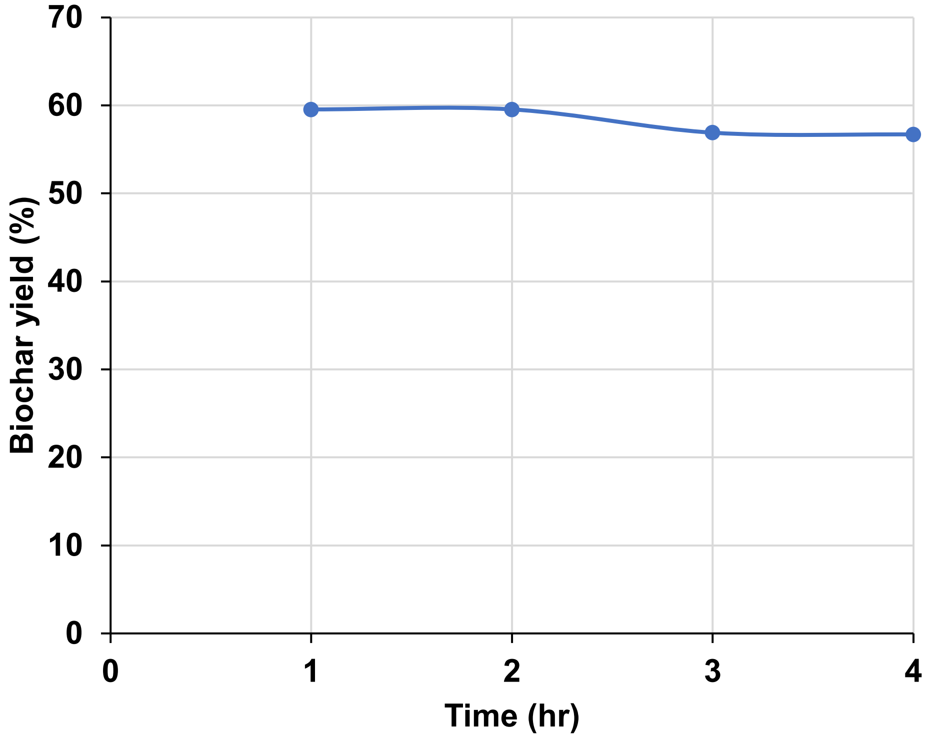


Fig. S4. Biochar yield (%) using Ru/C

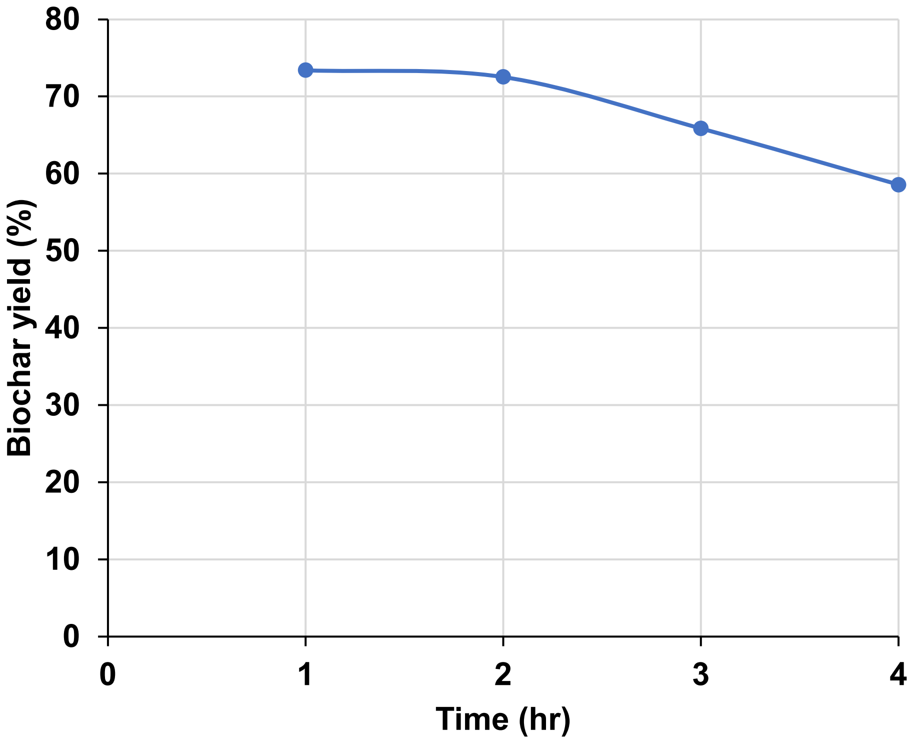


Fig. S5. Biochar yield (%) using Ni/ZrO_2

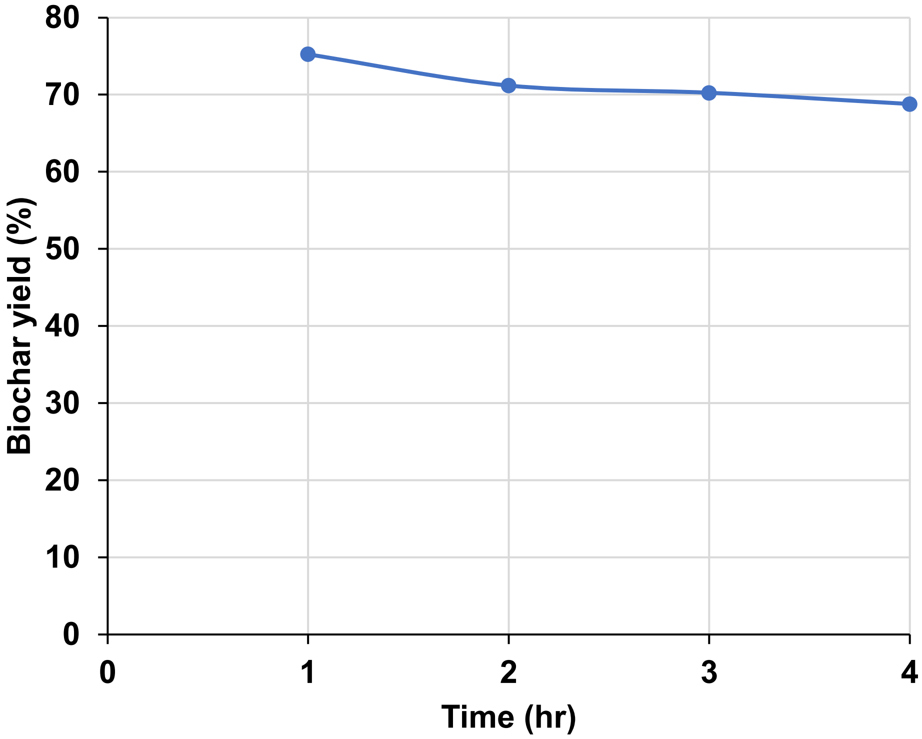


Fig. S6. Biochar yield (%) using Cu/Al_2O_3

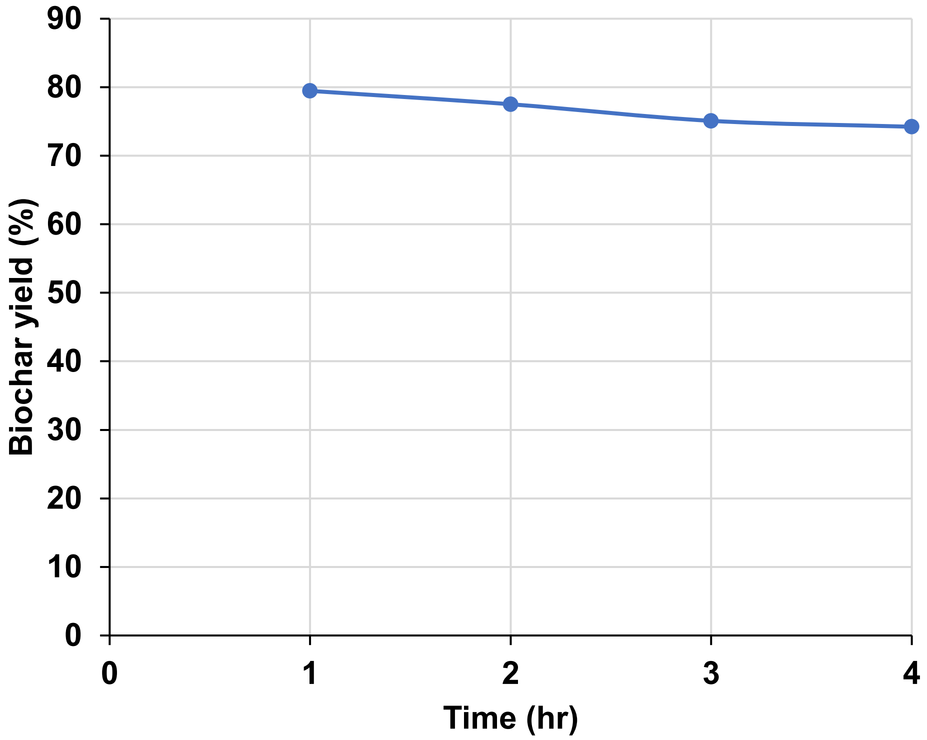


Fig. S7. GC-MS spectrum of Me-THF extracted ethylguaiacol from SD hydrogenolysis using Rh/C catalyst

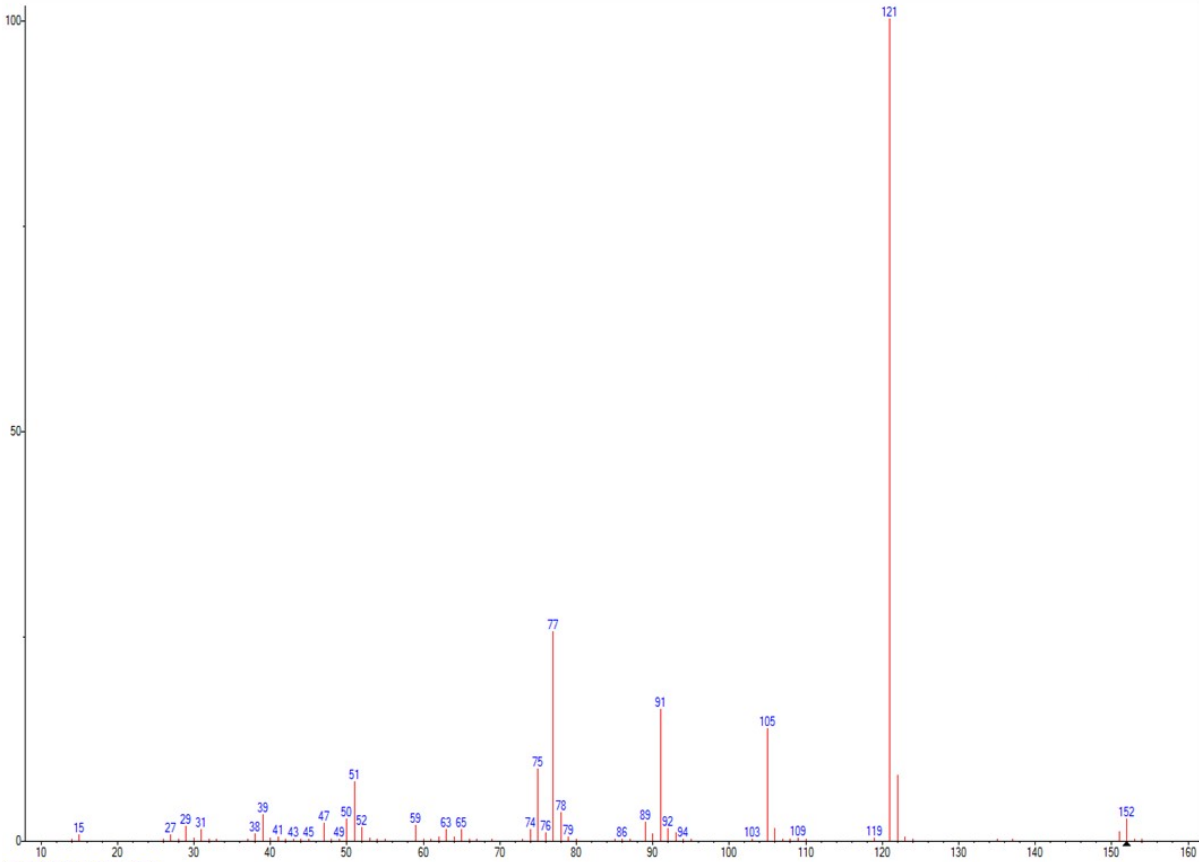
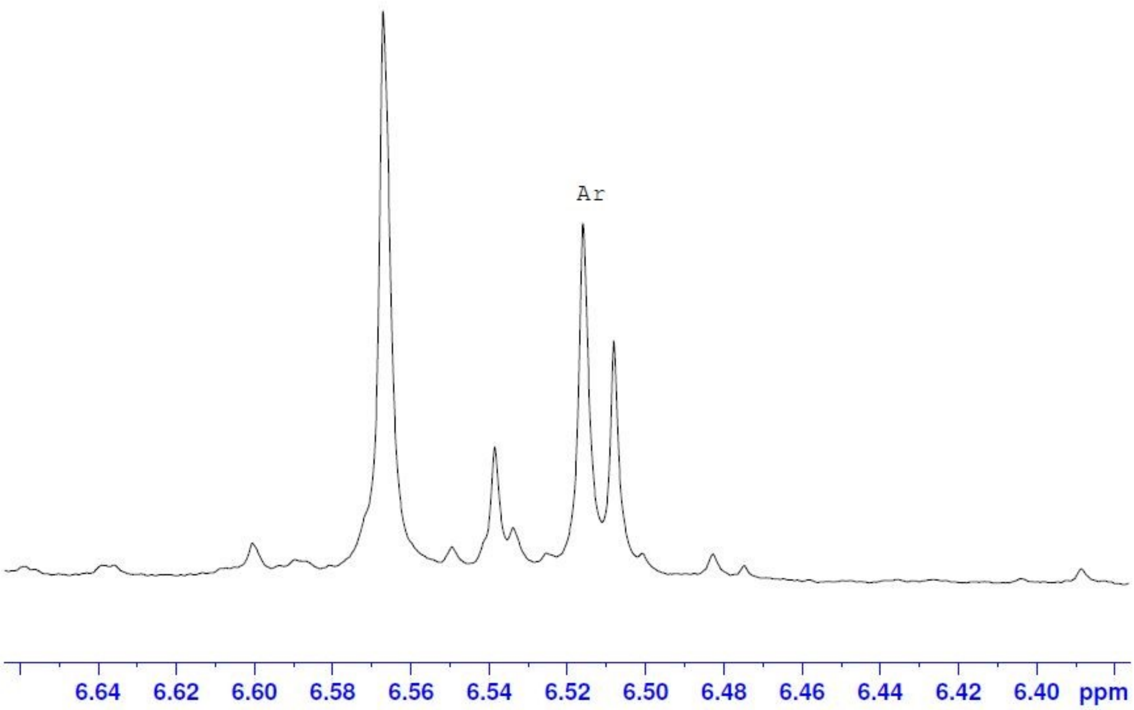


Fig. S8. Expanded section of ^{1}H NMR spectrum of aromatic hydrogen on the guaiacyl substituent in hydrogenolysis products



Determination of aromatic yields

In the region between 6.8 ppm and 7.2 ppm the aromatic hydrogens on the ethylguaiacyl substituent are evident. The area of 6.9 – 7.1 was integrated and taken to represent 3 CH groups on the ethylguaiacyl substituent of the aromatic products. The integration was used to calculate an arbitrary value representing the weight percentage of the aromatic yields. Hence, an arbitrary molecular weight was also chosen to be 180. Equation S1 was used for this calculation.

$$\text{Weight\%} = \frac{\left(\dfrac{\frac{int}{3} \times n_v \times 180}{M_s}\right) \times M_0}{M_b} \times 100$$

where: int. = integration 3 x aromatic hydrogens; n_v = moles of vanillin in sample; 180 = molecular mass average; M_s = mass of sample submitted; M_o = mass of oil (as crude yield); M_b = mass of biomass substrate used.

Error Analysis for bio-oil yield

Errors based on bio-oil yield were calculated using the method reported by [2] as shown by the equation below:

$$\text{Error} = \Delta X_{avg} \pm \frac{Range}{2\sqrt{number\ of\ samples}}$$

ΔX_{avg} = average of the yields, Range = highest yield – the lowest yield, number of samples = number of repeated experimental run

Table S1: Standard Deviations of bio-oil yield for each catalyst

Catalyst	Standard Deviation
Ni/ZrO_2	0.021213
Rh/C	0.049497
Cu/Al_2O_3	0.615183
Pd/C	0.021213
Ru/C	0.084853

Table S2: Separation efficiency for solid and liquid fraction for decanter centrifuge.

Separation efficiency (%)	Solid fraction	Liquid fraction
Mass	12.6	87.4
Total solids (dry matter)	50.9	49.1
Nitrogen	24.6	75.4
Phosphorus	63.9	36.1

References

[1] H. Wang, M. Tucker, Y. Ji, Recent development in chemical depolymerization of lignin: a review, Journal of Applied Chemistry 2013 (2013)

[2] Christopher S. McCallum, Stephen C. Bennett, W. Graham Forsythe, Mark D. Garrett, Christopher Hardacre, Kevin Morgan, Gary N. Sheldrake, Catalytic depolymerisation of suberin rich biomass with precious metal catalysts, RSC Communication, 2018.DOI: 10.1039/c8gc00605a