

Supporting information for:

Effect of micro- and nano-lignin on thermal, mechanical and antioxidant properties of biobased PLA/lignin composite films

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Characterization of Lignin/ Nanolignin

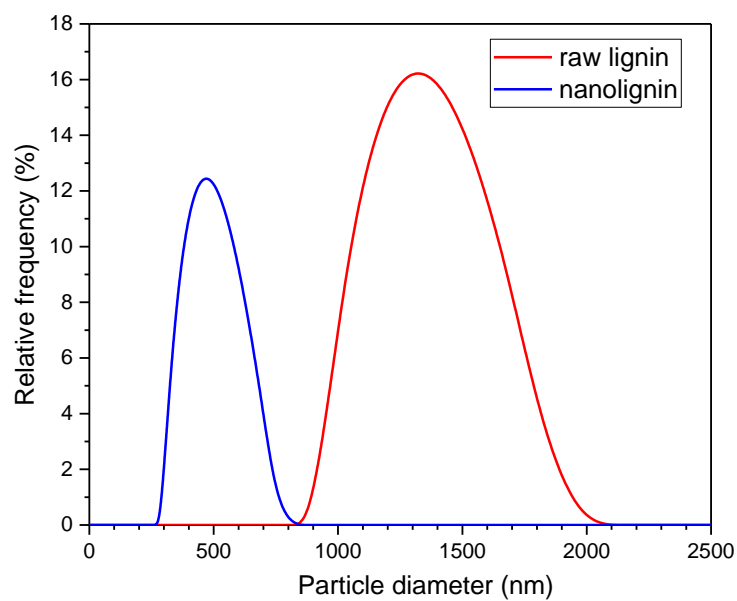


Figure S1. Particle size distribution curve of raw soda lignin and nanolignin corresponding to hydrodynamic diameter of 2.38 μm (polydispersity index, PDI = 0.29) and 524 nm (PDI = 0.161), respectively.

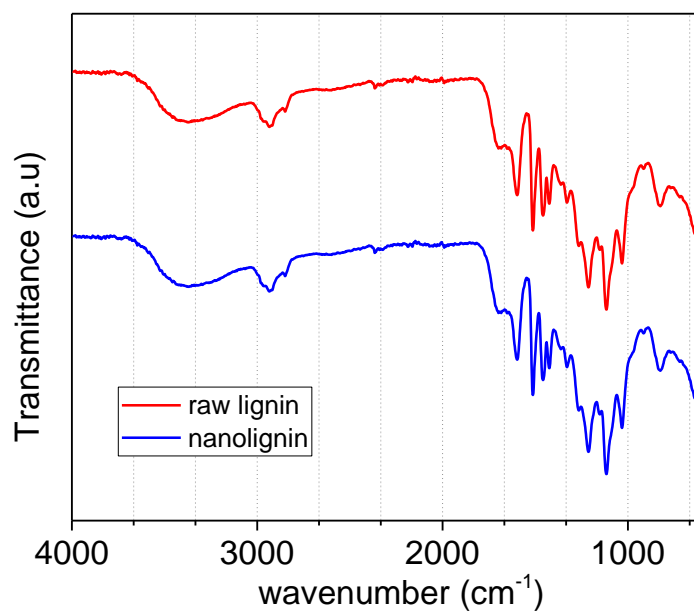
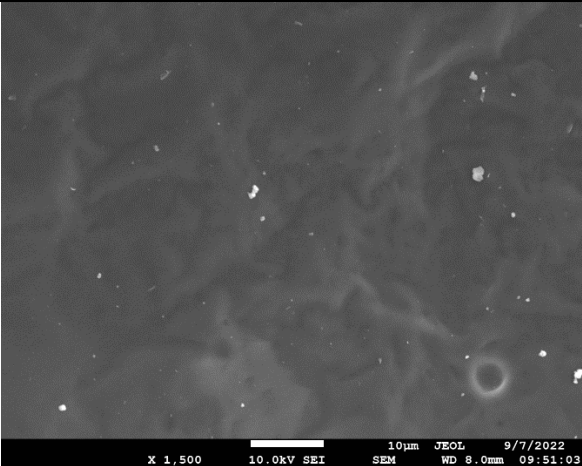
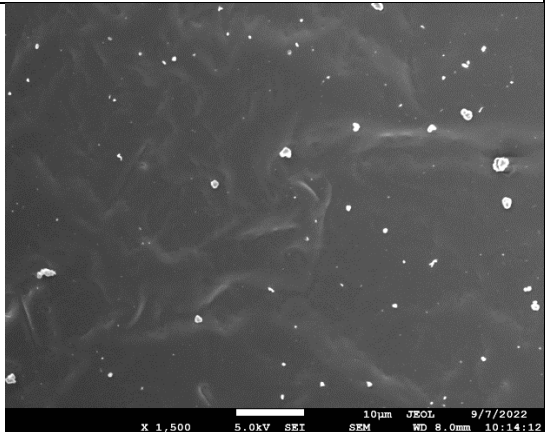
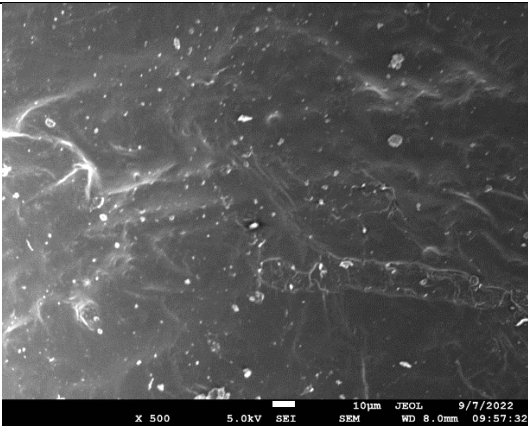
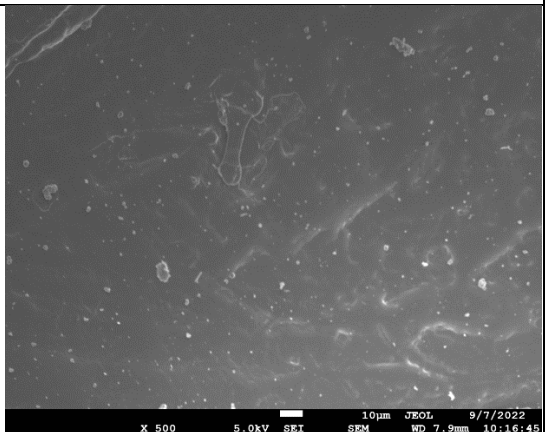
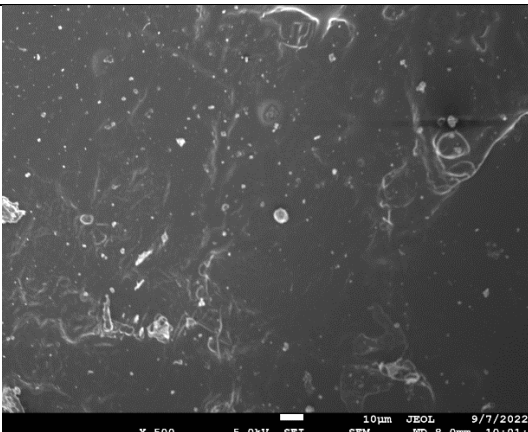


Figure S2. FTIR spectra of soda lignin and nanolignin.

Scanning Electron Microscopy (SEM)

PLA neat	
 <p>X 1,500 10.0kV SEI SEM 10µm JEOL 9/7/2022 WD 8.0mm 09:51:03</p>	
PLA-0.5%wt L	PLA-0.5%wt NL
 <p>X 1,500 5.0kV SEI SEM 10µm JEOL 9/7/2022 WD 8.0mm 10:14:12</p>	 <p>X 500 5.0kV SEI SEM 10µm JEOL 9/7/2022 WD 8.0mm 09:57:32</p>
PLA-1.0%wt L	PLA-1.0%wt NL
 <p>X 500 5.0kV SEI SEM 10µm JEOL 9/7/2022 WD 7.9mm 10:16:45</p>	 <p>X 500 5.0kV SEI SEM 10µm JEOL 9/7/2022 WD 8.0mm 10:01:46</p>
PLA-2.5%wt L	PLA-2.5%wt NL

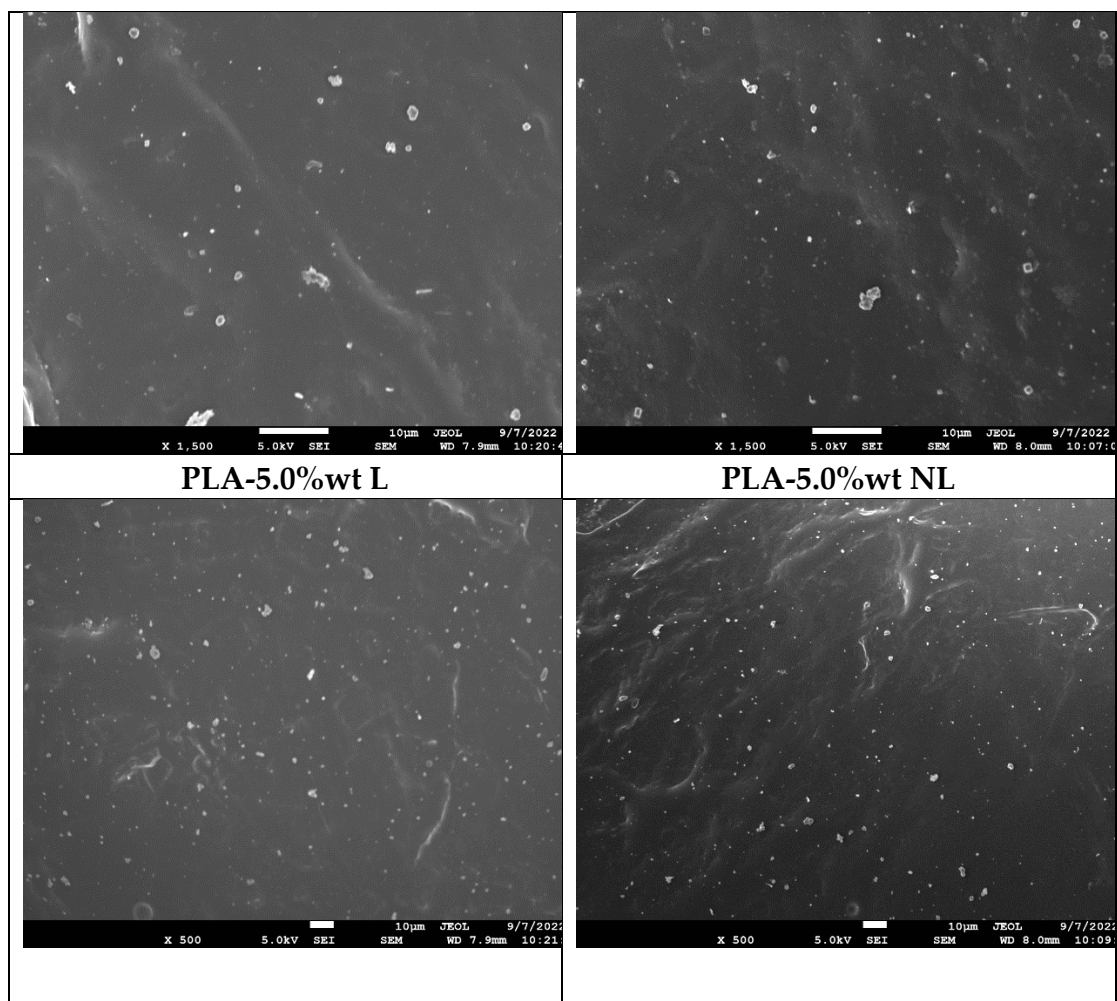


Figure S3. SEM images of PLA-L/ NL composites containing different L/NL content.

Mechanical properties

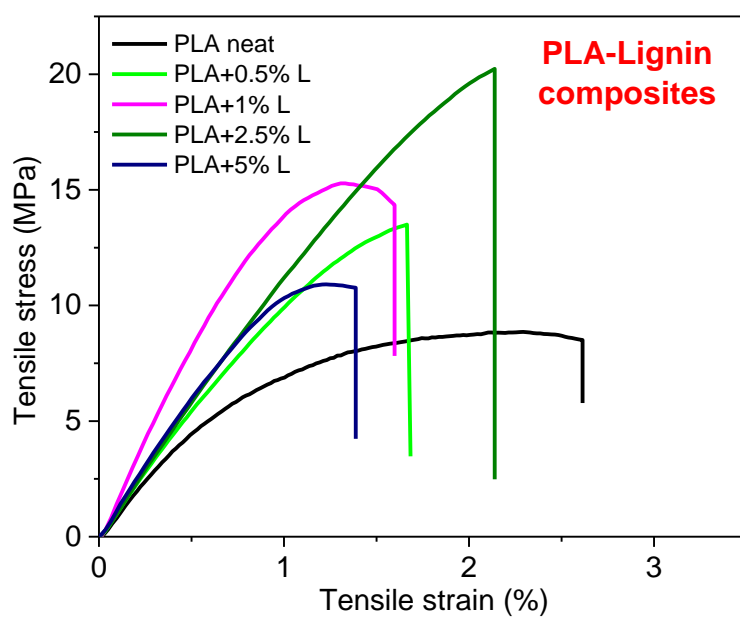


Figure S4. Tensile stress-strain curves of PLA-L composites.

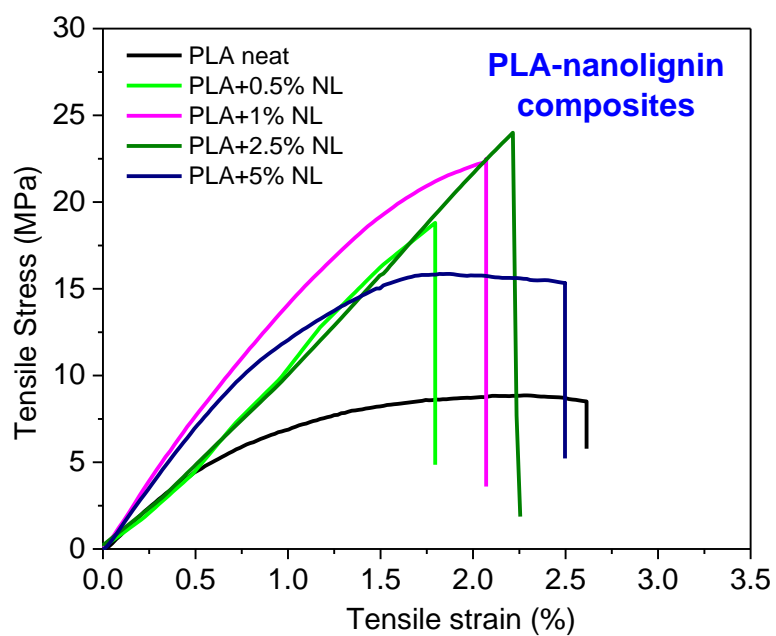


Figure S5. Tensile stress-strain curves of PLA-NL composites.

Antioxidant activity of composites

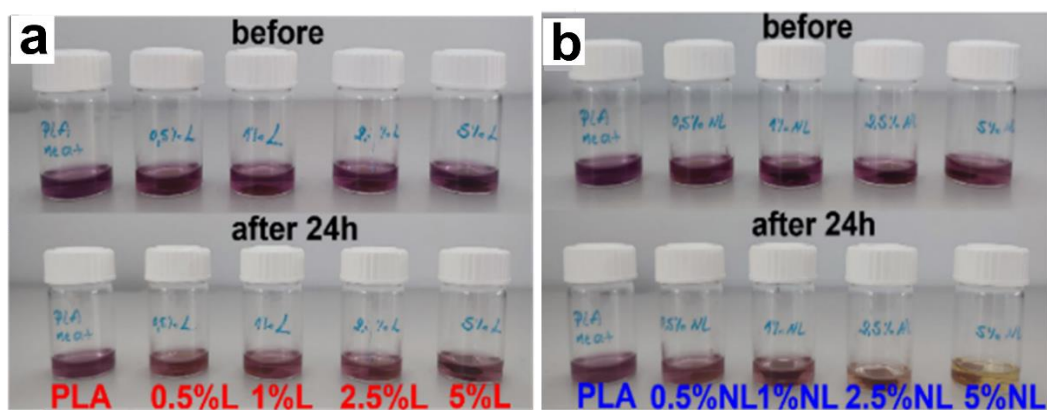


Figure S6. Qualitative antioxidant capacity of composites- Photographs of the DPPH / ethanol solution for different PLA-Lignin (a) and PLA-Nanolignin (b) composites after 24 h exposure to PLA-L/NL films.