

Figure S1. Photographs of the control materials C, X, and L, respectively. As observed, L does not form a free-standing film.

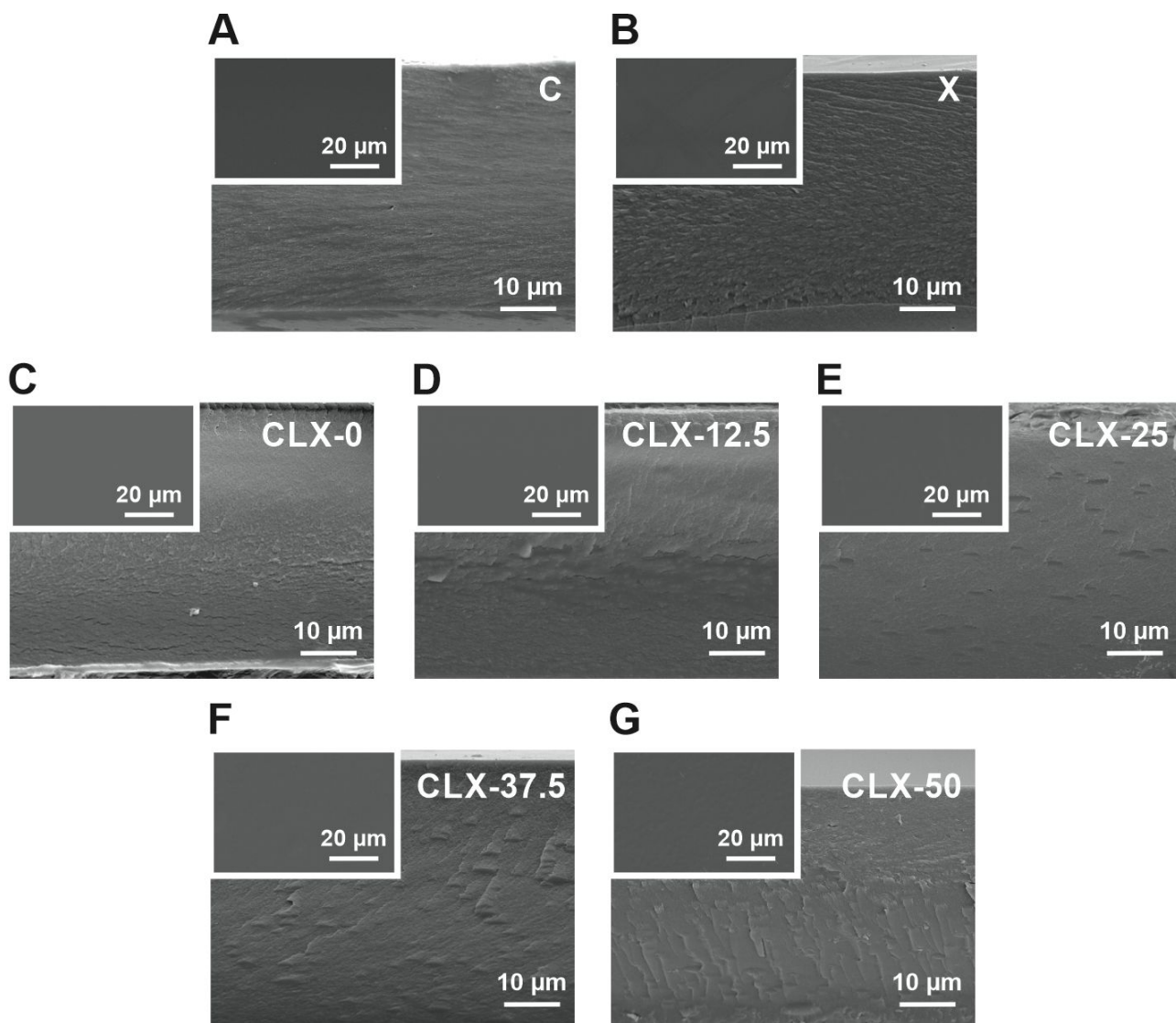


Figure S2. Cross-section SEM images of control samples C and X (**A**, **B**) and of lignin-based bioplastics (**C**, **D**, **E**, **F**, **G**), respectively (scale bar = 10 μm). Insets: corresponding top-views (scale bar = 20 μm).

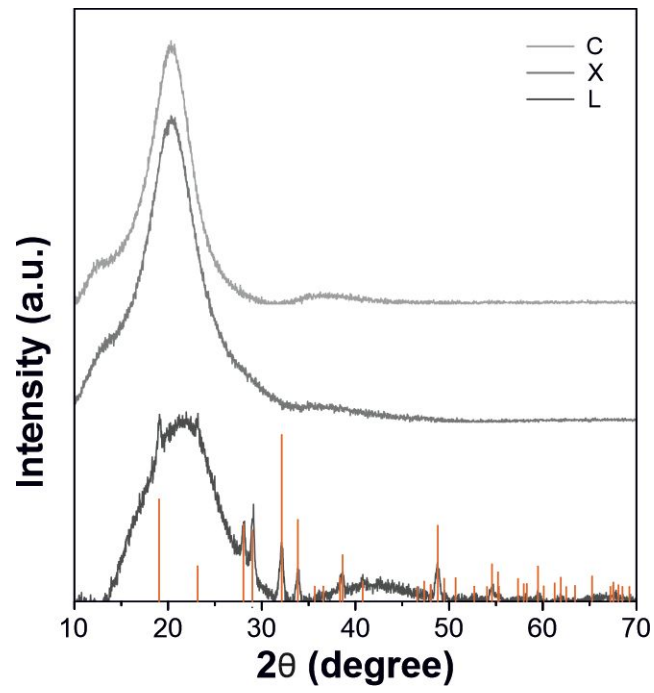


Figure S3. XRD patterns of C, X and L with the expected peak position reference for Na₂SO₄ (orange, ICSD 98-000-2895).

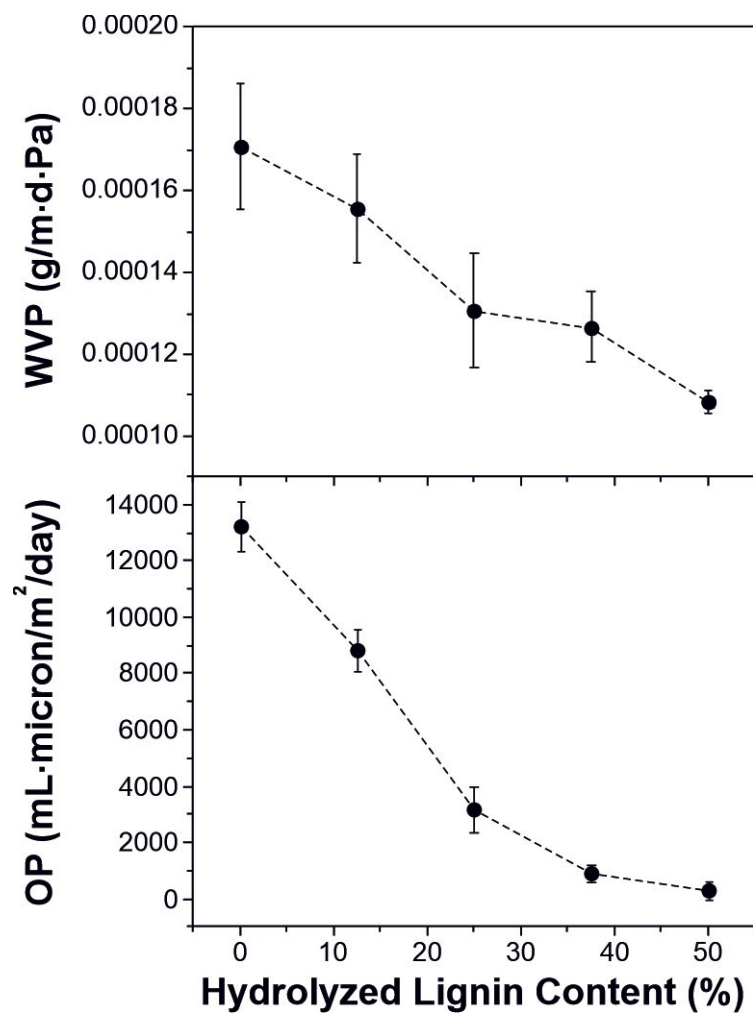


Figure S4. Water Vapor Permeability (WVP) and Oxygen Permeability (OP) of all the bioplastics samples.

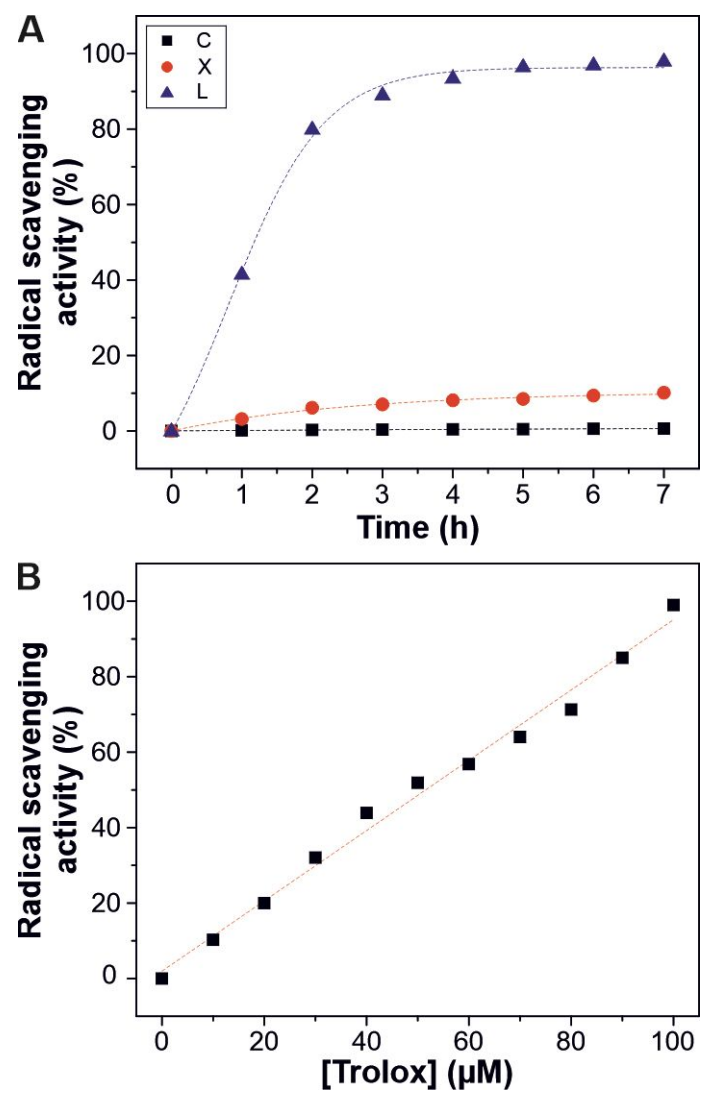


Figure S5. (A) antioxidant capacity of C, X and L with the time. (B) radical scavenging activity values after 7 hours for Trolox.

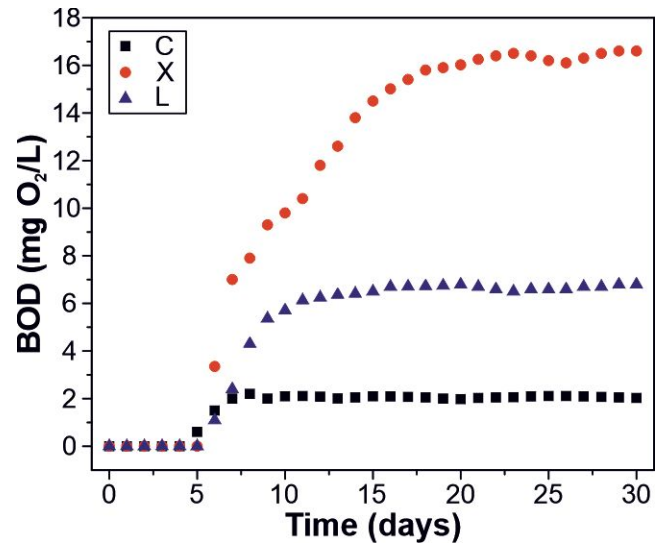


Figure S6. BOD data of C, X, and L.