

Área: FIS

Relationship between composition and physicochemical properties of blends of functionalized poly(lactic acid), poly(vinyl alcohol) and chondroitin sulfate

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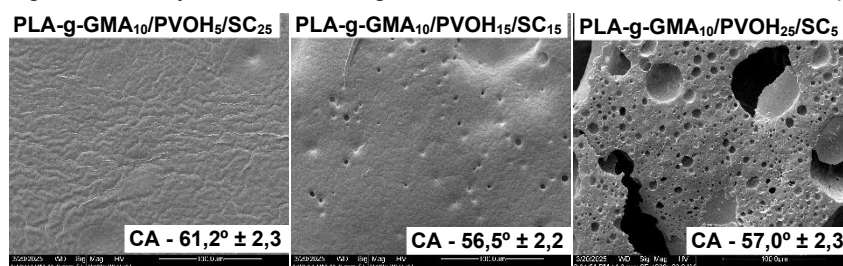
Highlights

The ternary blends presented macroscopically homogeneous surfaces.
Variation of PVOH can be used to modulate pores.
Higher PVOH content increased water absorption and caused an antiplasticizing effect.

Abstract

Poly(lactic acid) (PLA) stands out for being renewable, biodegradable, and bioabsorbable, characteristics that favor its biomedical applications. However, its hydrophobic nature and low mechanical resistance restrict some uses. The production of blends with poly(vinyl alcohol) (PVOH) and chondroitin sulfate (CS) emerges as a strategy to increase flexibility, hydrophilicity, and overall physicochemical and structural properties. This study aimed to produce ternary blends of functionalized PLA, PVOH, and CS, and to evaluate the impact of varying the PVOH/CS ratios on the structure and physicochemical properties of the materials. PLA was functionalized with glycidyl methacrylate (GMA), resulting in PLA-g-GMA₁₀ with a degree of modification of 2.6% (w/w). Three ternary blends were prepared by casting, containing 70% (w/w) PLA-g-GMA₁₀ and 30% (w/w) PVOH/CS in the proportions of 25/5, 15/15, and 5/25. The blends were characterized by Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), thermogravimetric analysis (TGA), and physicochemical analyses (contact angle (CA), water absorption, and flexural strength at 180°). The FTIR spectra confirmed the presence of PLA-g-GMA₁₀, PVOH, and CS, showing characteristic bands at 3300 cm⁻¹ (νOH), 1749 cm⁻¹ (νC=O ester), and 1680 cm⁻¹ (νC=O amide), respectively. The blends presented macroscopically homogeneous surfaces, with pore size and uniformity influenced by PVOH content: PLA-g-GMA₁₀/PVOH₅/CS₂₅ presented a compact surface without pores; PLA-g-GMA₁₀/PVOH₁₅/CS₁₅ presented smaller and uniform pores (4.7 μm ± 1.0 μm); and PLA-g-GMA₁₀/PVOH₂₅/CS₅ presented larger and heterogeneous pores (5.8 μm ± 3.0 μm). The blends with lower PVOH contents exhibited greater thermal stability than the individual polymers, suggesting interactions between the components and a synergistic effect on thermal degradation. All blends presented hydrophilic characteristics (CA < 90°). The increase in PVOH content increased water absorption and restricted the mobility of the polymer chains, resulting in an antiplasticizing effect that reduced flexural strength. Overall, varying the PVOH content allowed control of porosity, thermal behavior, and flexibility, increasing the suitability of the blends for biomedical applications, such as support structures or bioabsorbable devices.

Figure 1 - SEM images of ternary blends of PLA-g-GMA₁₀, PVOH, and CS, with their respective contact angles (CA)



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