Title : Effect of selected additives on mechanical properties of Poly(lactide) and Poly(lactide-*co*-caprolactone)

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ABSTRACT

Three-dimensional (3D) printing (3DP), especially Fused Deposition Modeling (FDM), has made significant advancements in the fields of tissue engineering and medical use. Polylactic Acid (PLA) and poly(lactic acid-*co*-caprolactone) (PLC) are commonly used materials for filament manufacturing in medical applications. However, both PLA and PLC have limitations in their mechanical properties for producing the FDM filament: PLA is rigid but brittle, while PLC lacks sufficient strength. In this work, the effects of various additives on the mechanical properties of PLA and PLC were studied to enhance their appropriateness. The addition of different additives, such as polyethylene glycol (PEG), glycerol, TMC-200, TMC-301, zirconium oxide (ZrO_2), and Tween 80, amount 0.5% w/w blended via the internal mixer. The mechanical properties of polymers blended with different additives were evaluated using tensile testing, thermal properties analysis, and dilute solution viscosity analysis. The results showed the mechanical properties of PLA/Tween 80 were improved when compared to other samples. The tensile strength and Young's modulus of PLA/Tween 80 were 18.704 ± 3.789 MPa and 845.475 ± 83.846 MPa, respectively, resulting in stronger materials with better tensile resistance. This was consistent with the DSC analysis, which showed a decrease in glass transition temperature (Tg). In the case of PLC/ZrO_2, the tensile strength and Young's modulus were 17.647 ± 1.409 MPa and 417.206 ± 60.004 MPa, respectively, making the material stronger and more ductile when compared with the other sample, which was further confirmed by an increase in Tg from DSC results. This data implies that integrating different additives into PLA and PLC can improve their mechanical qualities.

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