Preparation and characterisation of PBAT-based biocomposite materials reinforced by protein complex microparticles

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Abstract: In this work we report on the preparation and subsequent mechanical and dynamic-mechanical characterisation of new biodegradable composite materials based on poly (butylene adipate terephthalate) (PBAT) loaded with zein-TiO_2 complex microparticles . The masterbatches of the materials were prepared by solvent casting with different filler contents (0 (pure PBAT), 5, 10 and 20 wt%), in order to modify and modulate the properties of the composite. Scanning electron microscopy (SEM) images showed homogeneous dispersion of the filler, without microparticles aggregation nor phase separation between filler and matrix, suggesting a good interphase adhesion. Mechanical characterization on dumbbell specimens, obtained by injection moulding, consisted in uniaxial tensile test at constant speed. The Young's modulus (E) showed an actual improvement of the rigidity with the increase of the filler content. The yield stress (σ_y) presented a defined increase with growing percentage of filler, with opposite behaviour in comparison to the trend generally showed by other composite materials. Dynamic-mechanical analysis results exhibited an increasing trend in storage modulus (E') values, confirming a greater rigidity of the composites with higher filler content. The values of the glass transition temperature (T_g) remained fairly constant, meaning that the thermal stability of the material was not affected by the addition of different amounts of protein complex microparticles. Overall, the produced PBAT composites showed similar properties to low density polyethylene (LDPE), proving to be promising and more sustainable alternatives to traditional non-biodegradable thermoplastic polymers commonly adopted in food and agricultural fields.