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Composition optimization of PLA/PPC/HNT nanocomposites for mandibular fixation plate using single-factor experimental design

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Abstract

The need to overcome the secondary surgery to remove implanted metal fixation plate leads to the idea of replacing the

material with degradable bionanocomposite. In this research, polylactic acid/polypropylene (PLA/ PPC) blends incorporated with halloysite nanotubes (HNT) (0-6 wt %) were considered as the candidate material for mandibular fixation plate. A single-factor design using Design Expert software was used to determine 20 different compositions of PLA/PPC/HNT nanocomposites and their mechanical properties were then measured. The optimization of the PLA/PPC/HNT nanocomposite composition was performed based on the nano-composite's response to Young's modulus, tensile strength, and elongation at break. Further analysis suggested an optimum composition of 92.5/7.5 PLA/PPC with 6 wt % of HNT. The statistical results predicted that there was a 71.7% possibility that the proposed nanocomposite would have the following mechanical properties: Young's modulus of 2.18 GPa, a tensile strength of 64.16 MPa, and an elongation at break of 106.53%.

Keywords

Author Keywords: DOE; Design of experiment; PLA; PPC; HNT; Polylactic acid; polypropylene carbonate; halloysite nanotube; Optimization; Nanocomposites; Fixation plate

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