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Bifunctional Electrospun Fibers Based on Poly(Lactic Acid)/Calcium Oxide Nanocomposites as a Potential Scaffold for Bone Tissue Engineering

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Abstract : Calcium oxide nanoparticles (n-CaO) ca. 8 nm were obtained from eggshell waste. The n-CaO was incorporated into Poly(lactic acid) PLA matrix in 10 and 20 wt.% of filler content by electrospinning process to obtain PLA/n-CaO nanocomposite fibers as a potential use in scaffold for bone tissue regeneration. The fibers morphology and diameter were homogeneity, the PLA had a diameter of 2.2 ± 0.8 µm and, with the nanoparticles incorporation (20wt.%), reached ca. 2.9 ± 0.9 µm. The PLA/n-CaO nanocomposites fibers showed in vitro bioactivity, capable of inducing the precipitation of hydroxyapatite (HA) layer in the fiber surface after 7 days in Simulated Body Solution (SBF). The biocidal and biological properties of PLA/n-Cao with 20 wt.% were evaluated, showing a 30% reduction in bacterial viability against S. aureus and 11% for E. coli after 6 hours of bacterial suspensions exposure. Furthermore, the fibers did not show a cytotoxic effect on the bone marrow ST-2 cell line, permitting the cell adhesion and proliferation in Roswell Park Memorial Institute medium (RPMI). The PLA/n-CaO with 20 wt.% of nanoparticles showed a higher capacity to promote the osteogenic differentiation, significantly increasing the alkaline phosphatase (ALP) expression after 7 days compared to PLA and cell control. The in vivo analysis corroborated the biocompatibility of scaffolds prepared, the presence of n-CaO in PLA reduced the formation of fibrous encapsulation of the material improve the healing process.

Keywords : electrospun scaffolds, PLA based nanocomposites, calcium oxide nanoparticles, bioactive materials, tissue engineering
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