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Mechanical and Biodegradability of Porous Poly-ε-Caprolactone/Polyethylene Glycol Copolymer-Reinforced Cellulose Nanofibers for Soft Tissue Engineering Applications

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Abstract : The design and development of a new class of biomaterial has gained particular interest in producing polymer scaffold for biomedical applications. Improving mechanical properties, biological and controlling pores scaffold are important factors to provide appropriate biomaterial for implement in soft tissue repair and regeneration. In this study, poly-ε-caprolactone (PCL) /polyethylene glycol (PEG) copolymer (80/20) incorporated with CNF scaffolds were made employing solvent casting and particulate leaching methods. Four mass percentages of CNF (1, 2.5, 5, and 10 wt.%) were integrated into the copolymer through a silane coupling agent. Mechanical properties were determined using Tensile Tester data acquisition to investigate the effect of porosity, pore size, and CNF contents. Tensile strength obtained for PCL/PEG- 5 wt.% CNF was 16 MPa, which drastically decreased after creating a porous structure to 7.1 MPa. The optimum parameters of the results were found to be 5 wt.% for CNF, 240 µm for pore size, and 83% for porosity. Scanning electron microscopy (SEM) micrograph reveals that consistent pore size and regular pore shape were accomplished after the addition of CNF-5 wt. % into PCL/PEG. The results of mass loss of PCL/PEG reinforced-CNF 1% have clearly enhanced to double values compared with PCL/PEG copolymer and three times with PCL/PEG scaffold-CNF 1%. In addition, all PCL/PEG reinforced and scaffold- CNF were partially disintegrated under composting conditions confirming their biodegradable behavior. This also provides a possible solution for the end life of these biomaterials.

Keywords : PCL/PEG, cellulose nanofibers, tissue engineering, biodegradation, compost polymers
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