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Biomimetic and osteogenic natural HAP coated three dimensional implant for orthopaedic application(Article)

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Abstract

The excellent biocompatible and osteogenesis ability of multifunctional three-dimensional (3D) polymeric scaffolds have a vital role in bone regeneration application. Our prime focus of the investigation is the synthesis of snail shell-derived hydroxyapatite coated poly[bis(carboxyphenoxy)phosphazene] (PCPP)/poly(ε-caprolactone) (PCL) 3D scaffold. Snail shells are utilized for hydroxyapatite (HAP) synthesis via a modified chemical precipitation method. The interconnected PCPP/PCL polymeric scaffold was fabricated by the conventional solvent-casting/particulate-leaching method. Bioceramic HAP was further coated on the scaffold by the dip-coating technique. The obtained natural HAP from Turritella duplicata has minerals and organic substituents which are essential for biomedical application. HAP reinforcement significantly increases the mechanical property, compressive strength, and porosity of the scaffolds. The SEM image depicted the homogenous dispersion of HAP over the scaffold surface. Mechanical studies of the 3D polymeric scaffold at the 2% TSS-HAP content demonstrated a significant increase in compressive strength with desired porous structure. It showed increasing compressive strength from 1.52 MPa to 2.18 MPa and porosity of 82.26% to 76.18%. Snail shell HAP grafted polymeric scaffold shows mineralization with the formation of bone-like apatite. The HAP grafted bioceramic/polymeric scaffold surface helps in the attachment and proliferation of MG-63 cells. It also explored the biocompatible property and antibacterial against gram-positive/gram-negative bacteria. Overall, the fabricated 3D implant has improved mechanical strength, optimum pore size, and interconnected structure, which helps in mineralization and cancellous bone tissue engineering applications. © 2022 Elsevier Ltd

Author keywords

3D-Scaffold | Bone tissue engineering | Hydroxyapatite | Implant | Osteogenesis | Snail shell

Indexed keywords

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Engineering uncontrolled terms: 3D scaffolds | Bone tissue engineering | Implant | Mineralisation | Natural hydroxyapatite | Osteogenesis | Phosphazenes | Poly(ε caprolactone) | Polymeric scaffold | Snail shell

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