Characterization and In Vitro evaluation of a novel coated nanocomposite porous 3D scaffold for bone repair

ABSTRACT

The aim of this study is to tissue engineer a 3D scaffold that can be used for load bearing segmental bone defects (SBDs) repair. Three different scaffolds were fabricated using cockle shell-derived CaCO3 aragonite nanoparticles (CCAN), gelatin, dextran and dextrin with coated framework via Freeze-Drying Method (FDM) labeled as 5211, 5211GTA+Alginate, 5211PLA. Scaffolds were assessed using Scanning Electron Microscopy (SEM). The cytocompatibility of the organized scaffolds was assessed using cells multiplication and alkaline phosphatase (ALP) concentration via In Vitro cell culture using human Fetal OsteoBlast cells line (hFOB). The results showed a substantial difference in ALP concentrations between the cultures of different scaffolds leachable medium during the study period. The biological evaluation also showed that three scaffolds did enhanced the osteoblast proliferation rate and improved the osteoblast function as demonstrated by the significant increase in ALP concentration. Engineering analyses showed that scaffolds possessed 3D interconnected homogenous porous structure with a porosity ranging 6%-49%, pore sizes ranging 8-345 µm, mechanical strength ranging 20-65 MPa, young's modulus ranging 166-296 MPa and enzymatic degradation rate between 16%-38% within 2-10 weeks. The in vitro evaluation revealed that the scaffold 5211, 5211GTA+Alginate and 5211PLA fulfill all the main requirements to be considered as an ideal bone replacement.

Keyword: Aragonite; Bionanocomposite; 3D porous scaffold; hFOB; Bone repair