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Ectopic Osteoinduction of Porous Composite Scaffolds Reinforced with Graphene Oxide and Hydroxyapatite Gradient Density

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Abstract : Herein, the synthesis and characterization of chitosan-gelatin highly porous scaffold reinforced with graphene oxide, and hydroxyapatite (HAp), crosslinked with genipin was targeted. In tissue engineering, chitosan and gelatin are two of the most robust biopolymers with wide applicability due to intrinsic biocompatibility, biodegradability, low antigenicity properties, affordability, and ease of processing. HAp, per its exceptional activity in tuning cell-matrix interactions, is acknowledged for its capability of sustaining cellular proliferation by promoting bone-like native micro-media for cell adjustment. Genipin is regarded as a top class cross-linker, while graphene oxide (GO) is viewed as one of the most performant and versatile fillers. The composites with natural bone HAp/biopolymer ratio were obtained by cascading sonochemical treatments, followed by uncomplicated casting methods and by freeze-drying. Their structure was characterized by Fourier Transform Infrared Spectroscopy and X-ray Diffraction, while overall morphology was investigated by Scanning Electron Microscopy (SEM) and micro-Computer Tomography (µ-CT). Ensuing that, in vitro enzyme degradation was performed to detect the most promising compositions for the development of in vivo assays. Suitable GO dispersion was ascertained within the biopolymer mix as nanolayers specific signals lack in both FTIR and XRD spectra, and the specific spectral features of the polymers persisted with GO load enhancement. Overall, correlations between the GO induced material structuration, crystallinity variations, and chemical interaction of the compounds can be correlated with the physical features and bioactivity of each composite formulation. Moreover, the HAp distribution within follows an auspicious density gradient tuned for hybrid osseous/cartilage matter architectures, which were mirrored in the mice model tests. Hence, the synthesis route of a natural polymer blend/hydroxyapatite-graphene oxide composite material is anticipated to emerge as influential formulation in bone tissue engineering. Acknowledgement: This work was supported by the project 'Work-based learning systems using entrepreneurship grants for doctoral and post-doctoral students' (Sisteme de invatare bazate pe munca prin burse antreprenor pentru doctoranzi si postdoctoranzi) - SIMBA, SMIS code 124705 and by a grant of the National Authority for Scientific Research and Innovation, Operational Program Competitiveness Axis 1 - Section E, Program co-financed from European Regional Development Fund 'Investments for your future' under the project number 154/25.11.2016, P_37_221/2015. The nano-CT experiments were possible due to European Regional Development Fund through Competitiveness Operational Program 2014-2020, Priority axis 1, ID P_36_611, MySMIS code 107066, INOVABIOMED.

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