World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

Comparative Study of Calcium Content on in vitro Biological and Antibacterial Properties of Silicon-Based Bioglass

Authors : Morteza Elsa, Amirhossein Moghanian

Abstract : The major aim of this study was to evaluate the effect of CaO content on in vitro hydroxyapatite formation, MC3T3 cells cytotoxicity and proliferation as well as antibacterial efficiency of sol-gel derived SiO₂–CaO–P₂O₅ ternary system. For this purpose, first two grades of bioactive glass (BG); BG-58s (mol%: 60%SiO₂–36%CaO–4%P₂O₅) and BG-68s (mol%: 70%SiO₂–26%CaO–4%P₂O₅)) were synthesized by sol-gel method. Second, the effect of CaO content in their composition on in vitro bioactivity was investigated by soaking the BG-58s and BG-68s powders in simulated body fluid (SBF) for time periods up to 14 days and followed by characterization inductively coupled plasma atomic emission spectrometry (ICP-AES), Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), and scanning electron microscopy (SEM) techniques. Additionally, live/dead staining, 3-(4,5dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT), and alkaline phosphatase (ALP) activity assays were conducted respectively, as qualitatively and quantitatively assess for cell viability, proliferation and differentiations of MC3T3 cells in presence of 58s and 68s BGs. Results showed that BG-58s with higher CaO content showed higher in vitro bioactivity with respect to BG-68s. Moreover, the dissolution rate was inversely proportional to oxygen density of the BG. Live/dead assay revealed that both 58s and 68s increased the mean number live cells which were in good accordance with MTT assay. Furthermore, BG-58s showed more potential antibacterial activity against methicillin-resistant Staphylococcus aureus (MRSA) bacteria. Taken together, BG-58s with enhanced MC3T3 cells proliferation and ALP activity, acceptable bioactivity and significant high antibacterial effect against MRSA bacteria is suggested as a suitable candidate in order to further functionalizing for delivery of therapeutic ions and growth factors in bone tissue engineering.

Keywords : antibacterial, bioactive glass, hydroxyapatite, proliferation, sol-gel processes
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020