Title:
Synthesis and Characterization of Mesoporous Magnesium Silicate Nanoparticles as Controlled Release Drug Delivery Systems

Abstract:
Ordered mesoporous ceramics with unique combinatory properties such as high specific surface area, high pore volume, and narrow pore size distribution have a great tendency for drug retention and release of a large variety of therapeutic molecules. Recently, magnesium silicate nanostructured biomaterials with good bioactivity, biocompatibility, and mechanical properties are promising for applications in bone tissue engineering. In the present study, ordered mesoporous magnesium silicate (OMMS) was prepared by sol-gel method and the effect of calcination temperature on drug delivery behavior of ibuprofen (IBU) was investigated. The synthesized powders were calcined at 350, 550, 750 °C and characterized by X-ray diffraction (XRD), Fourier transmission infrared spectroscopy (FTIR), N2 adsorption–desorption, and transmission electron microscopy (TEM). The low angle XRD and N2 adsorption–desorption results showed that all samples contained ordered pores structure and demonstrated mesoporous characteristics with high specific surface area ranging from 386 to 504 m2/g, respectively. It was found that the sample calcined at 350 °C showed the slowest drug release rate among all samples after 240 h, which is due to smaller pore size and the existence of larger amounts of intrawall micro porosity. Cytotoxicity of MG63 osteoblast cell line was investigated by MTT assay, indicating no toxicity for all samples calcined at different temperatures. This study has revealed altering the calcination temperature may change the drug delivery behavior of OMMS by influencing textural properties and suggests OMMS as a promising local drug delivery system in bone tissue engineering applications.

Keywords:
Ordered mesoporous ceramic, Magnesium silicate, Controlled release, Calcination temperature, Ibuprofen.