Drug delivery and antimicrobial studies of chitosan-alginate based hydroxyapatite bioscaffolds formed by the Casein micelle assisted synthesis

ABSTRACT

The present study aims to develop a hydroxyapatite (HAP) based scaffold composite for orthopaedic applications and for that, we adopt a Casein (Cs) micelle assisted synthesis route for the formation of a composite. Following the synthesis and characterization of various fluorine (2% and 5%) substituted HAPs (FHAP), they have been tested for the release of Ciprofloxacin (CIP) drug and antimicrobial efficacy. The physicochemical characterization such as FTIR and Raman confirms the successful formation of the HAP composites. Similarly, the powder XRD and FESEM analysis have used for the confirmation of crystallinity and morphological behaviour, respectively. The elemental composition has confirmed using EDX analysis. The antimicrobial studies indicate that the 5% FHAP sample is possessing superior antifungal and antibacterial activities and the highest activity has been observed against the gram-positive bacteria (Staphylococcus aureus) with an inhibition zone of 47 mm while the gram-negative bacteria (Escherichia coli) has only 38 mm inhibition zone. The CIP drug release profile has been controlling with the Cs/5% FHAP sample. Therefore, this composite has carried out for the scaffold formation with the use of chitosan-alginate matrices. Further, characterization of chitosan-alginate/5% FHAP scaffold composite indicates porous, biodegradable, considerable water uptake and retention ability, along with the maintenance of controlled CIP drug-releasing properties. Based on the analysis, the as-synthesized chitosan-alginate/5% FHAP scaffold composite can be suitable for the biomedical and bioengineering applications of bone tissue growth and as an implant.

Keyword: Casein micelle; Hydroxyapatite; Ciprofloxacin drug release; Chitosan-alginate matrices; Bioactivity and biodegradability