Introduction

The use of HAp nanocrystals has caused an expanding interest in the fabrication of artificial bone like ceramic composites due to its similarity to bone minerals in size, crystallinity and morphology. The nano HAp not only plays a significant role in maintaining the mechanical properties of the natural bone but also offers an environment conductive for osteoconduction, protein adhesion and osteotoblast proliferation.

In the present work, an effort has been made to fabricate a biomimetic composite that contains nano hydroxyapatite (nHAp) and demineralised bone matrix (DBM), and characterize the same for its physicochemical properties. Further its osteoinduction abilities were assessed using osteoblast migration and proliferation.

Materials and Methods

In the present study, nHAp was prepared using mineralized liquid, a byproduct of glue and gelatin industry, employing wet precipitation methods. DBM was isolated from cattle tibial bones and a DBM-nHAp composite was prepared. The DBM was washed smashed into a paste 10 Gms of DBM paste and 12 Gms of nHAp powder were mixed thoroughly and extruded through a glass tube using a glass rod and lyophilized. The functional groups of nHAp and DBM were determined using FTIR analysis. The morphological structure was observed through SEM. The crystallinity was determined by XRD technique. In vitro biocompatibility was assessed by assessing the migration and proliferation of osteoblast for 12 days in the developed DBM-nHAp composite. After 2 ALP activity was analyzed using standard calorimetric assay using normal HAp as a control.

Results

The TEM pictures of nHAp displayed spherical shaped nano particles in the range of 2 to 50 nm. XRD analysis show that comparable and in agreement with the indexed X-ray powder diffraction pattern which is almost identical with the synthetic HAp. Molecular signature of functional group analyzed through FTIR spectrum of the DBM-nHAp composite has shown characteristic peaks of both DBM and HA (Amide absorption bands were observed in IR spectrum of DBM at 1654, 1543 and 1241 cm⁻¹ representing amide I, amide II and amide III respectively confirming the protenious nature of the material. The SEM picture of DBM-nHAp has shown coating of DBM on the surface of nHAp crystals with porous nature. Further, in vitro analysis showed the composite supported osteoblast growth and showed viability till 12 days. After 2 weeks there was a significant increase in ALP activity in comparison to normal HAp scaffold, showing the DBM-nHAp has improved biocompatibility and osteoinductive property.

Discussion and Conclusions

In this study, since both the DBM and nHAp are bio-based materials, the biocompatibility and acceptance of the bone graft by the host tissue is expected to improve. As the implant contains both organic and inorganic phases of the bone, with porous nature, the osteoinduction will occur by creeping substitution mechanism, which is a desirable property for an ideal bone graft.

References


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