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Hydroxyapatite nanoparticles for sustained delivery of vitamin D_3

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Background: Vitamin D3 (VD) and calcium phosphate play a vital role in bone homeostasis. Due to various reasons such as obesity or gastrointestinal problems, the use of pure VD and calcium phosphate supplements are rendered ineffective. Most cases of VD deviancies are associated with deficiencies of calcium and phosphorus due to a lack of mechanisms to absorb these ions through the gut epithelium. Thus, co-delivery of VD with calcium and phosphate can potentially resolve this problem. Due to the high affinity of $Ca_3(PO_4)_2$ for bone tissue, Hydroxyapatite (HA) is an ideal delivery system to deliver VD to target tissue.
Objective: This study investigated the possibility of using VD-loaded hydroxyapatite nanoparticles for the co-delivery of VD and $Ca_3(PO_4)_2$.
Method: Herein, HA nanoparticles were synthesized and loaded with VD using a vacuum evaporation method. The synthesized HA-VD nanoparticles were morphologically and chemically characterized by SEM, FTIR and TGA analysis. The release profile of VD and cytocompatibility of prepared nanocomposite was assessed.
Results: The synthesized HA particles were observed to be of a good spherical shape. HA nanoparticles were observed to possess an average diameter of approximately 40-60 nm. The loading percentage of VD was 10.86 w/w %. According to the VD release profile, the system had a two-stage release pattern, which includes a first-day burst release (35.0%) and sustained release for further ten days. Finally, the cytocompatibility of the nanoparticle system was assessed *in vitro* using preosteoblast cells, and the results showed that the system is non-toxic and well-tolerated. The tested HA-VD system is a valuable alternative for codelivery of VD, Ca^{2+} and PO_4^{3-} to their target tissues.
Conclusion: The evidence of this study suggests the use of VD-loaded HA nanoparticles as a potent biocompatible alternative for sustained- and targeted delivery of VD with Ca^{2+} and PO_4^{3-}