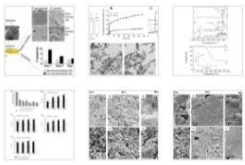

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In situ functionalizing calcium phosphate biomaterials with curcumin for the prevention of bacterial biofilm infections

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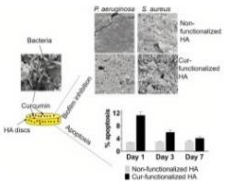
Highlights

- Curcumin-functionalized HA was synthesized in situ with wet precipitation technique.
- Curcumin-functionalized HA inhibited biofilm formation of *Staphylococcus aureus*.
- Curcumin-functionalized HA was non-toxic towards human osteoblast-femural cell line.

Abstract

This study developed a novel bioactive bone substitute (hydroxyapatite, HA) with improved anti-biofilm activity by functionalizing with curcumin (anti-biofilm compound) which provide sufficient flux of curcumin concentration for 14 days. The released curcumin acts to inhibit biofilm formation and control the number of viable planktonic cells simultaneously. To prepare curcumin-functionalized HA, different concentrations of curcumin (up to 3% w/v) were added simultaneously during the precipitation process of HA. The highest loading (50 mg/g HA) of curcumin onto HA was achieved with 2% w/v of curcumin. Physicochemical characterizations of curcumin-functionalized HA composites revealed that curcumin was successfully incorporated onto HA. Curcumin was sustainably released over 14 days, while higher curcumin release was observed in acidic condition (pH 4.4) compared to physiological (pH 7.4). The cytotoxicity assays revealed that no significant difference on bone cells growth on curcumin-functionalized HA and non-functionalized HA. Curcumin-functionalized HA was effective to inhibit bacterial cell attachment and subsequent biofilm maturation stages. The anti-biofilm effect was stronger against *Staphylococcus aureus* compared to *Pseudomonas aeruginosa*. The curcumin-functionalized HA composite significantly delayed the maturation of *S. aureus* compared to non-functionalized HA in which microcolonies of cells only begin to appear at 96 h. Up to 3.0 log reduction in colony forming unit (CFU)/mL of planktonic cells was noted at 24 h of incubation for both microorganisms. Thus, in this study we have suggested that curcumin loaded HA could be an alternative antimicrobial agent to control the risk of infections in post-surgical implants.

Graphical abstract



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Keywords

Curcumin; Hydroxyapatite; *Staphylococcus aureus*; *Pseudomonas aeruginosa*; Biofilm

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