Biodegradable Chitosan-Hydroxyapatite Composite Bone Scaffolds Infused With Anti-Microbial Nanoparticles

Brewer, June (School: North Carolina School of Science and Mathematics)

Biodegradable bone scaffolds have the potential to be an alternative treatment for bone grafts. Infusion with antimicrobial factors could provide a controllable release mechanism for targeted drug delivery and mitigate the adverse effects of oral antibiotics. This study synthesized and analyzed chitosan (CS)—hydroxyapatite (HAp)- based composite scaffolds infused with vancomycin (VAN)- loaded beta-cyclodextrin (beta-CD) nanoparticles. The scaffolds were formed using free-radical cross-linking, testing two cross-linking initiators, benzophenone (Bp) and azobisisobutyronitrile (AIBN). The compressive strength was affected by both the ratio of CS:HAp and the type and ratio of the crosslinker. The compressive strength decreased with an increase in HAp, and the AIBN CS/HAp scaffolds had a higher compressive strength than their Bp counterparts. The scaffolds' biodegradation was analyzed in simulated body fluid (SBF) for 8 weeks, during which time they underwent successful biodegradation in SBF, with AIBN scaffolds degrading more than the benzophenone scaffolds. The scaffolds were infused with VAN-loaded beta-CD nanoparticles, and the anti-microbial properties were tested through a zone of inhibition assay. Scaffolds infused with the nanoparticles demonstrated antimicrobial activity compared to those without. The synthesized scaffold demonstrated compressive strength within or above the range of typical bone grafts, biodegradability within the body, and antimicrobial properties, indicating promise as a treatment in place of bone grafts while acting as a drug delivery mechanism to prevent infection at the scaffold site.

Awards Won: