Green Synthesis and Characterization of Hydroxyapatite Nanoparticles Using Chicken Egg Shells for Cefazoline Delivery

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Hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$) is a naturally occurring inorganic mineral. It is used for biomedical applications due to biocompatibility, biodegradability, and osteoconductivity of their nanostructures. In this study, HAP NPs were synthesized using green and facile methods. This study was done to develop a facile synthesis method for producing hydroxyapatite nanoparticles using chicken egg shells for cefazolin delivery and to evaluate the effect of the method for the characteristics of the NPs. The research was a laboratory based experimental study that used wet chemical precipitation methods for the synthesis. In method 1, $Ca(CO)_3$ was transformed via $Al(OH)_3$ under controlled pH (10) and temperature (60 ^{0}C). Method 2 was done under thermal decomposition and HAP was obtained at 60 ^{0}C without external pH control. After that characterization was done using SEM, FT-IR and XRD analysis. According to the SEM analysis, spherical shape NPs were observed in average size of 10 nm with nanosize porosity and needle shapes were obtained with 15 nm x 100 nm. FTIR spectra were obtained for the both CFZ loaded and pure HAP NPs to identify the functional groups. Peak analysis of the both shapes revealed that their functional groups were perfectly indexed with the standard spectra of HAP NPs. CFZ- loaded HAP NPs illustrated the significance bonds of CFZ while making some changes of the pure HAP NPs spectra. XRD was done to identify the crystallinity. According to that, XRD patterns were matched with standard peaks of the HAP NPs. When calculating the crystallinity size, Spherical shape was given 30 nm and needle shape was given 12 nm of average sizes. Finally, HAP NPs were synthesized using green methods, and size and morphology was tuned using different structure-directing agents like $Al(OH)_3$. CFZ was loaded successfully for both morphologies and spherical shapes show higher CFZ loading capacity than needle- shapes due to the high surface area/volume ratio and strengths of the bonds in FTIR analysis.

Keywords: Hydroxyapatite, nanoparticles, cefazoline, spherical, needle