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Hydroxyapatite prepared from eggshell and mulberry leaf extract by precipitation method

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Abstract. Eggshell is a waste material after the usage of egg. In this work, biowaste chicken eggshells were used for preparing carbonated hydroxyapatite (HA) nanoparticles of high purity through aqueous precipitation method at room temperature. The eggshell-derived HA will be a cost-effective bioceramics for biomedical applications and an effective material-recycling technology. Additionally, mulberry leaf extract was used as a template to regulate the morphology, size and crystallinity of HA, and the effects of pH value were also examined. Characterization of the samples was performed by X-ray diffraction (XRD) and Fourier transform infrared (FT-IR) spectroscopy. Scanning electron microscopy (SEM) was used to determine the size, shape and morphology of HA. The results indicate that only one phase of HA were synthesized in the both absence and presence of mulberry leaf extract at pH of 7 and above, while DCPD or DCPA/DCPD phase was observed at pH 4 condition. The crystallite sizes of the HA samples obviously decreased when adding mulberry leaf extract as a template, while they decreased gradually as the solution pH levels increased. With increasing pH level from 7 to 14, the rod-like HA nanoparticles gradually changed to spherical shape at pH 14. Note that, the obtained product is Mg and Sr containing A- and B-type carbonate HA at alkaline pH and it can be a potential material for biomedical applications.

Keywords: eggshell; mulberry leaf extract; hydroxyapatite; precipitation method; pH value

1. Introduction

Hydroxyapatite (HA, $Ca_{10}(PO_4)_6(OH)_2$), which is the material most similar to the inorganic part of bones and teeth, has been vigorously investigated as implant materials for orthopedic and dental applications due to its excellent bioactivity, osteoconductivity, and osteoinductivity (Best *et al*. 2008). It is also confirmed that HA bioceramics show no toxicity, inflammatory response, pyrogenetic response (Habib *et al*. 2012). Besides, it has also been applied as an adsorbent in environmental protection (Vega *et al*. 2003), for progressing chromatography and other fields (Neira *et al*. 2009). In the past years, several synthesis techniques using a range of different

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