Optimum pH and Temperature for Calcium Phosphates: Their Effects on Crystallinity and Morphology

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Apatite is a major constituent of bones and teeth of human and commonly used as a coating substance for medical purposes. Other calcium phosphates such as amorphous calcium phosphate (ACP), octacalcium phosphate (OCP), hydroxylapatite (HAP), brushite, and monetite are also used for variable applications in bio-clinics and material industries. These applications of calcium phosphates greatly rely on their physicochemical properties such as morphology and crystallinity. Therefore, understanding and investigation of certain calcium phosphates with desired properties under different conditions play a key role in controlling applications in medical and material sciences.

A series of calcium phosphates was synthesized by a wet precipitation. Some routes of HAP were investigated over a wide range of temperature and pHs (25–80 ℃ and pH 4.5–10.0) using a combination of microscopic and spectroscopic analyses. XRD and FTIR show that ACP, OCP, monetite, and brushite are formed as a single phase at non-ideal conditions of HAP, respectively. From TGA results, it is found that brushite is converted to monetite under a range 175–200 ℃ when heated with the heating rate, 10 ℃/min. This phase transformation is also observed when brushite is aged at pH 8.5 and 60 ℃ for 24 hrs in solution. Morphology of brushite is sensitive to pH variations. At pH 6.5, tabular or platy crystals of brushite are observed whereas needle-like ones are predominant at pH 8.5. For HAP formed at pH 10.0, their shapes tend toward needle-like particles as temperature increases. HAP crystals at pH 8.5 are very similar in morphology to those of HAP at pH 10.0, but their lengths are two or three times as great as those at pH 10.0. These observations demonstrate that desired phase and properties of calcium phosphates can be controlled by pH, temperature, and aging time through a wet precipitation method.