The Effects and Interactions of Synthesis Parameters on Properties of Mg Substituted Hydroxyapatite

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Abstract : In this study, the effects and interactions of reaction time and capping agent assistance during sol-gel synthesis of magnesium substituted hydroxyapatite nanopowder (MgHA) on hydroxyapatite (HA) to β-tricalcium phosphate (β-TCP) ratio, Ca/P ratio and mean crystallite size was examined experimentally as well as through statistical analysis. MgHA nanopowders were synthesized by sol-gel technique at room temperature using aqueous solution of calcium nitrate tetrahydrate, magnesium nitrate hexahydrate and potassium dihydrogen phosphate as starting materials. The reaction time for sol-gel synthesis was varied between 15 to 60 minutes. Two process routes were followed with and without addition of triethanolamine (TEA) in the solutions. The elemental compositions of as-synthesized powders were determined using X-ray fluorescence (XRF) spectroscopy. The functional groups present in the as-synthesized MgHA nanopowders were established through Fourier Transform Infrared Spectroscopy (FTIR). The amounts of phases present, Ca/P ratio and mean crystallite sizes of MgHA nanopowders were determined using X-ray diffraction (XRD). The HA content in biphasic mixture of HA and β-TCP and Ca/P ratio in as-synthesized MgHA nanopowders increased effectively with reaction time of sols ($p < 0.0001$, two way Anova), however, these were independent of TEA addition ($p > 0.15$, two way Anova). The MgHA nanopowders synthesized with TEA assistance exhibited 14 nm lower crystallite size ($p < 0.018$, 2 sample t-test) compared to the powder synthesized without TEA assistance.

Keywords : capping agent, hydroxyapatite, regression analysis, sol-gel, 2- sample t-test, two-way analysis of variance (ANOVA)
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