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Effect of the pH on the Degradation Kinetics of Biodegradable Mg-0.8Ca Orthopedic Implants

Authors : A. Mohamed, A. El-Aziz

Abstract : The pH of the body plays a great role in the degradation kinetics of biodegradable Mg-Ca orthopedic implants. At the location of fracture, the pH of the body becomes no longer neutral which draws the attention towards studying a range of different pH values of the body fluid. In this study, the pH of Hank's balanced salt solution (HBSS) was modified by phosphate buffers into an aggressive acidic pH 1.8, a slightly acidic pH 5.3 and an alkaline pH 8.1. The biodegradation of Mg-0.8Ca implant was tested in those three different media using immersion test and electrochemical polarization means. It was proposed that the degradation rate has increased with decreasing the pH of HBSS. The immersion test revealed weight gain for all the samples followed by weight loss as the immersion time increased. The highest weight gain was pronounced for the acidic pH 1.8 and the least weight gain was observed for the alkaline pH 8.1. This was in agreement with the electrochemical polarization test results where the degradation rate was found to be high (7.29 ± 2.2 mm/year) in the aggressive acidic solution of pH 1.8 and relatively minimum (0.31 ± 0.06 mm/year) in the alkaline medium of pH 8.1. Furthermore, it was confirmed that the pH of HBSS has reached a steady state of an alkaline pH (~pH 11) at the end of the two-month immersion period regardless of the initial pH of the solution. Finally, the corrosion products formed on the samples' surface were investigated by SEM, EDX and XRD analyses that revealed the formation of magnesium and calcium phosphates with different morphologies according to the pH.

Keywords : biodegradable, electrochemical polarization means, orthopedics, immersion test, simulated body fluid
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