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Biomaterials

A Poly(lactide) Stereocomplex Structure with Modified Magnesium Oxide and Its Effects in Enhancing the Mechanical Properties and Suppressing Inflammation

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***B**iodegradable polymers such as poly(L-lactide) (PLLA) have been widely utilized as materials for biomedical applications. However, the relatively poor mechanical properties of PLLA and its acid-induced cell inflammation brought about by the acidic byproducts during biodegradation pose severe problems. In this study, these drawbacks of PLLA are addressed using a stereocomplex structure, where oligo-D-lactide-grafted magnesium hydroxide (MgO-ODLA) is synthesized by grafting D-lactide onto the surface of magnesium hydroxide, which is then blended with a PLLA film. The structure, morphology, pH change, thermal and mechanical properties, in-vitro cytotoxicity, and inflammation effect of the MgO-ODLAs and their PLLA composites are evaluated through various analyses. The PLLA/MgO70-ODLA30 (0–20 wt%) composite with a stereocomplex structure shows a 20% increase in its tensile strength and an improvement in the modulus compared to its oligo-L-lactide (PLLA/MgO70-OLLA30) counterpart. The interfacial interaction parameter of PLLA/MgO70-ODLA30 (5.459) has superior properties to those of PLLA/MgO70-OLLA30 (4.013) and PLLA/$Mg(OH)_2$ (1.774). The cell cytotoxicity and acid-induced inflammatory response are suppressed by the neutralizing effect of the MgO-ODLAs. In addition, the inflammatory problem caused by the rapid acidification of the stereocomplex structure is also addressed. As a result, the stereocomplex structure of the MgO-ODLA/PLLA composite can be used to overcome the problems associated with the biomedical applications of PLLA films.*

1. Introduction

Since the synthesis of polylactide by Carothers at DuPont in 1932, many researchers have studied polyester polymers such as polylactide, polyglycolide, and polycaprolactone.[1–3] Among these polymers, polylactide is currently the most widely used owing to its biocompatibility and biodegradability via the Krebs cycle.[4,5] Although polylactide is biocompatible its transplantation into the body is known to cause problems such as cell death and inflammation caused by foreign body reaction. In particular, when polylactide is transplanted into the body chronic inflammation may occur unless this is controlled in the acute inflammatory stage.[6–9] Pistner et al. reported that inflammation in rats was continuously induced until poly(L-lactide) (PLLA) was completely absorbed due to a reaction with the lactic acid itself and with foreign bodies generated during the biodegradation of PLLA.[10]

Some studies have been conducted on the suppression of this continuous cell death and cell inflammation due to the transplantation of polylactide. Virmani et al. demonstrated the mechanism of restenosis using poly(lactide-co-caprolactone)

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