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Abstract

Preparation of Alginate Hydrogel with Carbonated Water and Its Application for Wound Dressings †

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Abstract: Hydrogels are known to properly promote wound healing by providing a moist environment on wound sites. Alginate, a polysaccharide extracted from brown algae, reacts with Ca^{2+} to form hydrogels with high biocompatibility. The most common method of preparing alginate hydrogels is to preliminarily mix $CaCO_3$ with an alginate solution and subsequently add an acid agent such as glucono-δ-lactone to ionize $CaCO_3$ for gelation gradually. However, to accelerate the gelation rate, adding an excessive amount of acidic agent is necessary, which leads to acidification of hydrogels and unsolicited tissue damage. Rapid gelation of hydrogels expands the applicability of hydrogels, including in situ gelation at wound sites. In this study, we prepared the alginate hydrogels with carbonated water, which promotes the dissolution of $CaCO_3$ and volatilizes to the atmosphere after gelation. The carbonated water transiently decreased the pH of the alginate/$CaCO_3$ solution at pH ~5.5 and accelerated the gel transition within 3 min. After the gelation,

CO_2 in the hydrogels volatilized through the gel surface, and the final pH of hydrogels converged at a pH of ~8.5, which is supposed to be suitable for fibroblast proliferation and wound closure. The physicochemical properties of the prepared hydrogels were determined to be excellent concerning transparency, absorb physiological saline, and possess a high-water content (approximately 99%). The hydrogel prepared in this study showed excellent wound healing effects by in vivo evaluations of full-thickness skin wound healing in mice. These results demonstrate that alginate hydrogels prepared with carbonated water are promising for wound care.

Keywords: Biomaterials, Hydrogels, Wound dressings, Alginate, Carbon dioxide

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