Dissertation Title	Injectable Self-Healing Biopolymer-Based Hydrogel Containing Herbal Extract for Chronic Wound Treatment
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ABSTRACT

The treatment of chronic wounds such as full-thickness wounds is crucial for preventing infection, which can result in severe conditions and potential amputation. Injectable self-healing hydrogel has gained much interesting for full-thickness wound healing because the hydrogel material can be injected directly and fulfill the wound site. Moreover, the hydrogel material has self-healing properties, which prolongs the healing process due to the recovery ability after damage to the hydrogel. For the first study, quaternized chitosan (QCS) was modified to improve the solubility and antibacterial activity. Also, oxidized pectin (OPEC) was modified to achieve aldehyde groups for Schiff's base reaction with the amino groups from QCS. Then, the hydrogel was optimized by varied concentrations and volumes of QCS and OPEC. The gelation of the hydrogels was evaluated and displayed for less than 1 min. Furthermore, the self-healing of hydrogels was studied and showed 30 min after cutting and continuous self-healing. The mechanical properties of the pure hydrogels were characterized. The compressibility was 162 and 117, which was not significantly different for pure hydrogel. However, the HG_0.6:0.4 showed a significantly higher hardness than HG_0.8:0.2. Moreover, the adhesiveness of HG_0.6:0.4 was 133 Pa within a suitable range for application as a wound dressing. The cytotoxicity and cell migration of pure hydrogels exhibited no cytotoxicity to NCTC clone 929 cells, and HG_0.6:0.4 showed higher cell migration than HG_0.8:0.2 and control. Meanwhile, the extraction media from the pure hydrogels displayed no antibacterial properties against *E. coli* and *S.*

aureus. From the result, HG_0.6:0.4 has the best potential use for the wound dressing material for the treatment.

For the second study was to improve the biological activities of hydrogels by incorporating with the α-mangostin (MT) or curcumin (CM)-β-cyclodextrin (CD) inclusion complex (MTx and CMx, respectively). MTx and CMx were prepared to improve the water solubility. The water solubility and XRD of drug-β-CD inclusion complexes were evaluated in this study. Moreover, the antioxidant and anti-inflammatory activities of drug-β-CD inclusion complexes were also evaluated. The results showed that the gelation time of the hydrogels containing drug-β-CD inclusion complexes was within 1 min, and the gel fraction was 81-85%. The injectable self-healing hydrogel containing drug-β-CD inclusion complexes promoted mechanical properties and good performance in antioxidant and anti-inflammatory activities. Furthermore, the antibacterial activity of these hydrogels against *E. coli* and *S. aureus* was up to 80% bacterial inhibition. The hydrogels containing drug-β-CD inclusion complexes were non-toxic to the cells and showed faster wound closure than the pure hydrogels. Thus, these injectable self-healing hydrogels containing MTx or CMx are good candidates for use as wound dressing materials.

Keywords: Quaternized Chitosan, Oxidized Pectin, Self-healing, Curcumin, α-Mangostin, Wound Healing