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ORIGINAL PAPER

Novel in situ mucoadhesive gels based on Pluronic F127 and xyloglucan containing metronidazole for treatment of periodontal disease

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Abstract Novel thermoresponsive in situ-forming hydrogels were prepared from co-solutions of Pluronic F127 (PF; triblock-copolymer of polyethylene oxide, polypropylene oxide and polyethylene oxide) and 0.1 wt% tamarind seed xyloglucan (0.1TSX). Based on test tube inversion method, co-solutions comprising 18 or 20 wt% PF and 0.1TSX (18PF/0.1TSX or 20PF/0.1TSX) gelled at 29 and 26 °C compared with 28 and 25 °C for equivalent concentration of PF solutions. DSC analyses indicated that 18PF/0.1TSX and 20PF/0.1TSX exhibited micellization temperatures of 15.5 and 14.9 °C, respectively, compared with 16.2 and 15.7 °C, respectively, for 18PF and 20PF. The lower micellization temperature but higher gel formation temperature suggests that 0.1TSX assists micelle formation but may interrupt order pack structure of micelle that is necessary for gelling. SEM revealed the cylindrical pore structure of lyophilized gels with diameters around 35 µm for 18PF, 20PF and 42 µm for 18PF/0.1TSX and approximately 78 µm for 20PF/0.1TSX. Extractables, released from PF/0.1TSX gels in phosphate buffered saline, did not reduce the viability of mouse osteoblast-like (MC3T3-E1) cells compared with the control, whereas those from PF gels were very cytotoxic with cell viability of 54–60% compared with the control. Therefore, the addition of 0.1TSX resulted in a significant decrease in cytotoxicity of PF. PF/0.1TSX gels exhibited improved mucoadhesive strength compared with PF gels and sustained the release of incorporated metronidazole antibacterial. These biocompatible systems which are in the liquid state before administration and undergo gelation in situ to form a gel at body temperature may, therefore, be injected into periodontal pockets to achieve sustained local delivery of antibacterials for the treatment of periodontitis.

Keywords Pluronic F127 · Xyloglucan · Mucoadhesion · In situ gel · Metronidazole · Drug delivery system

Introduction

Periodontitis is an inflammatory condition causing damage to the supporting structures of the teeth including the alveolar bone and the periodontal ligament. Accumulation of plaque at the gingival margin provokes an inflammatory response within the tissues that eventually results in the formation of pockets between the tooth and the soft tissue of the gum, leading to loss of the tooth if left untreated [1–3]. Treatment regimens typically involve cleaning of the tooth surface to remove plaque and calculus to prevent further damage and relapse after treatment. Antimicrobial agents are usually used as adjuncts to mechanical treatment [4]. The side effects of systemic antibiotic administration and ineffective access of antiseptic mouthwashes to the periodontal pocket have drawn attention to the sustained delivery of therapeutics to the periodontal pocket, to achieve higher concentrations at the site of infection [1]. The ideal formulation should be non-toxic, non-irritating and biodegradable, easily inserted and delivered the drug for a desired period of time.

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