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Comparative studies on the properties of glycyrrhetinic acid-loaded PLGA microparticles prepared by emulsion and template methods

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ABSTRACT

The O/W emulsion method has been widely used for the production of poly (lactide-*co*-glycolide) (PLGA) microparticles. Recently, a template method has been used to make homogeneous microparticles with predefined size and shape, and shown to be useful in encapsulating different types of active compounds. However, differences between the template method and emulsion method have not been examined. In the current study, PLGA microparticles were prepared by the two methods using glycyrrhetinic acid (GA) as a model drug. The properties of obtained microparticles were characterized and compared on drug distribution, *in vitro* release, and degradation. An encapsulation efficiency of over 70% and a mean particle size of about 40 μm were found for both methods. DSC thermograms and XRPD diffractograms indicated that GA was highly dispersed or in the amorphous state in the matrix of microparticles. The emulsion method produced microparticles of a broad size distribution with a core–shell type structure and many drug-rich domains inside each microparticle. Its drug release and matrix degradation was slow before Day 50 and then accelerated. In contrast, the template method formed microparticles with narrow size distribution and drug distribution without apparent drug-rich domains. The template microparticles with a loading efficiency of 85% exhibited a zero-order release profile for 3 months after the initial burst release of 26.7%, and a steady surface erosion process as well. The same microparticles made by two different methods showed two distinguished drug release profiles. The two different methods can be supplementary with each other in optimization of drug formulation for achieving predetermined drug release patterns.

1. Introduction

Oil-in-water (O/W) emulsion method has been widely used in encapsulation of active pharmaceutical ingredients into microparticles (Ye et al., 2010). This method generally forms microparticles with a spherical shape and a broad size distribution, which may cause a lack of good reproducibility (Bock et al., 2011). Since morphology has been demonstrated to be an important factor for *in vitro* and *in vivo* performance of microparticles (Tsai et al., 2013), new techniques have been developed for better control of particle size and size distribution. Acharya et al. (2010a) have described a new microfabrication technique, known as the polymer (or hydrogel) template method, for preparation of microparticles. This approach provides precise control of particle size and shape with a narrow size distribution, and also higher encapsulation capacity and efficiency for drug loading, in comparison with the conventional emulsion-based methods. The effects of particle size, drug properties, and poly (lactide-*co*-glycolide) (PLGA) types on drug release from microparticles prepared by the template method were described (Lu et al., 2014), but the differences in drug release properties between microparticles prepared by the hydrogel template method and an emulsion method have not been examined.

As one of the polymers used in clinical products approved by the U.S. Food and Drug Administration (FDA), PLGA has become one of the most widely used biodegradable and biocompatible materials in microparticle production (Pandita et al., 2015).

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