Gelatin-Based Hydrogel Materials for Controlled Sorption and Release of Metoprolol

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Gelatin-based materials, particularly hydrogels, are widely used in various biomedical science fields such as drug delivery and tissue engineering [1-2]. In this study, we utilized microfluidic techniques to generate two different gelatin methacryloyl (GelMA) hydrogels with inverse macroscopic structures but similar microscopic network structures, specifically porous hydrogels and hydrogel particles. Inverse macroscopic structures mean that the node size of the porous hydrogels equals the diameter of the hydrogel particles, as shown in Figure 1. The similarity of the hydrogel network structures of both materials, in terms of the hydrogel volume ratio upon swelling, was confirmed by using X-ray microtomography (µCT). Furthermore, the ion transport property of both hydrogel materials, in terms of sorption and release, were investigated using metoprolol as a model drug. We investigated the effect of the material shape, porous hydrogels and hydrogel particles, the material size, pores 550 and 850 µm in diameter, and particles 230 and 150 µm in diameter, on the sorption and release of metoprolol. The study was conducted under two conditions, equilibrium and time-dependent kinetics. We found that at equilibrium, the hydrogel morphology and size do not influence the sorption and release. On the other hand, they significantly affect the sorption and release kinetics. Metoprolol kinetics can be accelerated by increasing the pore size in the case of the porous hydrogel, and by decreasing the particle diameter in the case of the hydrogel particles, achieving the goal of controlling the sorption and release kinetics of metoprolol with the hydrogel matrix.

Keywords:
GelMA, microfluidics, porous hydrogels, hydrogel particles, X-ray microtomography, sorption, release

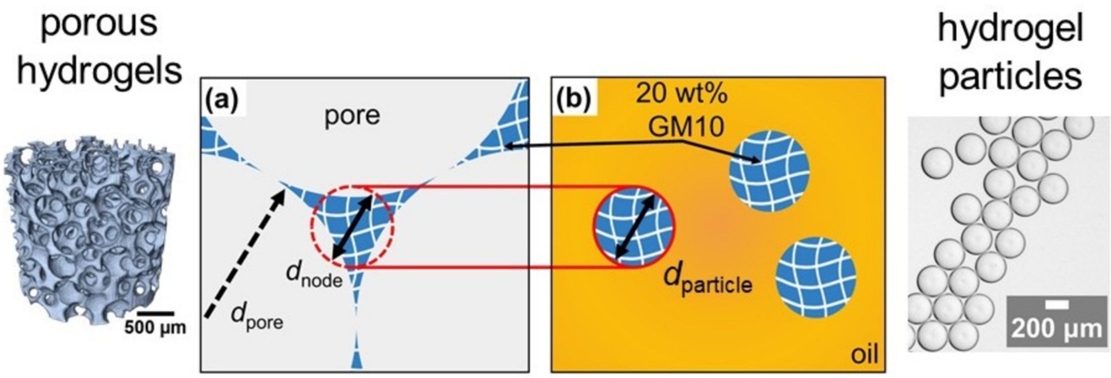

Figure 1: Schematic 2D drawing of GM10 (a) porous hydrogel and (b) hydrogel particles. The dashed circle in (a) represents a circle with a diameter (dnode) that has the same area as the blue area enclosed by three pores, i.e. the node. Fulfilling the condition dparticle = dnode one obtains hydrogels

References:

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