Drug release kinetics of L-Ascorbic acid 2-phosphate sesquimagnesium salt hydrate from porous carboxymethyl cellulose: comparison of aerogels and cryogels

Sujie Yu, Rudy Valette, Tatiana Budtova

Centre de Mise en Forme des Matériaux (Cemef), MINES-ParisTech, PSL, France

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Carboxymethyl cellulose (CMC) is a well-known cellulose derivative used in various applications. In particular, CMC is widely used in biomedical applications due to its non-toxic, biocompatible and biodegradable properties. However, not much is known about the use of CMC for making bio-aerogels and their potential biomedical application. In this work, porous CMC materials as potential wound healing materials were prepared from CMC solutions, followed by solvent exchange and then drying with supercritical CO2 and freeze drying, leading to "aerogels" and "cryogels", respectively. The hydrophilic drug L-Ascorbic acid 2-phosphate sesquimagnesium salt hydrate (Asc-2P) was used as a model drug as it is known to possess antioxidant activity and collagen synthesis. The drug was dissolved in CMC solution, and release from aerogels or cryogels in a simulated wound exudate medium was studied. The goal was to compare the in vitro release behavior and drug loading efficiency from CMC aerogels and cryogels as a function of the drying methods and the physicochemical properties (CMC degree of substitution, density, specific surface area and morphology) of materials. Higher water absorption was obtained for CMC cryogels (up to 2500%) as compared to aerogels (100-1700%). Cryogels showed a higher loading efficiency (up to 100%) and fast release and dissolution time in comparison with aerogels. The drug-loaded aerogels show controllable and sustained release of Asc-2P. The behavior of drug release is dependent on the CMC degree of substitution and density in the case of aerogels. In contrast, for cryogels, the degree of substitution and density didn't noticeably influence release kinetics. The sustained release from the aerogels based of CMC of low degree of substitution (0.7) is able to reach 48 h in a simulated wound exudate medium. In summary, we demonstrated that the release of Asc-2P from CMC aerogels and cryogels can be tuned via the density, degree of substitution and drying methods, which opens the prospects for their use in biomedical applications.