Water-based preparation of spider silk films as drug delivery matrices

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Abstract

The main focus of this work was to obtain a drug delivery matrix characterized by biocompatibility, water insolubility and good mechanical properties. Moreover the preparation process should be compatible with protein encapsulation and the obtained matrix should be able to sustain release a model protein. Spider silk proteins represent exceptional natural polymers due to their mechanical properties in combination with biocompatibility. As both hydrophobic and slowly biodegrading biopolymers, recombinant spider silk proteins fulfill the required properties for a drug delivery system. In this work, we present the preparation of eADF4(C16) films as drug delivery matrices without the use of any organic solvent. Water-based spider silk films were characterized in terms of protein secondary structure, thermal stability, zeta-potential, solubility, mechanical properties, and water absorption and desorption. Additionally, this study includes an evaluation of their application as a drug delivery system for both small molecular weight drugs and high molecular weight molecules such as proteins. Our investigation focused on possible improvements in the film's mechanical properties including plasticizers in the film matrix. Furthermore, different film designs were prepared, such as: monolayer, coated monolayer, multilayer (sandwich), and coated multilayer. The release of the model protein BSA from these new systems was studied. Results indicated that spider silk films are a promising protein drug delivery matrix, capable of releasing the model protein over 90 days with a release profile close to zero order kinetic. Such films could be used for several pharmaceutical and medical purposes, especially when mechanical strength of a drug eluting matrix is of high importance.

Keywords: spider silk; film; multilayer; coating; 2-pyrrolidone; glycerol