Development and Characterization of Aqueous-Based Recombinant Spider Silk Protein Biomaterials with Investigations into Potential Applications | Biological Engineering

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Full Abstract

Spider silks are impressive protein structures that possess several desirable properties for biomaterials such as, biodegradability, mechanical robustness, and biocompatibility. Unfortunately, the feasibility of collecting silks directly from spiders is extremely unlikely and consequently any significant or useful silk has to be synthetically produced. The use and application of these recombinant spider silk proteins (rSSps) is also limited by solvation and formation methods. However, these latter issues may be alleviated with a recently developed biomimetic aqueous-based solvation system.

The general aims of this project are to: further refine the aqueous solubilization process, use this method to develop and characterize novel rSSps materials, and finally apply these materials for specific applications or proof of concepts. The method and derived materials will undergo design, building, testing, and characterization, with the intent being to identify critical features or correlations by applying engineering approaches and methods. This will primarily be accomplished by evaluating physical and chemical features of the rSSps materials for instance, mechanical properties or spectroscopically determined molecular configurations, and associating the observed results. This will yield further knowledge about the materials and their properties and lead to further customization or tunability that will match a specific form with a specific function. Areas and applications that can benefit from the intrinsic properties of spider silks such as, tissue scaffolds, encapsulation devices, green products, or biomedical devices will be attempted and tested. Based upon the results obtained during these initial attempts and the fundamental properties identified for the components, further optimization, characterization, and applications will be tested and validated.

In summary, the comprehensive objective of this project is to further improve a solvation method and the resulting material products by applying and identifying new constraints and parameters of the system. By using an iterative investigation process, which will be adjusted based upon result feedback and critical properties, it is the proposed intent to characterize this system from start to finish. The end result of accomplishing these goals will be a rSSps materials system that has properties, processes, and products defined in a standardized, logical manner that can be implemented with minimal effort.