SilkyColi: Reprogramming the physical and functional properties of synthetic silks.

Silk as a Versatile Biomaterial
- Silks have remarkable mechanical properties, with tensile strength similar to that of steel.
- Silks can be chemically modified to confer a range of new functionalities, expanding silks' natural repertoire.
- Silks are biodegradable, and easily manipulated, making them excellent biomaterial candidates.

Critical Issues in Silk Manufacturing
- Cloning genetic variants of silk structures is time-consuming and difficult due to the repetitive nature of the DNA sequences.
- Manufacturing functionalized silk proteins are hindered by high cost and poor scalability.
- Recombinant spider silk production is hampered by low protein yields and purity relative to natural silk.

Our Project Goals:
- Adapt existing cloning techniques as a new method to rapidly assemble spider silk genes.
- Design novel peptides to incorporate functional domains into Bombyx mori silk fibers.
- Explore production of silks from alternative species for unique materials design.

Engineering Spider Silk with Iterative Capped Assembly
Iterative Capped Assembly is a technique designed for constructing repetitive genes. We used ICA to control the length and composition of recombinant silk genes. ICA constructs silk genes by sequentially ligating individual monomeric repeats of about 100 base pairs into a long chain.

Production of Multi-Species Silk Fibers and Films
Silk requires processing before it can be used in vitro. Dialyzed silk can be processed into various materials, including films or hydrogels. Alternatively, lyophilized silk can be dissolved into a liquid dope, which can then be spun into a fiber through a variety of methods.

Production of Silk Fibroin from Honeybees
Honeybee silk is secreted by the salivary glands of honeybees to construct cocoons and provide structural support for the hive. It presents an intriguing alternative to spider and silkworm silk because the non-repetitive nature of the honeybee silk genes (AnseiF3) allows for simple cloning and genetic engineering of multiple silk fusion proteins.

Production of Recombinant Co-Spinning Proteins for Rapid Silk Fiber Functionalization
In order to functionalize wild silk, we constructed a BioBrick to co-spin with native Bombyx mori fibroin, producing a strand with the functional domain of interest attached to the structure.

Acknowledgments
- Advising:...
- Affiliated:...
- Human Practices:...
- Future Directions:...

References
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