Abstract

This year, GreatBay_SZ aims to manufacture recombinant spider silk with Escherichia coli (E. coli) and color the silk for application in cloth industry. We modularized three significant domains of spidroin - the N-terminal, the repetitive region, and the C-terminal - and integrated them into various spidroin to form silk. Then we dyed the silk with microbial natural pigments deoxyviolacein and indigo. To obtain better color and a more convenient dying process, we fused the repetitive region to chromoproteins and mixed them with spidroin during spinning. Our team hopes to provide a novel approach for cloth production and explore new possibilities for spider silk applications.

Introduction

In order to achieve a variety of colors, we designed a new dying approach. We improved chromoproteins for better combination effect with our spider silk. In total, we constructed 2rep-sfGFP, 2rep-eforRed, and 2rep-amilCP, and obtained silk with the color of fluorescent green, fluorescent red, and blue silk.

Chromoprotein Engineering

A. Non-repetitive N-terminal region
B. Multiple repetitive regions
C. Non-repetitive C-terminal region

Natural Dyes Synthesis

To obtain environmentally friendly colored spider silk, we decided to apply natural pigments to our silk. We constructed two genetic circuits to over produce pigments deoxyviolacein (purple red) with a yield of 85.81±9.09mg/L and indigo (blue) with a yield of 6.97±0.44mg/L. We introduced a mini-spidroin model NT-2Rep-CT, realized the ever production of such spider silk to a yield of 33±54mg/L, and successfully obtained the silk spun. We as well designed three types of mini-spidroin, NT4RepCT, NTWCT, and NT3WCT to produce spider protein (spidroin) for silk generation.

Hardware and Demonstration

After visiting scientists and industries, we designed our machine to achieve automatic spinning. Meanwhile, we further refined our hardware to render it a novel dying approach after silk generated.

Figure 1. The overview of our spidroins and silk spinning methods.

How to weave a spiderman battle suit? We try spider silks.

Public Engagement

Since our project requires us to combine practices from dyeing industry and fiber production industry, we have consulted people with different social roles, from traditional colorists to professors specialized in spider silk production, and visited sites from dyeing factories to companies with electrospinning technologies.

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