Synthesizing Spider Silk Protein from E. Coli

Background

Spider silk is a valuable material due to its extreme strength and elasticity. However, spider silk is difficult to produce in mass quantities because of the many factors which get in the way of producing large amounts of pure protein. Harvesting the silk from spiders is not efficient. A major issue is spiders like to kill each other until they have their own web space, so storing spiders is impractical, and the silk harvested from spiders does not allow for large quantities of the pure protein. Also the protein from spiders is only useful in producing fibers.

Cleaning the holding tank like a good undergrad

Process

The production of spider silk protein begins with culturing a single colony of E. coli, which can express the desired gene for spider silk. The colony is moved into an incubator, and fed nutrients to continue its growth. As the growth of the bacteria continues, the bacteria are routinely monitored to make sure the desired trait is being expressed. When this is confirmed, the tank temperature is raised. The higher temperature begins to precipitate out unwanted material. After a run in a centrifuge, the now purer solution, containing the spider silk protein, is put through TFF.

The TFF system filters by size. Since the desired protein is a specific size, two filters of different sizes remove unwanted materials. The first filter removes everything smaller than 750kDa, and moves it to a concentration container. That solution is sent through another filter, which removes everything smaller than 50kDa. The protein is between 50kDa and 750kDa, so the protein stays in the concentration container.

The solution is treated with buffer to remove unwanted salts, concentrated to reduce volume, and freeze dried to form a dry protein powder.

Conclusion

This lab has been a great learning experience. With a lot of trial and error, I have seen brand new processes come to life. The people in charge of research have done a fantastic job of explaining processes, and not only the how, but the why as well. I never realized how innovative researchers have to be in order to make breakthroughs in their field. From the nine months I have worked in this lab, I have seen major accomplishments, and I am very excited to see what else will happen in the time to come. Spider silk is “an ancient biomaterial for the future” with so much potential.