Biotech In focus

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The Amazing Spider Goat

This week's Biotech in Focus is based on a paper written by Michael Rogers, a University of Hawaii at Manoa student who recently enrolled in TPSS 416 (Introduction to Social, Ethical, and Political Issues Associated with Biotechnology). Designed for non-majors, this class is offered by the Department of Tropical Plant and Soil Sciences in UH Manoa's College of Tropical Agriculture and Human Resources.

What do Spider-Man, one hundred villagers in Madagascar, and a goat have in common? All three have produced the miracle fiber that is spider silk. Well almost all three, Spider-Man is a fictitious character of course! Tougher than synthetic fibers such as Kevlar and with tensile strength comparable to high-grade steel alloy, spider silk is super lightweight, can stretch 40 percent of its length without breaking, and remains flexible at very cold temperatures. Given these remarkable properties, spider silk has a host of potential uses. In the future, spider silk may improve products ranging from protective gear and medical supplies to architectural structures. While humans have tinkered with materials for thousands of years, early spiders made silk almost 400 million years ago, long before birds, mammals, or even reptiles existed.

Unlike silk worms, spiders are difficult to farm because they are territorial and cannibalistic. This makes mass production of spider silk a challenge. For example, villagers in Madagascar recently spent three years catching golden orb spiders, harvesting their silk, and releasing them, 1.2 million spider captures in total. The result of their spider silk collecting efforts is a stunning museum piece, a one-of-a-kind golden tapestry that measures eleven feet by four feet.


Panel (Lamba Akotifahana), 2008. Madagascar.

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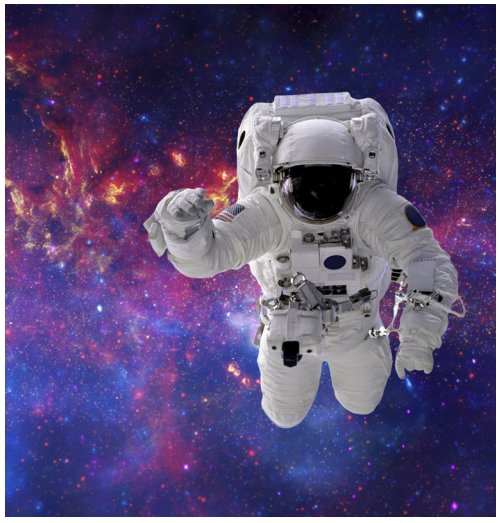
Milking For Silk

If spider silk is to be employed for wider practical uses a more economical way to produce it is needed. Scientists have devised a way to create spider silk by milking goats. Spider silk is made entirely from proteins, and mammals have milk-producing mammary glands that are very efficient at making proteins. Researchers found that they could genetically engineer a goat to produce spider silk protein in its milk and in tobacco. The goat is a versatile, easy-to-handle animal that was domesticated thousands of years ago for its meat and milk. Spider genes containing the instructions to make silk proteins were inserted into the DNA of goat embryos. The goats can be milked twice a day, and the spider silk protein can be extracted from the milk to produce spider silk at a substantially greater rate and quantity than spiders can provide.

Incredible Strength

Remember the scene in Spider-Man 2 when Spider-Man stops a speeding train with spider silk? Scientists have calculated that spider silk of the diameter shown in that scene could have indeed stopped the train in real life! This demonstrates the incredible strength characteristic of spider silk.

Future Superheros



A future superhero in a spider silk parachute might someday land on a suspension bridge hanging from spider silk wires, fend off villains with the aid of lightweight spider silk body armor, and be stitched up later with spider silk sutures. If saving the world requires travel through outer space, a spider silk spacesuit would remain flexible in the extreme cold.

Possibilities

The possibilities are limited only by imagination. There will of course be extensive testing regarding animal welfare and safety of this technology before it is developed to commercial scale.

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