

'Spider-goats' start work on wonder web

By Roger Highfield, Science Editor

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A HERD of goats containing spider genes is about to be milked for the ingredients of spider silk to mass-produce one of nature's most sought-after materials.

Scientists have for the first time spun synthetic spider silk fibres with properties approaching the real thing, paving the way for their use in artificial tendons, medical sutures, biodegradable fishing lines, soft body armour and a host of other applications.

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Webster and Peter, genetically altered goats unveiled today by the Canadian company Nexia, are the founders of a GM herd whose offspring will produce spider silk protein in their milk that can be collected, purified and spun into the fibres. Females will begin mass-producing spider milk in the second quarter of this year for a variety of military and industrial uses.

Spider silk has long been admired by material scientists for its unique combination of toughness, lightness and biodegradability. Dragline silk, which comprises the radiating spokes of a spider web, is stronger than the synthetic fibre Kevlar, stretches better than nylon and, weight for weight, is five times stronger than steel.

These incredible qualities are the product of 400 million years of evolution. Now spider yarn has been spun by the US Army and the company Nexia Biotechnologies of Montreal, marking a milestone in efforts to ape arachnids.

The work "opens up a lot of things on the practical level and on a research level," said Dr Randy Lewis, a spider silk expert at the University of Wyoming, Laramie. Dr Jeffrey Turner, President of Nexia, said: "Mimicking spider silk properties has been the holy grail of material science and now we've been able to make useful fibres.

"It's incredible that a tiny animal found literally in your backyard can create such an amazing material by using only amino acids, the same building blocks used to make skin and hair."

Spider silk is a material science wonder, "a self-assembling, biodegradable, high-performance, nanofibre structure one-tenth the width of a human hair that can stop a bee travelling at 20 miles per hour without breaking. Spider silk has dwarfed man's achievements in material science to date."

Today, in the journal *Science*, the scientists describe details of the production of different dragline spider silk proteins. First, they turned cells from cows' lungs and baby hamster kidneys into silk protein "factories" by giving them genes from two different species of orb-weaving spiders whose dragline silks have been documented to be among the strongest.

The silk proteins from one of these species were then spun from a solution in water to produce water-insoluble fibres of the spider silk, which the company calls BioSteel. The researchers found that the spinning conditions used were adequate to produce fibres that were one third the strength of natural spider silk but still good enough for microsurgery, for instance.

For about a century, people have tried to farm spider silk. Spiders can be coaxed to make it, but attempts to create "spider farms" have failed because of the territorial nature of spiders.

For the past decade, scientist have tried to spin their own yarn. They were successful in producing spider silk proteins in bacteria and yeast but these tended to form insoluble clumps inside the cells. Even when extracted, they could only be turned into worthless brittle fibres.

The Nexia team - inspired by the work of Prof Fritz Vollrath at Oxford University, now working in Kenya - used bovine and hamster cells that secreted silk proteins.

They concentrated these proteins in water, then extruded them through a tiny hole at the end of a syringe and into another solution of methanol, prompting the proteins to assemble into fibres that were lighter, yet tougher, than Kevlar and nearly as elastic as nylon.

By playing with the production conditions, or adding a second spider protein, they hope to achieve the flex of natural silk.

"We and others have been working on spider silk for a considerable time and are thrilled finally to have the opportunity to spin synthetic silks and move the field towards real applications," said Dr Jean Herbert of Natick Soldier Centre.

External Links

Nexia and US Army spin man-made spider silk [17 Jan '02] - Nexia

(<http://nexiabiotech.com/HTML/investor/webcast.shtml>)

Science magazine [registration required] (<http://www.sciencemag.org/content/current/>)

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