

Scientists stick to spider silk for biodegradable alternative to traditional glue

July 20 2020, by Ben Robinson



Credit: Pixabay/CC0 Public Domain

Scientists have successfully produced synthetic spider silk to create a new biodegradable glue alternative.

The Manchester University-based researchers found that their homemade [synthetic spider silk](#) glue works as well as commercially available adhesives without being environmentally harmful.

The glue was made by coaxing [harmless bacteria](#) to produce [spider](#) silk in addition to their normal proteins. The bacteria could then be fed sugar and nutrients to produce the spider silk glue through fermentation. The process is similar to the fermentation of beer but with spider silk glue being made instead of alcohol.

Research published today in the journal *Materials Today Bio*, shows the spider silk glue was found to be especially good at sticking glass together with an initial [adhesive](#) strength rating of 6.28, when compared with a commercial speciality glass glue has a strength of 11.9. The new breakthrough opens the door to a range of sustainable alternatives to an industry which is worth billions of dollars annually.

Dr. Aled Roberts from the Manchester Institute of Biotechnology who led the research said: "We found evidence that the mechanism of adhesion was due to unfolding of the protein and reorganization into a dense hydrogen-bonded structure rich in what are known as β -sheets. This was interesting because natural spider silk has been shown to undergo a similar transformation into a β -sheet rich structure as spiders spin their silk—and is understood to be what makes spider silk so strong and tough. Kevlar also gets its strength from a densely hydrogen-bonded network."

Natural proteins were commonly used as glues before synthetic adhesives were developed. Collagen (from animal hooves), casein (from cheese) and gluten (from grain) were all used as glues before we developed chemical synthesis methods to make adhesives from [crude oil](#).

Today, protein-based glues have been almost completely displaced by

synthetic alternatives, which are produced on a vast scale with the global market totalling \$41 billion in 2010. This industrial process from oil contributes significantly to global emissions of greenhouse gasses and volatile organic compounds (VOCs) so alternatives are required.

These findings should help with the design and formulation of other protein-based adhesives which, with further optimisation, could compete with commercial crude-oil derived adhesives and give us renewable, biodegradable and green glues as we had in the past.

Many organisms produce specialized proteins specifically for adhesion. Mussels produce a strong protein-based [glue](#) that allows them to stick to slippery rocks in rough inter-tidal zones. Spiders also produce tough [silk](#)-based glues which they use to capture fast-moving insects in their webs.

As the world transitions away from [fossil fuels](#) and towards a renewable future, there is a growing need to replace CO₂-intensive crude-oil derived adhesives with greener alternatives. One option could be to return to protein-based glues, whose properties could be designed and optimized using the tools of synthetic biology.

Unlike synthetic crude-oil derived adhesives, these protein-based glues would be water-based, non-toxic, biodegradable and environmentally non-persistent. They would also be grown under benign conditions ([ambient temperatures](#) and pressures) and could be produced through fossil-fuel free, green synthesis routes—via processes similar to the fermentation of beer.

More information: A.D. Roberts et al. Non-covalent protein-based adhesives for transparent substrates—bovine serum albumin vs. recombinant spider silk, *Materials Today Bio* (2020). [DOI: 10.1016/j.mtbio.2020.100068](https://doi.org/10.1016/j.mtbio.2020.100068)

Provided by University of Manchester

Citation: Scientists stick to spider silk for biodegradable alternative to traditional glue (2020, July 20) retrieved 19 April 2024 from <https://phys.org/news/2020-07-scientists-spider-silk-biodegradable-alternative.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.