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Efficient immunotherapy using spider silk

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Spider silk guarantees that special pharmaceutical substances can make it to the centre of immune cells and achieve their maximal effect. Together with the company AMSilk, researchers from the University of Bayreuth, the LMU in Munich, and the Universities of Genf and Freiburg in Switzerland have developed transport particles from artificial spider silk that are capable of significantly increasing the efficiency of immunotherapies for cancer and tuberculosis. They can also be employed in preventive vaccinations against infectious diseases or for vaccine storage in the tropics. The scientists have published their findings in the journal *Biomaterials*.

"The biotechnologically produced spider silk biopolymers we used to craft new transport particles in the laboratory are non-toxic, do not elicit any immune reactions, and exhibit no other damaging effects to the body," explained Prof. Dr. Thomas Scheibel, Chair of Biomaterials at the University of Bayreuth. The team of researchers from Germany and Switzerland made use of these advantages of spider silk to overcome an obstacle that has stood in the way of some immunotherapeutic methods. To enable the human immune system to take action against cancer or tuberculosis once they are present, it is necessary to stimulate certain immune cells known as T-lymphocytes. To this end, a small protein molecule – a peptide – must be placed in the cell. The usual method of injecting this substance into the bloodstream is not particularly efficient. The reason is that a large portion of the peptide is broken down in the body before it ever reaches the immune cells. However, if it is packed in spider silk, it is able to reach its destination safely.

The scientists emphasize that there is still a long road ahead before the findings are applied in clinical practice. "A number of additional tests will be needed before the substance transporter is actually able to be used to treat serious illnesses. Nonetheless, our research findings to date represent a promising step in this direction," Scheibel said. Additional adjuvants that currently facilitate certain immunotherapies may then no longer be needed.

New prospects for preventive medicine

This also opens up a range of possible applications in preventive medicine, since the new transport particles are equally effective at accurately delivering vaccines to the B-lymphocytes. These immune cells trigger the production of anti-bodies that are capable of recognizing pathogens from infectious diseases and render them harmless. In many countries, such as those in the tropical regions of Africa, storing vaccines is still a major problem. The reason is that when vaccines are exposed to high air temperatures, their effectiveness decreases. However, the transporters made of spider silk exhibited impressive durability in the laboratory. They even withstand temperatures of over 100 degrees Celsius for several hours and are able to protect the vaccines from the effects of temperature and light. Spider silk will thus be able to contribute to ensuring that the storage of vaccines in the tropics – e.g. in the scope of large-scale prevention programmes – does not fail due to unfavorable climate conditions.

Scientists recently succeeded in extending the medical applications of the substance transporters in an important way. In the past, they were only suited for packing small particles. However, the team at the University of Bayreuth also employed them for holding larger antigens, such as entire proteins, and release them in a controlled manner. This study was published in *ACS Biomaterials Science & Engineering*.

Both of the new studies followed a basic scientific idea currently gaining more and more prevalence in biomedicine and other branches of science: nature is becoming a model for innovations aimed at bringing a high degree of benefit to humans. Scheibel aptly summarized the point: "This approach has a name that is a succinct expression of what has made our research such a success: 'bio-inspiration'."

More information: Sushma Kumari et al. Recombinant Spider Silk Hydrogels for Sustained Release of Biologicals, *ACS Biomaterials Science & Engineering* (2018). DOI: 10.1021/acsbiomaterials.8b00382

Matthias Lucke et al. Engineered hybrid spider silk particles as delivery system for peptide vaccines, *Biomaterials* (2018). DOI: 10.1016/j.biomaterials.2018.04.008

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