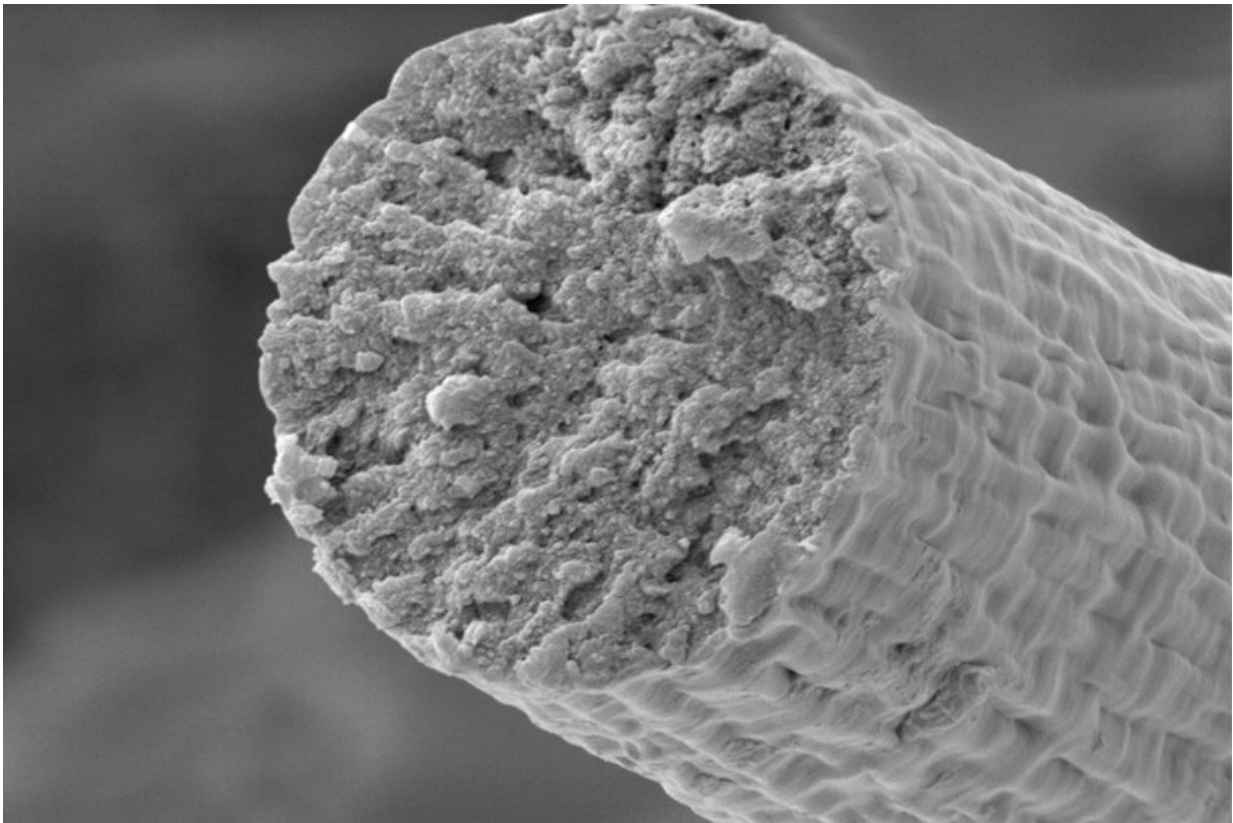


Synthetic biology enables microbes to build muscle

August 30 2021



Researchers at the McKelvey School of Engineering at Washington University in St. Louis have developed a synthetic chemistry approach to polymerize proteins inside of engineered microbes. This enabled the microbes to produce the high molecular weight muscle protein, titin, which was then spun into fibers. In the future, such material could be used for clothing, or even for protective gear. Credit: Washington University in St. Louis

Would you wear clothing made of muscle fibers? Use them to tie your shoes or even wear them as a belt? It may sound a bit odd, but if those fibers could endure more energy before breaking than cotton, silk, nylon, or even Kevlar, then why not?

Don't worry, this muscle could be produced without harming a single animal.

Researchers at the McKelvey School of Engineering at Washington University in St. Louis have developed a synthetic chemistry approach to polymerize proteins inside of engineered microbes. This enabled the microbes to produce the high molecular weight muscle protein, titin, which was then spun into fibers.

Their research was published Monday, August 30 in the journal *Nature Communications*.

Also: "Its production can be cheap and scalable. It may enable many applications that people had previously thought about, but with natural [muscle fibers](#)," said Fuzhong Zhang, professor in the Department of Energy, Environmental & Chemical Engineering. Now, these applications may come to fruition without the need for actual animal tissues.

The synthetic muscle protein produced in Zhang's lab is titin, one of the three major protein components of muscle tissue. Critical to its [mechanical properties](#) is the large molecular size of titin. "It's the largest known protein in nature," said Cameron Sargent, a Ph.D. student in the Division of Biological and Biomedical Sciences and a first author on the paper along with Christopher Bowen, a recent Ph.D. graduate of the Department of Energy, Environmental & Chemical Engineering.

Muscle fibers have been of interest for a long time, Zhang said.

Researchers have been trying to design materials with similar properties to muscles for various applications, such as in soft robotics. "We wondered, 'Why don't we just directly make synthetic muscles?'" he said. "But we're not going to harvest them from animals, we'll use microbes to do it."

To circumvent some of the issues that typically prevent bacteria from producing large proteins, the research team engineered bacteria to piece together smaller segments of the protein into ultra-high molecular weight polymers around two megadaltons in size—about 50 times the size of an average bacterial [protein](#). They then used a wet-spinning process to convert the proteins into fibers that were around ten microns in diameter, or a tenth the thickness of human hair.

Working with collaborators Young Shin Jun, professor in the Department of Energy, Environmental & Chemical Engineering, and Sinan Keten, professor in the Department of Mechanical Engineering at Northwestern University, the group then analyzed the structure of these fibers to identify the molecular mechanisms that enable their unique combination of exceptional toughness, strength, and damping capacity, or the ability to dissipate mechanical energy as heat.

Aside from fancy clothes or protective armor (again, the fibers are tougher than Kevlar, the material used in bulletproof vests), Sargent pointed out that this material has many potential biomedical applications as well. Because it's nearly identical to the proteins found in muscle tissue, this synthetic material is presumably biocompatible and could therefore be a great material for sutures, tissue engineering, and so on.

Zhang's research team doesn't intend to stop with synthetic [muscle](#) fiber. The future will likely hold more unique materials enabled by their microbial synthesis strategy. Bowen, Cameron, and Zhang have filed a patent application based on the research.

"The beauty of the system is that it's really a platform that can be applied anywhere," Sargent said. "We can take proteins from different natural contexts, then put them into this platform for polymerization and create larger, longer proteins for various material applications with a greater sustainability."

More information: Microbial production of megadalton titin yields fibers with advantageous mechanical properties, *Nature Communications* (2021). [DOI: 10.1038/s41467-021-25360-6](https://doi.org/10.1038/s41467-021-25360-6)

Provided by Washington University in St. Louis

Citation: Synthetic biology enables microbes to build muscle (2021, August 30) retrieved 24 April 2024 from <https://phys.org/news/2021-08-synthetic-biology-enables-microbes-muscle.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.