Silkworms and shrimp may help regenerate damaged skin and bone

July 24 2024, by Gareth Willmer

Credit: Quang Nguyen Vinh from Pexels

Researchers are exploring new nature-based solutions to stimulate skin and bone repair.

In the cities of Trento and Rovereto in northern Italy and Bangkok in Thailand, scientists are busy rearing silkworms in nurseries. They're hoping that the caterpillars' silk can regenerate human tissue. For such a delicate medical procedure, only thoroughbreds will do.

"By changing the silkworm, you can change the chemistry," said Professor Antonella Motta, a researcher in bioengineering at the University of Trento in Italy. That could, in turn, affect clinical outcomes. "This means the quality control should be very strict."

Silk has been used in surgical sutures for hundreds of years and is now emerging as a promising nature-based option for triggering human tissue to self-regenerate. Researchers are also studying crab, shrimp and mussel shells and squid skin and bone for methods of restoring skin, bone and cartilage. This is particularly relevant as populations age.

Shift in approach

"Tissue engineering is a new strategy to solve problems caused by pathologies or trauma to the organs, as an alternative to transplants or artificial device implantations," said Motta, noting that these interventions can often fail or expire. "The idea is to use the natural ability of our bodies to rebuild the tissue."

The research forms part of the five-year EU-funded SHIFT project that Motta coordinates, which includes universities in Europe, as well as partners in Asia and Australia. Running until 2026, the research team aim to scale up methods for regenerating skin, bone and cartilage using bio-based polymers and to get them ready for clinical trials. The goal is to make them capable of repairing larger wounds and tissue damage.

The research builds on work carried out under the earlier REMIX project, also funded by the EU, which made important advances in understanding the different ways in which these biomaterials could be used.

Building a scaffold

Silk, for instance, can be used to form a "scaffold" in damaged tissue that then activates cells to form new tissue and blood vessels. The process could be used to treat conditions such as diabetic ulcers and lower back pain caused by spinal disk degeneration. The SHIFT team have been exploring minimally invasive procedures for treatment, such as hydrogels that can be applied directly to the skin, or injected into bone or cartilage.

The approaches using both silkworms and some of the marine organisms have great potential, said Motta.

"We have three or four systems with different materials that are really promising," she said. By the end of SHIFT, the goal is to have two or three prototypes that can be developed together with start-up and spin-off companies created in collaboration with the project.

One of the principles of the SHIFT team has been been exploring how best to harness the concept of a circular economy. For example, they are looking into how waste products from the textile and food industries can be reused in these treatments.

Yet with complicated interactions at a microscale and the need to prevent the body from rejecting foreign materials, such tissue engineering is a big challenge.

"The complexity is high because the nature of biology is not easy," said Motta. "We cannot change the language of the cells, but instead have to learn to speak the same language as them."

But she firmly believes the nature-based rather than synthetic approach is the way to go and thinks treatments harnessing SHIFT's methods could become available in the early 2030s.

"I believe in this approach," said Motta. "Bone designed by nature is the best bone we can have."

Skin care

Another EU-funded project known as SkinTERM which runs for almost five years until mid-2025 is also looking at novel ways to get tissue to regenerate itself, focusing on skin. To treat burns and other surface wounds today, a tiny layer of skin is often grafted from another part of the body. This often causes the appearance of disfiguring scars, and the patient's mobility can be impacted when the tissue contracts as it heals. Current methods can also be painful.

The SkinTERM team are therefore investigating how inducing interactions in networks of cells might enable skin to regenerate.

"We could do much better if we move towards regeneration," said Dr. Willeke Daamen, who coordinates SkinTERM as a researcher in soft tissue regeneration at Radboud University in Nijmegen, the Netherlands. "The ultimate goal would be to get the same situation before and after being wounded."

Researchers are studying a particular mammal—the spiny mouse—which has a remarkable ability to heal without scarring. It is able to self-repair damage to other tissues like the heart and spinal cord too. This is also true of early fetal skin.

The team are examining these systems to learn more about how they work and the processes occurring in the area around cells, known as the extracellular matrix. They hope to identify factors that might have a role in the regenerative process, and test how it might be induced in humans.

Kick-start

"We've been trying to learn from those systems on how to kick-start such processes," said Daamen. "We've made progress in what kinds of compounds seem at least in part to be responsible for a regenerative response."

Many lines of research are being carried out among a new generation of multidisciplinary scientists being trained in this area, and a lot has already been achieved, said Daamen.

They have managed to create scaffolds using different components related to skin regeneration, such as the proteins collagen and elastin. They have also collected a vast amount of data on genes and proteins with potential roles in regeneration. Their role will be further tested by using them on scar-prone cells cultured on collagen scaffolds.

"The mechanisms are complex," said Dr. Bouke Boekema, a senior researcher at the Association of Dutch Burn Centers in Beverwijk, the Netherlands, and vice-coordinator of SkinTERM.

"If you find a mechanism, the idea is that maybe you can tune it so that you can stimulate it. But there's not necessarily one magic bullet."

By the end of the project next year, Boekema hopes the research could result in some medical biomaterial options to test for clinical use. "It would be nice if several prototypes were available for testing to see if they improve outcomes in patients."

More information:

- SHIFT
- SkinTERM
- EU health research and innovation

Provided by Horizon: The EU Research & Innovation Magazine

Citation: Silkworms and shrimp may help regenerate damaged skin and bone (2024, July 24) retrieved 24 July 2024 from https://phys.org/news/2024-07-silkworms-shrimp-regenerate-skin-bone.html