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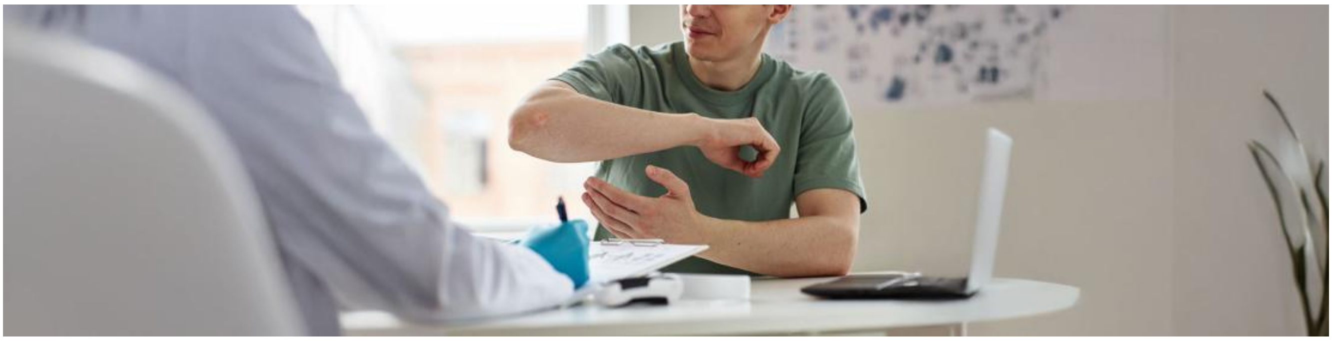

The living patch: could a tea-inspired material help treat eczema?

Inspired by the microbes that make kombucha tea, EU-funded researchers are developing a living patch that could detect and treat eczema flare-ups while opening the door to a new generation of smart materials containing living cells.

04 August 2026 - By MICHAELA NESVAROVA

For millions of people living with atopic dermatitis, commonly known as eczema, managing the condition can feel like a constant struggle. Flare-ups are unpredictable, existing treatments are broad and relief is often temporary.

During flare-ups, harmful bacteria multiply rapidly, crowding out the beneficial microbes that normally help keep the skin healthy and inflammation under control.

Professor Tom Ellis, a synthetic genome engineer at Imperial College London, believes the answer may lie in an unusual source: a wearable patch that is, in a meaningful sense, alive.

Working with colleagues across Europe, Ellis is one of the lead researchers on the EU-funded NextSkins initiative that runs until 2027. The research team is exploring how engineered living materials (ELMs) could be used to create new kinds of medical treatments based on living microorganisms, such as bacteria and yeast.

Living patch

One of the team's most promising prototypes is a thin, skin-like patch. Its bottom layer contains engineered proteins that detect enzymes released by harmful bacteria during an eczema flare. That signal triggers living yeast cells deeper in the patch to produce and release therapeutic molecules exactly where they are needed.

The patches can be made tens of centimetres across, with therapeutic molecules released over the whole surface, and could even be adapted into sleeves, bandages or garment inserts for wider coverage.

Most current eczema treatments are topical ointments that take a very broad approach. “They go to all cells and interact with all microbes on the skin,” Ellis said. “This is not ideal, because there are many different bacteria and fungi living on our skin and many of them are beneficial.”

The goal of the NextSkins researchers is to develop a therapy that targets harmful microbes while leaving the rest of the skin’s delicate microbial ecosystem intact, helping to restore its natural balance rather than disrupt it.

“We want to make therapies that focus on the bad guys and the bad guys alone,” said Ellis.

Inspiration from kombucha

The inspiration comes from kombucha, the fermented tea drink in which yeast and bacteria naturally grow together.

The patch works by enclosing engineered living yeast cells within a matrix of bacterial cellulose. Rather than acting continuously, the engineered cells are designed to detect chemical signals produced when harmful bacteria associated with eczema begin to dominate the skin microbiome.

“The wearable patch would detect the chemical signals associated with an eczema flare-up and the cells in the patch would be triggered and release therapeutic agents,” explained Marie-Eve Aubin-Tam, a professor of bionanoscience at Delft University of Technology in the Netherlands, who coordinates the NextSkins work.

The patch is designed in three layers, mirroring the specialised structure of human skin, where different layers perform different functions such as sensing, protection and repair.

A bottom layer interacts with the wearer’s skin, a central hydrated layer contains the living cells, and an outer layer prevents the material from drying out. Despite this layered design, the finished patch would be just a few millimetres thick and easy to wear.

During kombucha fermentation, the microorganisms naturally produce a jelly-like layer of bacterial cellulose on the surface of the liquid.

“This layer usually just gets thrown away by kombucha makers,” Ellis explained. “We use it instead as the environment where the engineered yeast can grow.”

One platform, two materials

The eczema patch is just one demonstration of the technology’s wider potential.

The researchers are developing two very different materials from the same bacterial cellulose base used in the therapeutic patch. By changing which microorganisms live within that structure, they can give each material entirely different properties

“We aim to show how this matrix can be used as a platform to host cells or ecosystems of cells that communicate with each other, as well as with the environment, and respond to the signals they receive,” said Aubin-Tam.

Together, these tiny microbial communities behave rather like miniature living tissues, communicating with one another and responding collectively to changes in their surroundings.

Alongside the therapeutic patch, the team is developing a tough, self-healing composite designed for protective equipment and everyday objects that could one day replace ceramics or plastics. Envisaged sample applications include helmets, suitcases and phone cases.

Although very different in appearance and purpose, both materials rely on the same underlying principle: using living cells to perform functions that conventional materials simply cannot.

The therapeutic patch senses and responds. The protective composite heals itself, much like skin does after a cut. While the patch must remain moist and supple, the protective material is dry and rigid.

“We use only microbes in our work, but many different types,” said Aubin-Tam. “The protective composite is based on Bacillus bacteria. These bacteria can form spores, allowing them to survive harsh conditions. They remain dormant within the material and can be activated when needed.”

Still at the foothills

Since 2022, the NextSkins team has produced early prototypes of both materials and engineered the microbial components needed to build them.

The next challenge is to combine these components and encourage the different microorganisms to organise themselves into the layered structures that give the materials their unique properties.

“By nature, microbes just want to grow and divide,” said Ellis. “Forcing them to organise into layers is therefore very challenging.”

The researchers have therefore adopted a pragmatic approach, sticking with the original idea of self-grown, self-organised materials while also exploring 3D printing to control shape more precisely.

“We originally wanted everything to be self-grown,” said Aubin-Tam. “But that makes the materials more limited because we can’t create complex 3D shapes.”

Ellis cautioned that despite progress in the field of ELMs, real-world use remains some way off.

“When it comes to real-life applications, we are still at the foothills. We are now laying the foundation for this technology.”

A living alternative

Success here could take engineered living materials far beyond wearable patches.

“If you look at living organisms from a materials perspective, they are extraordinary,” said Aubin-Tam. “They can grow, adapt to stimuli, heal themselves, and even move.”

Both Aubin-Tam and Ellis believe ELMs could eventually offer a more sustainable alternative to the materials we rely on today.

“If you think about it, the majority of our materials are already biomaterials, like wood or cotton,” Ellis said. “At the moment, we simply harvest them and use them.”

A real gamechanger, said Ellis, would be scaling up this kind of structured growth: not just producing microbes in bulk, which is already routine, but growing them directly into usable, shaped materials.

“If we could make living things into materials themselves, we could stop cutting down forests and decrease the carbon footprint,” he said.

For now, the researchers are working towards a more immediate milestone: a proof-of-concept patch that can be tested on skin models, the first real test of whether the living material works as intended.

If they succeed, it will mark a significant step toward a new kind of medicine, one that does not just treat the skin, but works alongside it.

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More info

- NextSkins (CORDIS)
- NextSkins project website
- EIC Pathfinder Challenge – Engineered Living Materials