

NTU researchers create biomaterial to help repair bones using waste consisting of bullfrog skin, fish scales



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Published MAY 27, 2021

Updated MAY 27, 2021

30 SHARES



A research team from the Nanyang Technological University in Singapore has developed a new biomaterial made entirely from discarded bullfrog skin and fish scales that could help in bone repair.

- **The biomaterial scaffold is a composite of collagen from bullfrog skin and hydroxyapatite from fish scales**
- **Collagen provides support for cells to attach to, while hydroxyapatite provides a source of calcium and phosphate to promote bone formation.**
- **Bullfrog skin and fish scales are two of Singapore's largest aquaculture waste side streams**

SINGAPORE — Researchers from the Nanyang Technological University have discovered a new way of repurposing food waste for medical use by turning discarded bullfrog skin and fish scales into a “biomaterial scaffold” that can be used for tissue repair.

The porous biomaterial contains the same compounds that are predominant in bones, and acts as a support for bone-forming cells to adhere to and multiply, which then leads to the formation of new bone.

Laboratory experiments found that human bone-forming cells seeded onto the biomaterial scaffold successfully attached themselves and started multiplying – a sign of growth.

The hope is that the biomaterial could be used to help the regeneration of bone tissue lost to disease or injury, such as jaw defects from trauma or cancer surgery, said Assistant Professor Dalton Tay of the NTU School of Materials Science and Engineering (MSE) during a press conference on Thursday (May 27) to present the findings of the study.

It could also assist bone growth around surgical implants such as dental implants.

The researchers believe the biomaterial is a promising alternative to the current standard practice of using a patient’s own tissues, which requires additional surgery for bone extraction.

They also found that the risk of the biomaterial triggering an inflammatory response is low, added Asst Prof Tay, who led the study.

The findings of the study, which began in 2018, were published online in the peer-reviewed journal *Materials Science and Engineering C* in April this year.



The scientists believe the biomaterial is a promising alternative to the current standard practice of using a patient’s own tissues, which requires additional surgery for bone extraction. At the same time, the production of this biomaterial tackles the problem of aquaculture waste. Photo: Nanyang Technological University

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Touching on why his team decided to create such a biomaterial, Asst Prof Tay said that while there are efforts to recycle food waste in Singapore by turning it into animal feed, he believes more can be done with it.

“When it comes to seafood, there are a lot of very useful chemicals and biological materials that can be reclaimed...and then potentially used for high value medical applications,” he said.

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With Singaporeans consuming about five million kilograms of frog meat — or about 15 million frogs — and around 95 million kilograms of fish annually, bullfrog skin and fish scales are two of Singapore’s largest aquaculture waste side streams.

To create the biomaterial, bullfrog skin is processed by blending it, removing impurities and then extracting the collagen.

Meanwhile, hydroxyapatite is harvested from fish scales through calcination and air-drying from species such as the snakehead.

Collagen provides support for cells to attach to, while hydroxyapatite provides a source of calcium and phosphate to promote bone formation, said Asst Prof Tay.

These biomaterials are combined together and then cast into a mould to produce a tough, three-dimensional porous scaffold. It is a process which takes less than two weeks though the research team expects to be able to further shorten the time taken in future.

The team receives the biomaterial from Khai Seng Fish Farm and Jurong Frog Farm.

When asked by TODAY what happens to the biomaterial scaffold after it has been applied to the body, Asst Prof Tay said they have yet to conduct trials on animals yet.

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However, based on in vitro studies, he said the biomaterial is resorbable, and that collagen can be degraded over time by enzymes found in the body after any bone defects have been repaired.

Asst Prof Tay said the research team is now further evaluating the long-term safety and efficacy of the biomaterial as dental products under a grant from the China-Singapore International Joint Research Institute that is expected to take two years.

“Then we will see whether we can move into human clinical trials,” he said, adding that it would be at least five years before it would be ready for use in hospitals.