SCIENCE

Discarded fish scales and frog skin used to make bone repair material

By Ben Coxworth
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The lead scientists, from left to right – Asst. Prof. Dalton Tay, Dr. Wang Jun Kit and Prof. Matthew Hu Xiao
NTU Singapore

The people of Singapore consume a lot of fish, and – perhaps surprisingly to some of us – a lot of frog meat. Scientists have now developed a method of converting the waste from both foods into a material that helps bone to regrow.

Ordinarily, when someone is missing a piece of one of their bones (due to accident or disease), doctors fill the gap with bone harvested from elsewhere in their body. Not only is it a very invasive procedure, but it also weakens the site from which the replacement bone is taken – typically in the hips, ribs or leg.

One alternative that's currently being explored involves filling the gap with a human-made material, instead of actual bone. That material has a three-dimensional scaffolding-like microstructure that encourages adjacent bone cells to migrate in and start reproducing. Over time, the material itself harmlessly biodegrades, and is entirely replaced with newly grown bone tissue.

A team at Singapore's Nanyang Technological University has created a new type of such material, utilizing discarded snakehead fish scales and American bullfrog skin. All of the animals were raised on farms, and had already been harvested for their meat.

The skin, the scales and the finished product

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The process begins by removing impurities from the frog skin, blending it to form a thick paste, diluting that paste with water, then extracting collagen from it. At the same time, a calcination technique is used to extract a calcium-phosphate compound by the name of hydroxyapatite from the fish scales. After being air-dried and ground into a powder, that hydroxyapatite is added to the collagen.

The resulting mixture is poured into a mold, forming a three-dimensional porous scaffolding-type material once it solidifies. When bone-forming cells were "seeded" onto the material, they quickly proceeded to reproduce, to the extent that they were uniformly distributed throughout the scaffold within just one week.

Importantly, the material also showed no indications that it would cause recipients' immune systems to produce an inflammatory response, which *can* happen when foreign substances are implanted in the body. Animal studies are now being planned.

"We took the 'waste-to-resource' approach in our study and turned discards into a high-value material with biomedical applications, closing the waste loop in the process," says Asst. Prof. Dalton Tay. "Our lab studies showed that the biomaterial we have engineered could be a promising option that helps with bone repair."