Medical Xpress

Scientists discover fish scale-derived collagen effective for healing wounds

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NTU Singapore scientists found that collagen (in right petri dish) processed from snakehead fish scales has potential for biomedical applications. Credit: NTU Singapore

Scientists from Nanyang Technological University, Singapore (NTU Singapore) have established that collagen derived from fish scales could be effective for various biomedical applications such as wound healing.

Commonly removed before cooking, the research team found that fish scales contain collagen that, when further modified and applied to mice, promoted blood and lymphatic vessel formation, thus improving the potential for tissue repair and regeneration.

Led by NTU scientists Assistant Professor Cleo Choong and Associate Professor Andrew Tan, and collaborating with Associate Professor Véronique Angeli from the National University of Singapore, the team's findings were published recently in the peer-reviewed journal *Acta Biomaterialia*.

Not only is collagen itself a promoter of wound healing, it also offers promise as a carrier of drugs that can enhance wound healing, such as growth factors. However, in its natural, unmodified form, collagen becomes soluble only in acidic conditions, which damage the drugs.

Using chemical modification, the NTU scientists were able to create water-soluble collagen from the fish scales, opening up the possibility that this collagen could incorporate drugs and be successfully used to fabricate wound dressings with superior healing potential.

In a previous related study published in the *Journal of Materials Science: Materials in Medicine*, the same team of NTU scientists found that fish scale-derived collagen would induce human umbilical vein endothelial cells to express 2.5 times more of a specific type of collagen responsible for blood vessel formation, as compared to endothelial cells cultured on bovine collagen. This suggests that fish scale-derived collagen has potential to be developed for use in biomedical applications.

NTU Singapore scientists have found potential biomedical uses for collagen derived from fish scales which are usually discarded. From left: Associate Professor Andrew Tan, research fellow Dr Wang Jun Kit and Assistant Professor Cleo Choong. Credit: NTU Singapore

The team's findings have caught the attention of international collagen-based biomedical product manufacturing companies, who are interested in using non-mammalian sources to overcome biological and cultural drawbacks associated with bovine and porcine collagen.

Assistant Professor Cleo Choong from the NTU School of Materials Science and Engineering said, "Currently, collagen is widely used for various biomedical applications. However, most of the commercially available collagen-based products are from mammalian animal sources

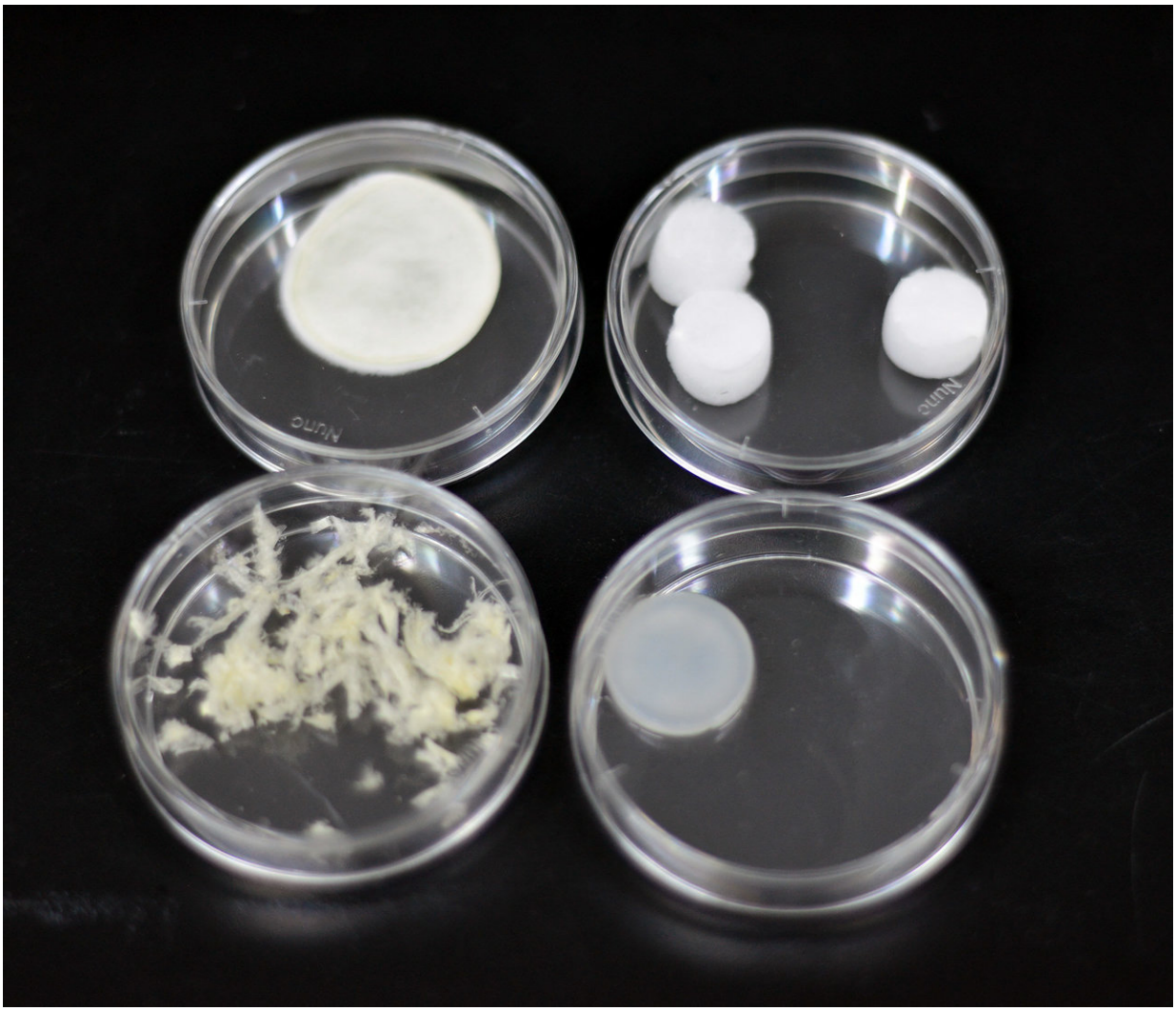
such as pigs, cows and sheep.

"Consequently, clinical application of these materials has been limited due to cultural and religious restrictions associated with these mammalian tissue-derived materials. In addition, more checks and processing have to be in place due to the risk of diseases that can be transmitted from mammals to humans."

Associate Professor Andrew Tan from the NTU School of Biological Sciences said, "Collagen is commonly used for wound dressing material due to its favourable biological properties. Applying collagen dressings to a wound to stimulate tissue growth can provide relief for a wide variety of injuries. Collagen dressings come in all shapes and sizes – gels, pastes, powders and pads. It can potentially treat wounds of all dimensions."

About 200 milligrams (mg) of collagen can be derived from 10 grams of fish scales—the amount that can be obtained from one or two fish. There is little cost in getting the fish scales since they are usually discarded, as compared to sources such as cowhide which have a wide range of other uses. Excluding labour costs, the materials used to extract 100 mg of collagen from fish scales in the lab is just over S$4.

Local fisheries partnering in research



Collagen in different forms could be suitable for different wounds. (Clockwise from top left): Processed collagen made into a patch, foam, hydrated gel, and unstructured form. Credit: NTU Singapore

The research team partnered a local Singaporean fish farm that supplied the team with fish scales from sea bass, snakehead and tilapia.

Mr Teo Khai Seng, owner of Singapore's KhaiSeng Trading & Fish Farm Pte Ltd said, "We descale and sell over 200 fish a day to

wholesalers, restaurants and walk-in customers. If these discarded fish scales can lead to successful biomedical applications in future, it would be a good use of these waste materials."

The team is in talks with a few local fisheries to explore ways of converting aquaculture waste material into useful materials, as well as to scale-up the collagen extraction process for effective waste-to-resource management.

According to the 2016 State of World Fisheries and Aquaculture report published by the United Nations' Food and Agriculture Organisation, aquaculture production is expected to reach 102 million tonnes by 2025. As a result, a considerable amount of aquaculture waste is produced yearly.

Over the past six years, the NTU team behind this research has been focussed on ways to convert low-value, unmarketable aquaculture waste to higher-value resource.

Other projects by the NTU team involve deriving carbohydrates from shrimp shells and brown seaweed for biomedical applications.

In a related project to the one on fish scales, the scientists have found bullfrog skins to also be a good source of collagen. "Our results turn fish scales and bullfrog skins, which are often discarded, into a potentially useful alternative source of collagen," said Assistant Professor Cleo Choong.

More information: Jun Kit Wang et al. Fish scale-derived collagen patch promotes growth of blood and lymphatic vessels in vivo, *Acta Biomaterialia* (2017). DOI: 10.1016/j.actbio.2017.09.001