Laboratory Equipment

Antibacterial Bandage Made from ‘King of the Fruits’ Husk

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Proving once again that one man’s trash is another man’s treasure, scientists have upcycled the thick, thorny husk of durian fruit into an antibacterial gel bandage that protects wounds and promotes healing.

In parts of Asia, durian is referred to as the “king of fruits,” with Singapore importing and consuming an estimate 10 million durians a year. Native to Borneo and Sumatra, the durian is distinctive for its thorn-covered rind, which is removed prior to consumption. Once discarded, the rinds are burned, creating an environmental issue.

But William Chen and his team at Nanyang Technological University (Singapore) have found a way to turn rind into a non-toxic, biodegradable, organic bandage that has a smaller environmental footprint than even today’s gold standard bandages.

Conventional hydrogel patches, most often made from synthetic materials, use metallic compounds such as silver or copper ions to enhance the antimicrobial properties of the bandage. These materials obviously help reduce infection risk, but also minimize the formation of excessive scar tissue—which has the potential to become an issue years after treatment. However, the synthetic materials approved for biomedical use can be costly. Made from natural waste materials, Chen’s hydrogel patch is much less expensive.

As described in *ACS Sustainable Chemistry & Engineering*, the research team extracted high-quality cellulose from durian husks, before combining it with glycerol, a waste byproduct of the biodiesel and soap industry. They then added natural yeast phenolics, which prevents the growth of bacteria, such as Gram-negative *E. coli*, Gram-positive *Staphylococcus aureus*, and the subsequent formation of biofilm.

"With the growing threat of antibiotic-resistant superbugs, the world will need multiple alternative ways to prevent infections. An effective way to protect open wounds is with antimicrobial bandages that are biocompatible and safe for prolonged use by humans. This is especially important for diabetic patients suffering from chronic wounds," said Chen, the director of NTU's Food Science and Technology program.

As proof-of-concept, Chen and his team tested the antimicrobial hydrogels as wound dressings on animal skin. They showed good antimicrobial effects for up to 48 hours. The soft gel sheets, which is similar to conventional silicon sheets, can be cut into bandages of various shapes and sizes.

"By adopting a waste-to-resource approach and the use of green manufacturing techniques, we have shown that it is possible to reduce consumption of Earth's natural resources, reuse what was thought of as rubbish, and recycle

them into valuable products that are useful for mankind," said Chen.

The research team is currently looking for industry partners interested in taking the antibacterial bandage to market; however, wound dressing is not the only application for the innovative development.

In a previous study, Chen showed that organic hydrogels can be successfully used for wearable, flexible, stretchable electronics, such as today's smart watches and fitness bands. For this research, Chen used cellulose extracted from okara—the waste leftover from soybean pulp during the making of soy milk— to develop a prototype hydrogel that could conduct electrical signals.

"As shown in many of our research papers, fundamental research in food science and technology carries far more interdisciplinary applications in other industries, such as healthcare, biomedical applications and specialty chemicals," Chen concluded.

Photo: A large hydrogel patch derived from discarded durian husks can help wounds to heal better. It can also be cut into small pieces to fit plasters of varying sizes. Credit: NTU Singapore