Scientists' silk structure is secret to process of regenerating salivary cells

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The silkworm, which produces the essential ingredient for fine silk fabric, also plays a critical role in a new process designed to provide relief for millions of individuals with dry mouth, a devastating oral and systemic health issue.

A research team led by Chih-Ko Yeh, B.D.S., Ph.D., from The University of Texas Health Science Center at San Antonio, is the first to use silk fibers as a framework to grow stem cells into salivary gland cells. The process has been submitted for a patent.

Dr. Yeh is a professor in the Department of Comprehensive Dentistry whose lab focuses on salivary gland research. Other major team leaders include Xiao-Dong Chen, M.D., Ph.D., also a professor of comprehensive dentistry, whose expertise is stem cell research, and Joo Ong, Ph.D., professor and chair of biomedical engineering at The University of Texas at San Antonio. Dr. Ong's lab conducts research in material science and tissue engineering.

Saliva's role

Saliva is critical to good health. It helps with speaking, swallowing, washing food off teeth, initial food digestion and preventing oral infections. Insufficient saliva can cause chronic bad breath, cavities, gum disease, as well as systemic infections.

There is no treatment for low-producing or nonfunctioning salivary glands, and the glands have little regenerative capability.

The research team's new process is the first major step toward helping more than 4 million people in the U.S. with a degenerative autoimmune disease called Sjögren's syndrome, in which the body attacks its own tear ducts and salivary glands.

Low saliva production also is a devastating problem for thousands of patients who have had radiation treatment for head and neck cancer, as well as about 50 percent of older Americans whose medications can cause dry mouth, also known as xerostomia.

Regeneration process

"Salivary gland stem cells are some of the most difficult cells to grow in culture and retain their function," Dr. Yeh said.

"In our process, we purified the silk fibers by removing a number of contaminants. We put stem cells from rat salivary glands on the silk framework with a media to nourish them. After several weeks in culture, the cells produced a 3-D matrix covering the silk scaffolds. The cells had many of the same characteristics as salivary gland cells that grow in the mouth," he said.

"Until now, retention of salivary gland cell properties has not been possible using other tissue culture techniques. This unique culture system has great potential for future salivary gland research and for the development of new cell-based therapeutics." Dr. Yeh explained.

The process was published in the May edition of the scientific journal *Tissue Engineering* Part A.

Dr. Yeh explained that silk is a good choice for stem cell scaffolding because it is natural, biodegradable, flexible and porous, providing the developing cells easy access to oxygen and nutrition. It also does not cause inflammation, as other scaffold materials have.

Future research Because there are few salivary gland stem cells in the human mouth, the scientists plan to continue using rat salivary glands to refine the process, but eventually hope to use stem cells derived from human bone marrow or umbilical cord blood to regenerate salivary glands for humans.

"Our group pioneered the development of cell culture technology for harvesting large numbers of stem cells from human bone marrow and human umbilical cord blood," Dr. Yeh said, noting that stem cells from these two sources are abundant and can be guided into different types of cells using tissue engineering.

Dr. Yeh hopes that within the next decade stem cells can be transfused into damaged human salivary glands to jumpstart tissue repair or engineered into artificial salivary gland tissue to replace damaged glands.

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