The healing touch of cotton

By Amy Spillman, Agricultural Research Service Information Staff

Cotton gauze has been used to dress wounds for hundreds of years because it is naturally soft, pliable, and absorbent. Now, a scientist from the USDA Agricultural Research Service (ARS) and his collaborators are using modern technology to further improve this cotton product and add to its list of beneficial characteristics. ARS has succeeded in patenting and licensing one type of improved gauze, and the researchers are working on creating another.

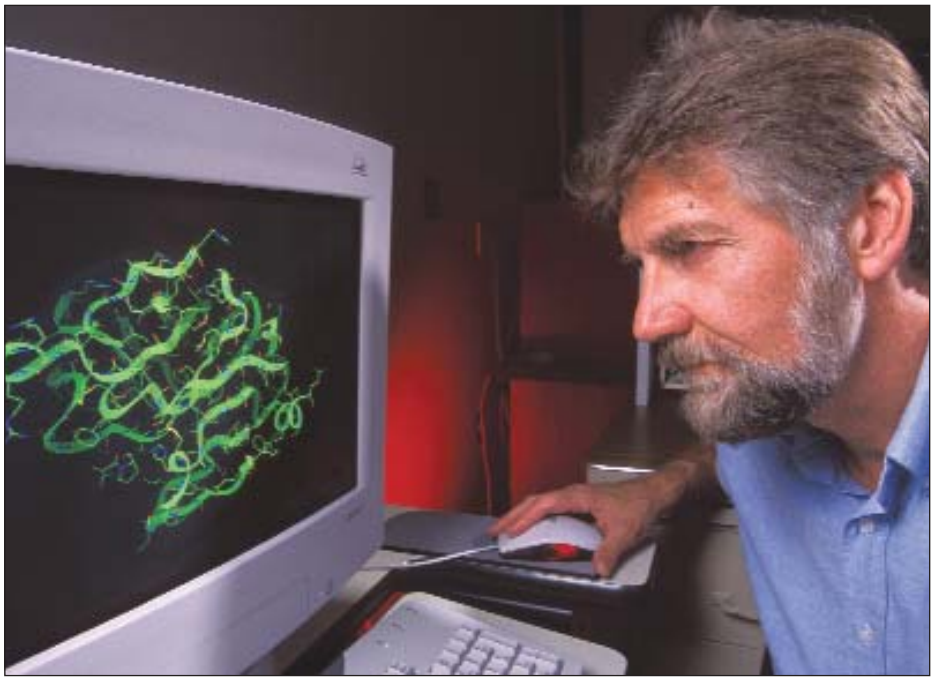
CHRONIC WOUND DRESSINGS

Vince Edwards, a chemist in the Cotton Textile Chemistry Research Unit at the ARS' Southern Regional Research Center in New Orleans, Louisiana, has a background in medicinal chemistry. Although his research is focused on cotton chemistry, he keeps up to date on findings in the medical world as well.

In 1997, he was reading the clinical journal *Wound Repair and Regeneration* when his interest was piqued by an article from scientists at the Medical College of Virginia (MCV) at Virginia Commonwealth University, in Richmond.

Researchers there, led by Dorne Yager, had identified a certain protease, or enzyme, present in elevated levels in bedsores, diabetic foot sores, and other wounds that won't heal. This particular protease, called elastase, breaks down connective tissue proteins that are essential to proper wound healing.

"In normal wounds, elastase and other proteases do a good job of breaking down dying tissue and clearing debris from the site," says Kel Cohen, director of the Division of Plastic and Reconstructive Surgery at the MCV Wound Healing Center. "But in chronic wounds, these enzymes build up and overcompensate." In fact, in the chronic skin ulcers common to long-term hospital patients, elastase can build to more than 20 times normal levels.



Chemist Vince Edwards examines a computer graphic image of an enzyme model used in the design of cotton-based chronic-wound dressings. (Photo by Peggy Greb.)

Although occlusive dressings — synthetic bandages that limit water vapour loss and promote moist wound environments — are being used more frequently on chronic wounds, cotton gauze remains a popular dressing material because of its low cost and high absorbency.

Edwards says, "After reading about the MCV research, I thought we might be able to work together to make a new kind of cotton dressing, since cotton fibres are an excellent carrier for wound-healing agents."

He began collaborating with the Virginia medical group and in 1999 developed a way to chemically modify cotton gauze so that it selectively targets and soaks up elastase. "We bonded medicinal chemicals to cotton textiles to create a 'smart' wound dressing," he says.

The team has achieved promising results during in-vitro testing and expects to achieve similar results during in-vivo testing. Edwards explains their in-vitro experiment:

"After receiving informed consent from a patient with a chronic wound and the Virginia Commonwealth University Committee on the Conduct of Human Research, we took fluid from the patient's pressure ulcer. We clarified and buffered the wound fluid in a saline solution.

"Then we soaked both modified and unmodified gauze samples in the wound fluid. The modified gauze, which specifically targeted elastase, was able to sequester a lot more of it than the unmodified gauze," says Edwards.

"We haven't yet tested these smart wound

dressings on patients with chronic wounds, but that's our next step," says Cohen.

Every year, about one million Americans develop chronic wounds, or pressure ulcers, which result in patient-care costs approaching $US750 million. The modified gauze that Edwards and his collaborators developed is simple and inexpensive to manufacture. It may ultimately be used in hospitals and nursing homes.

Tissue Technologies, a company based in Richmond, Virginia, has licensed the technology. In 2002, it received a phase-one grant from the National Institutes of Health (NIH) through the Small Business Innovation Research program. In July 2002, the company applied for phase-two funding — $US1 million — which would be enough to pay for a clinical trial. Cohen, who is chief operating officer for Tissue Technologies, has served as a special research fellow at NIH and would oversee the clinical trial at a hospital in Richmond if they receive the funds.

BURN DRESSINGS

Edwards and his collaborators have not limited themselves to improving gauze for chronic wounds. They are also working on ways to improve cotton burn dressings. Currently, they are developing a method to graft alginate, which is produced by brown seaweed, to cotton fibres.

Cotton-based alginate dressings are absorbent and easily conform to the shape and size of a wound. They are dry when applied but form a soft gel when they interact with wound fluid and so maintain a moist, wound-healing environment. The wound dressing materials are designed to accommodate movement around joints while providing water vapour transmissibility.

Edwards and his collaborators are achieving impressive results with this research, although several more years of testing may be required before it is introduced to the public. *The Journal of Biomedical Materials Research* will soon publish an article about their work.

This research is part of Quality and Utilization of Agricultural Products, an ARS National Program (#306) described on the World Wide Web at http://www.nps.ars.usda.gov.

J. Vincent Edwards is in the USDA-ARS Cotton Textile Chemistry Research Unit, Southern Regional Research Center, 1100 Robert E. Lee Blvd., New Orleans, LA 70179-0687; ph: (504) 286-4360, fax: (504) 286-4271.

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Technician Sarah Batiste applies a finishing technique to cotton gauze modified to be a specialised dressing for chronic wounds. (Photo by Peggy Greb.)