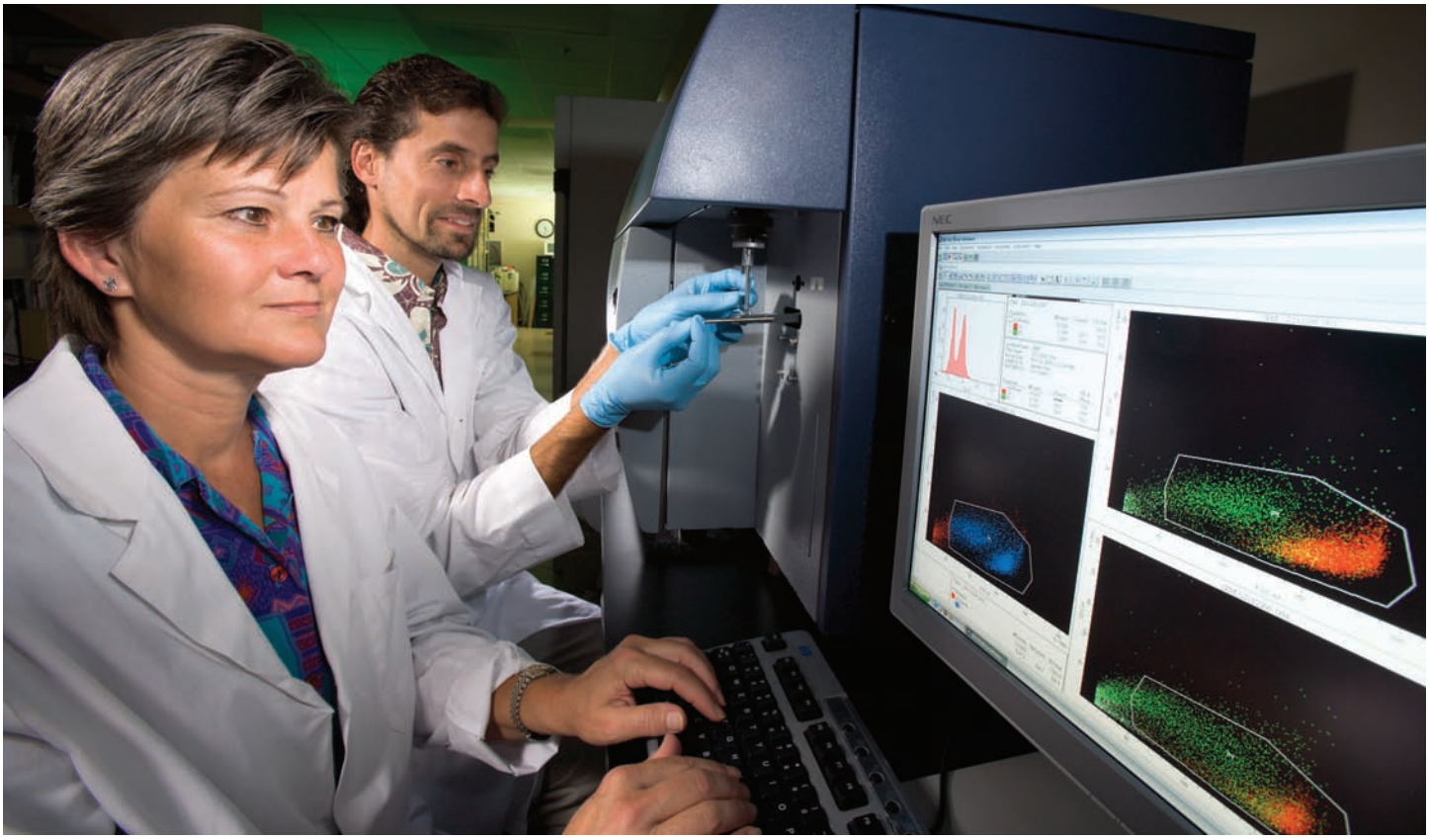
PEGGY GREB (D1055-1)



Susan Zunino and David Storms, molecular biologists at the ARS Western Human Nutrition Research Center, Davis, California, are using fluorescence-activated cell sorting to analyze apoptosis (programmed cell death) in leukemia cells after exposure to different antioxidant phytochemicals. Their research has shown that certain phytochemicals can kill these leukemia cells.

How Plants Protect Us

Unmasking the Secret Power of Phytochemicals

Rosemary, the fragrant herb that enlivens roast chicken and other favorites, and turmeric, the mainstay spice of curry dishes, contain powerful natural compounds that, in test tubes, can kill cells of a childhood cancer. What's more, grapes, strawberries, and other familiar fruits—and some vegetables—also have chemicals that can destroy the cells of this cancer, known as "acute lymphoblastic leukemia."

Susan J. Zunino, an Agricultural Research Service molecular biologist, leads the nutrition-focused research that has resulted in these first-ever findings. She's investigating the health-imparting effects of plant chemicals, or phytochemicals, using laboratory cultures of both healthy human blood cells and cancerous ones as her models.

Zunino is based at the agency's Western Human Nutrition Research Center in Davis, California, about an hour's drive northeast of San Francisco. She's collaborating in the investigations with molecular biologist David Storms, at the Davis center; Jonathan Ducore, at the University of California-Davis Cancer Center; and Navindra Seeram, at the University of California-Los Angeles.

Zunino's pioneering studies, published in *Cancer Research* and *Cancer Letters,* reveal the previously unknown ability of about a half-dozen phytochemicals to stop growth of this type of leukemia. The findings are of interest to cancer researchers and to nutrition researchers exploring the health benefits of compounds in the world's edible fruits, vegetables, herbs, and spices.

Death of Leukemia Cells: How Do Phytochemicals Triumph?

For the most part, scientists don't yet have all the details about how phytochemicals bolster healthy cells and battle harmful ones.

BRIAN PRECHTEL (K9189-1)

Strawberries and other familiar fruits—and some vegetables—contain natural phytochemicals that can destroy leukemia cells.

That's true even for better-known phytochemicals such as the resveratrol in red grapes, blueberries, and some other fruits.

Zunino's investigations provide some new clues about how phytochemicals attack cancer cells. She has studied carnosol from rosemary, curcumin from turmeric, resveratrol from grapes, and ellagic acid, kaempferol, and quercetin in strawberries. The work demonstrated the ability of these phytochemicals to kill the acute lymphoblastic leukemia cells and also suggested ways in which the compounds might do that.

For example, Zunino and colleagues showed that the phytochemicals interfere with the orderly operations of mitochondria, the miniature energy-producing power plants inside cells. Without energy, cells die.

Mitochondria exposed to resveratrol and the other phytochemicals became inoperative. But more work is needed to fully understand how the phytochemicals achieved that. And the team wants to know more about the phytochemicals' other modes of action that resulted in the cancer-cell death.

Can Phytochemicals Help Prevent Diabetes?

In related research, Zunino, working with Storms and Charles Stephensen, a physiologist at the Davis research center, determined for the first time that some component of table grapes prevented the progression of type 1 diabetes in mice and increased their survival. That was in contrast to diabetic mice that were not fed grapes.

Scientists provided the fruit in the form of a freeze-dried powder made from table grapes, the kind sold fresh in the produce section of supermarkets. The powder, provided by the California Table Grape Commission, made up 1 percent of the chow fed to some of the mice. That's the human equivalent of about six servings of grapes per day.

Zunino's experiment apparently is the first to show a link between eating grapes and preventing progression of type 1 diabetes. If the results from this study of 30 laboratory mice hold true for humans, the research could offer new options for protection against this chronic autoimmune disease.

According to the National Institutes of Health, an estimated 1 in every 400-600 children and adolescents in the U.S. population has type 1 diabetes.

Right now, the researchers don't know which grape compounds provided the protective effect. Similarly, the exact sequence of steps that led to the protection is also not yet proven. But the scientists think that the grape phytochemicals may have prevented unwanted entry of immune cells into the pancreas.

Mice fed the grape powder had fewer immune cells in the pancreas than did the other mice in the experiment. But what's the relation between immune cells in the pancreas and type 1 diabetes?

Immune cells in the pancreas can mistakenly attack specialized cells known as "beta cells." Beta cells produce insulin, which is needed to help regulate the amount of sugar in the bloodstream. If immune cells in the pancreas attack and kill beta cells, the pancreas can run out of beta cells. When that happens, type 1 diabetes can result.

People with type 1 diabetes have to carefully monitor the amounts of sugar-containing foods they eat, including sweet, fresh table grapes. How ironic that this luscious fruit might actually hold a key to preventing the progression of type 1 diabetes. This may be a perplexing riddle of Nature—perhaps one that Zunino's team will soon solve.—By **Marcia Wood,** ARS.

This research is part of Human Nutrition, an ARS national program (#107) described on the World Wide Web at www.nps.ars.usda.gov.

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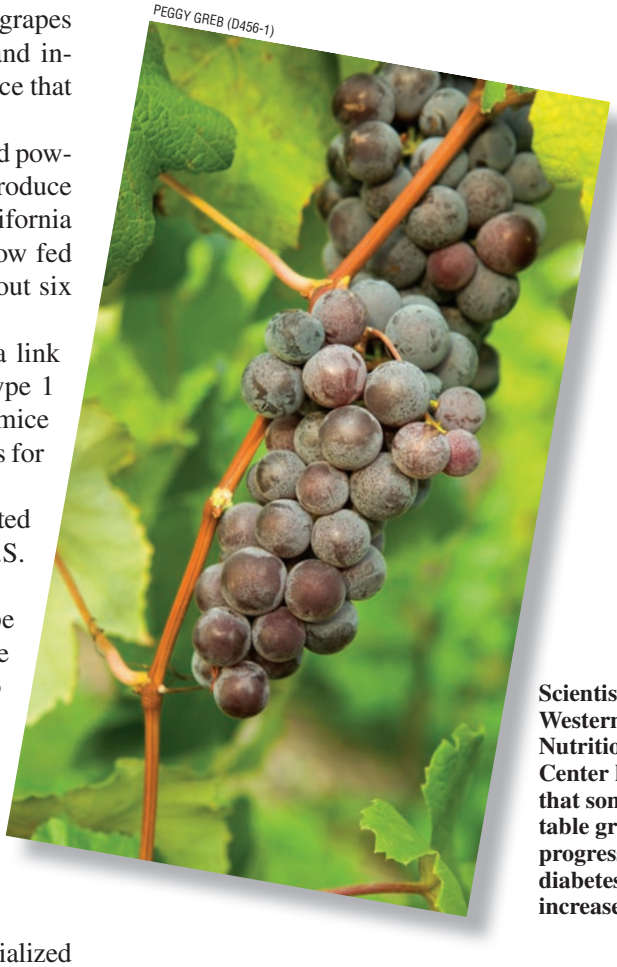

Scientists at ARS's Western Human Nutrition Research Center have determined that some component of table grapes can prevent progression of type 1 diabetes in mice and increase their survival.