Cancer-killer tomatoes

Tomatoes, the most popular garden vegetable in America and an absolute must-have for salads and spaghetti sauce, might soon have another use: as a powerful cancer fighter. This discovery was made quite by accident by scientists at Purdue University (West Lafayette, IN) and the U.S. Department of Agriculture's Agricultural Research Service (Beltsville, MD). The researchers were enlisted to develop higher-quality tomatoes that would ripen later through genetic engineering. After developing the new tomatoes, the researchers discovered that they contained significantly more of the cancer-fighting antioxidant lycopene.

Lycopene is a pigment that gives tomatoes and pink grapefruits a red color; but in the body, it is a proven antioxidant that may lower the risk of certain diseases, including cancer and heart disease. Lycopene is one of approximately 600 known carotenoids—chemicals that are responsible for the red, orange, and yellow color in fruits and vegetables. It is found in other foods such as watermelon, guava, rose hips, and red chili.

"We were quite pleasantly surprised to find the increase in lycopene," Avtar Handa, professor of horticulture at Purdue, said in a press release. "This is one of the first examples of increasing the nutritional value of food through biotechnology. In fact, it may be the first example of using biotechnology to increase the nutritional value of a fruit," Handa says.

Despite the benefits that lycopene offers, it has been difficult for researchers to increase the amount of lycopene in the diet. Research and studies have found that taking purified antioxidants as a dietary supplement does not work like good old-fashioned, straight-from-the-plant antioxidants. One study found that giving β-carotene to smokers actually increased their chances of developing cancer.

"When you take lycopene as a drug, it doesn't have the same effect," says Randy Woodson, director of agricultural research programs at Purdue. "There is still a lot of biology to understand before we know why phytonutrients in food are so much more effective than if they are given as supplements."

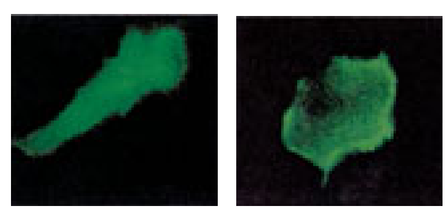
To develop the lycopene-rich tomato, the researchers inserted a yeast-derived gene that was combined with a promoter gene into tomato plants. The promoter gene helps turn on the yeast gene in the tomato, which then causes lycopene in the tomato to increase. The promoter also tells the yeast gene when and where to turn on in the tomato. The yeast gene then produces an enzyme that affects the production of growth substances in plants called polyamines, which are known to help prevent apoptosis. Handa says that this insertion technique might also be used to increase the amount of other antioxidants in foods.

—FELICIA M. WILLIS

Amoeba motion may be key for cancer

At first glance, amoebas and cancer cells have little in common. The first subsist independently as simple one-celled life forms, while the second feed off the bounty of larger organisms, often bringing about their downfall. However, researchers recently discovered a key similarity: The same protein that determines an amoeba's direction of motion also prevents the formation of cancerous tumors in animals.

Scientists from the Johns Hopkins University School of Medicine (Baltimore) recently reported that a protein called PTEN binds to the back of the amoeba's cell membrane when a chemical attractant is sensed, allowing the cell to move purposely toward the attractant (*Cell* **2002,** *109*, 599–610). Because PTEN "brings up the rear", the molecules crucial for allowing the cell to reach out and move forward are restricted to the front of the cell.



Wild-type amoeba, left, and PTEN -deficient amoeba attempt to swim toward attractants.

AMOEBA IMAGES COURTESY OF PETER DEVREOTES; TOMATOES PHOTO: PHOTODISC

Peter Devreotes and Miho Iijima tagged PTEN with green fluorescent protein to localize the protein in the cell during amoeba movement. They also monitored the movement and sensing abilities of amoebas whose PTEN gene was deleted or mutated.

The researchers found that without PTEN, or without it attached properly to the cell membrane, the amoebas could not determine direction well. Instead of moving in a straight line and adjusting quickly if the source of the attractant was moved, cells without PTEN have bigger "fronts" that tugged them in several directions at once, impeding their progress.

In many types of cancer, the human version of PTEN is mutated, quite often in the region that binds the protein to the cell membrane. On the basis of their observations in amoebas, the researchers suspect that those mutations may alter the protein's cellular distribution, adversely affecting its ability to halt cell division.

It is not known if PTEN in human cells is also involved in directional sensing or cell mobility, notes Devreotes, even though it is similar in sequence to the amoeba's version and provides a similar molecular function—to remove phosphate groups from inositol phospholipids within the cell membrane. If the human version does play a part in sensing and cell motion, the findings could have implications for understanding the spread of cancer from one part of the body to another.

—CHRISTEN L. BROWNLEE

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