Fruit Cell Wall Proteins Help Fungus Turn Tomatoes From Ripe to Rotten

January 23 2008

Using tomatoes as a research plant, scientists at the University of California, Davis, have discovered that two plant enzymes that occur in the plant's cell walls cooperate with each other to make ripe fruit more susceptible to a disease-causing fungus.

"Identifying the role that these cell-wall enzymes play in making the harvested fruit more vulnerable to disease is important for designing strategies for limiting fruit losses to disease during storage, handling and distribution," said Ann Powell, a plant scientist who led the research team on this project.

The study findings are reported in the Jan. 22 issue of the *Proceedings of the National Academy of Sciences*.

One of the hallmarks of plant cells is their tough exterior cell wall. As the fruit ripens, the cell walls break down, and the fruit becomes softer and more flavorful. At the same time, the fruit also becomes more susceptible to diseases caused by fungi and bacteria.

Researchers have known for some time that two enzymes, known as polygalacturonase and expansin, contribute individually to the ripening-related breakdown of the cell walls. (Enzymes are proteins that trigger and control chemical reactions.) The UC Davis research team wondered if these two cell wall enzymes might also be responsible for the increased disease-susceptibility of ripening fruit. These diseases are responsible for substantial losses of high-quality harvested fruit during storage, shipping, marketing and consumer handling.

To test this notion, they selected two genetically modified tomato plant varieties. One of the varieties had been altered so that it did not produce polygalacturonase, and the other did not produce expansin. Powell had crossed these two varieties, resulting in a variety that produced neither of these enzymes.

The researchers, including plant biology graduate student Dario Cantu and postdoctoral fellow Ariel Vicente, inoculated tomatoes from each of the genetically modified varieties, as well as the variety resulting from the cross, with Botrytis cinerea, a common fungus that causes rotting on many fruits and vegetables. Tomatoes from a control group, whose enzyme production had not been altered, were also inoculated with the fungus.

The research team found that tomatoes from the plants that were genetically modified to suppress production of only one of the cell-wall enzymes were not any less susceptible to the fungus. However, when both of the enzymes were lacking in the crossed variety, the cell walls of the fruit did not readily break down, and the fruit was dramatically less susceptible to infection by the Botrytis cinerea fungus.

"It appears that these two enzymes work cooperatively in a way that breaks down the cell wall and leaves the fruit more vulnerable to pathogens like the gray mold caused by this fungus," Powell said.

"Interestingly, this process occurs at a stage in the plant's development that allows both the plant and the pathogen to successfully reproduce," she noted. "This convenient and mutually beneficial timing may well have resulted from the co-evolution of the fruit and its respective pathogens."

Collaborating on this study with Powell, Cantu and Vicente were professional researcher Molly Dewey, formerly of UC Davis and Oxford University; researcher Carl Greve and plant science professors John Labavitch and Alan Bennett.

Source: UC Davis