

# Process that controls tomato ripening discovered

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Scientists have discovered a set of chemical changes to a plant's DNA plays a pivotal role in tomato ripening, signaling to the fruit when the time is right to redden. Credit: Yun-Ru Chen, BTI

(Phys.org)—Everyone loves a juicy, perfectly ripened tomato, and scientists have long sought ways to control the ripening process to improve fruit quality and prevent spoilage.

A new study by researchers at the Boyce Thompson Institute for Plant Research (BTI) and the U.S. [Department of Agriculture](#)'s Agricultural Research Service (ARS), both on the Cornell campus, reveals that

epigenetics, a set of [chemical changes](#) to a plant's DNA, plays a [pivotal role](#) in tomato ripening, signaling to the fruit when the time is right to redden. The discovery opens the door to new ways of thinking about how to develop varieties of tomatoes that can survive the trip from the farm to the grocery store with flavor and texture intact. The paper was published Jan. 27 on the journal *Nature Biotechnology*'s website.

"Most previous breeding efforts were focused on the [DNA sequence variation](#) in the genome," says Zhangjun Fei, a co-author on the paper and an associate professor at BTI. "This opens a new era. Now it's possible to use epigenetic variation rather than just changes in DNA sequence to breed better crops."

In recent years, scientists have discovered that in addition to the instructions contained in an organism's DNA, there is also a layer of epigenetic information superimposed on that DNA that can control how and when genes are expressed. In one common epigenetic modification, [methyl groups](#) are attached to sites on an organism's DNA, and heavy methylation can essentially shut down a gene.

In his laboratory at BTI, ARS [molecular biologist](#) James Giovannoni and his colleagues took up the question of whether epigenetics might play a role in tomato ripening. The ripening hormone [ethylene](#) is made in [plant tissues](#) but can also be applied in tomato processing to ripen the fruit for market. Very young tomatoes, with immature seeds, do not ripen in response to ethylene, and scientists have tried without success to understand the genetic trigger that signals to the tomato flesh that maturation has been reached.

To test whether epigenetics might be at work in this ripening trigger, researchers injected unripe tomatoes with a compound that inhibits the enzymes that methylate DNA. The tomatoes ripened prematurely, a strong indication that DNA methylation regulates ripening. The

compound itself would never be used to control ripening, but it does demonstrate the underlying principle that methylation is critical.

"Once we realized that the inhibitor can disrupt the mysterious mechanism that regulates fruit ripening, we decided to find the most crucial ripening genes that are controlled by the transcription factor RIN (ripening inhibitor) and examine how methylation changes during fruit development. Suddenly, everything became clear." says co-author Silin Zhong, a BTI scientist and research fellow of the Human Frontier Science Program organization.

Zhong and others found that tomato fruits undergo a major epigenetic overhaul during ripening, losing cytosine DNA methylation in many locations on the genome, particularly in promoters targeted by RIN. What's more, this epigenetic reprogramming does not happen in tomato mutants that are deficient in ripening.

"This change in DNA methylation, and specifically of promoters of ripening genes, is what makes the fruit respond to ethylene and then ripen," says Giovannoni. "We believe we have identified a new component of the ripening switch—one that may serve as an additional target or tool to regulate tomato shelf life and quality."

The group is following up on the findings. "We want to check whether this is a general pattern" in other types of fruits, Fei says. If so, it may eventually be possible to improve other fruit crops by targeting methylation on ripening genes, fine-tuning the process to achieve a better product.

Provided by Cornell University

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