Ability to alter color and ripening rates of tomatoes provides novel opportunity for crop improvements

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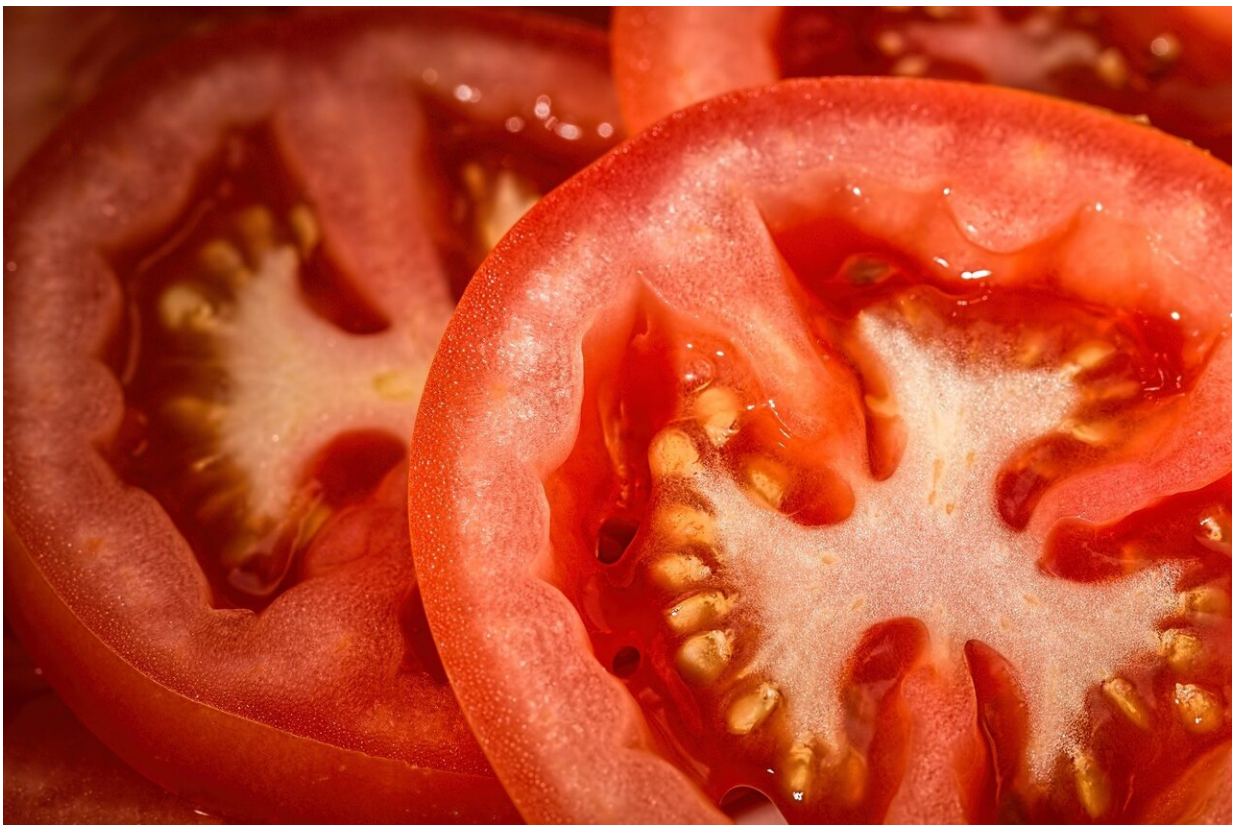

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Scientists at the University of Oxford's Department of Plant Sciences have discovered how the overall process of fruit ripening in tomato

(including color changes and softening) can be changed –speeded up or slowed down—by modifying the expression of a single protein located in subcellular organelles called the plastids.

The production of fruit is a vital process for plants because it enables them to reproduce and thrive. One strategy that plants use to ensure that their fruit are successful is to give them a colorful appearance, so that they are attractive to animals for seed dispersal.

In tomato, the fruit ripening process involves dramatic changes in tiny "organelles" inside the fruit cells called plastids. It is these plastids that are responsible for giving color to the fruit.

In spite of their central importance in delivering fruit color, surprisingly little was known about how plastids participate in the ripening process.

The Oxford team has now discovered a function in fruit for a protein located in the plastids called SP1 (this SP1 protein controls a regulatory pathway called CHLORAD, which was discovered by the group in 2019). The new finding reveals an important regulatory or controlling role for plastids in the fruit ripening process in tomato.

Significantly, the results published today in *Nature Plants* provide a theoretical basis for the modification or manipulation of the ripening of fleshy fruits such as tomato, providing a novel opportunity for crop improvement.

Corresponding author, Professor Paul Jarvis from Oxford's Department of Plant Sciences, said: "The regulatory properties of SP1 revealed in our study show that it has real potential as a technology for crop improvement. For example, it could be used to develop early or late fruiting varieties of fleshy fruits, or to improve the transportability or shelf-life of fruit by delaying ripening without compromising the quality

of the ripe fruit.

"It's fascinating that the amount of a single protein in these tiny subcellular structures called plastids can have such far-reaching consequences for fruit ripening in tomato."

The work is based on the modification of the expression of the tomato SP1 gene (as well as the related tomato SPL2 gene) in transgenic tomato plants. Transgenic plants with reduced or elevated levels of expression of SP1 were studied in detail, using a range of techniques including phenotyping, electron microscopy, gene expression analysis, and metabolomics.

More information: The chloroplast-associated protein degradation pathway controls chromoplast development and fruit ripening in tomato, *Nature Plants* (2021). DOI: 10.1038/s41477-021-00916-y

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