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## How Beets Became Beet-Red

As the seasons change, a riot of red shows up in the world around us, showcasing some of the most vivid hues that plant biochemistry can create. The red pigments in maple leaves, called **anthocyanins**, are the same kind that light up the cranberries you might cook for a Thanksgiving feast or the ruddy apples you'd put in a pie.

But as you slide a tray of beets into the oven to roast, you'll be seeing something that's completely different at the molecular level.

Beets, it turns out, have evolved another, separate way of being red. In a paper published in **New Phytologist**, biologists recently reported that they have discovered a key step in the evolution of this process, which not only helps explain the origins of a brilliant natural color, but could have uses far beyond brightening your dinner table.

The pigments that give red beets their incandescent tint are called **betalains**. They're made using an amino acid called tyrosine, the starting material for thousands of compounds made by plants.

Plants modify tyrosine by adding other molecules to create an enormous array of useful substances. This is how morphine is made in the opium poppy, and mescaline in cactuses. Intrigued by this process, Hiroshi Maeda, a professor at University of Wisconsin and senior author on the paper, collaborated with beet experts to study how the plants make betalains from tyrosine.

Right away they found something peculiar.

A tyrosine-making enzyme, which in most plants gets turned off after a certain amount is made, stays on longer in beets and some related species, producing an overload of the amino acid. This, it turns out, is likely the pivotal change that gave beets the starting material they would need to develop their special red.



At first, there would have been no use for the extra tyrosine. “The plants are freaked out: ‘What should I do with this?’” Dr. Maeda said. Eventually, however, some plants started to find a way to make something out of it.

At a later stage in their evolutionary history, red beets developed enzymes that use the extra tyrosine to create the rich scarlet we know so well. Scientists do not know exactly why this ability helped beets thrive. While some research suggests betalains may help plants weather stress, perhaps their primary usefulness is that humans — and presumably other creatures, like pollinators — love the way they look, Dr. Maeda said.

Beyond questions of color, the research has implications for medicine.

While morphine is still produced in plantations of opium poppies, the discovery of an enzyme that increases the tyrosine used to make the painkilling molecule could have effects on how that drug and others are made. The team is working to see whether they can boost tyrosine levels in other plants by giving them the enzyme found in beets.

Until then, you can thank beets and their betalains for the bright red shades in other things you might enjoy. The anthocyanins in strawberries, for instance, are not stable enough to be relied on as food coloring in certain products.

“If you look at the label very carefully on organic strawberry ice cream,” Dr. Maeda said, “often you find beet juice added.”

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