Unexpected protein interactions needed to build flowers

reader comments

6 with

Share this story

The pros and cons of moonlighting—taking up an extra job in addition to full-time employment—are hotly debated. But in biology, moonlighting is not uncommon, as individual proteins often perform multiple functions. For many years, scientists knew that the Unusual Floral Organ (UFO) protein seems to do some moonlighting.

Based on the protein's structure, its role in plants is thought to target proteins for destruction. But it also works with the Leafy (LFY) protein to aid flower formation. A team of scientists from France has now shed light on how this protein performs two roles.

Flowers and a UFO

When it comes to flower formation, the Leafy (LFY) protein is a veritable workhorse. Flowers are built from parts named sepals, petals, stamens, and carpels, which are arranged in whorls. The LFY protein, acting alone or in combination with other proteins, is responsible for activating genes essential for creating each of these parts. LFY combines with UFO to

help form petals and stamens.

According to the study's lead author, François Parcy of CNRS and University of Grenoble Alpes, the reason it took more than 25 years to figure out the UFO-LFY mechanism was because of "the misleading nature of the UFO protein."

UFO belongs to a group of around 700 proteins characterized by a pattern of amino acids, called an F-box domain, that regulates the levels of other proteins. Parcy said UFO marks other proteins for destruction: "It puts a chemical marker on a protein selected for degradation. As soon as a protein is marked, [some] cell machinery, called [a] proteasome, recognizes the mark and chops the protein into hundreds of pieces."

Advertisement
So, you might expect that UFO also marks LFY for destruction. "Normally, it should degrade the LFY protein, too. However, in the case of LFY, we find that the UFO has a completely different function—that of binding to a region of the DNA that cannot be accessed by LFY alone," Parcy said.

When LFY and UFO get together, they stick to DNA near genes that are essential for the formation of petals and stamens.

Parcy and his team began their research four years ago by producing the UFO protein in large amounts in insect cells. "It was quite challenging, as the UFO is one of the most difficult proteins to produce artificially," Parcy remarked.

Wherever flowers are

It turned out that UFO doesn't need to destroy other proteins to work with LFY. "We then modified it by removing the F-box domain responsible for triggering the degradation of partner proteins. To our surprise, we found out that, despite removing its main assumed function, the protein still worked fine with

the LFY protein," Parcy said. The experiment revealed the UFO protein performs some other function beyond targeting proteins for destruction.

That additional function appears to involve changing the DNA sequences that Leafy sticks to. The researchers obtained the 3D structure of the interaction among LFY, UFO, and the DNA regions they bind to using cryo-electron microscopy. According to Parcy, when UFO and LFY act together, they are able to stick to regions of DNA responsible for petal and stamen formation. Neither of these proteins can stick to this DNA on their own.

"It means that while each protein has the capacity to weakly touch the DNA region, when combined, it adds to their strength, resulting in an interaction with a new DNA motif," he said.

The LFY-UFO association is present in all flowering plants. In rice, too, the two proteins, LFY and UFO, stick together to enable them to bind new regions of the DNA, which results in the development of the part of the plant that holds its grain, called the panicles.

https://arstechnica.com/?p=1919874