Team identifies molecular pathway that allows roses to smell so sweet

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An international team of botanists, plant biologists and biochemists, has found an important pathway used by roses to produce their familiar sweet smell. In their study, reported in *Proceedings of the National*

Academy of Sciences, the group tracked down the pathway that allows binding molecules to produce the chemicals required to create the aroma associated with roses.

Roses have been a favored flower for many years, and horticulturalists have worked to improve the aspects favored by consumers, creating types of roses that last longer in a vase, for example, or that have non-natural colors. An unfortunate side effect of cross-breeding roses has been the gradual loss of their unique aromatic fragrance. In this new effort, the research team sought to learn more about the process involved in producing the sweet smell of roses and perhaps to restore it in cross-bred flowers.

Prior research has shown that a chemical called geraniol makes roses smell the way they do. Rose plants make the chemical using a reaction that involves an enzyme called farnesyl diphosphate (FPP) and other enzymes including NUDX1 hydrolase, which is produced inside of plant cells. It also involves cytosol, which exists in the flowers' petals.

To create enough geraniol, the plants need to generate a lot of NUDX1 hydrolase, which can only happen if there are plenty of binding molecules called geranyl diphosphate (GPP). Thus, for a rose to generate a lot of sweet-smelling geraniol, the two main substances involved in its creation must be created in close proximity to one another—but that did not seem to be the case when the researchers took at look at where they are generated. That indicated a missing pathway between them.

To find that pathway, the team chose one specific plant, called Old Blush—a pink rose with a lovely aroma. They shut down possible pathways in different plants and then watched to see how much geraniol they were able to produce They isolated a pathway in plant cytosol, and found it played a second role—it created compounds that were related to GPP, along with GPP itself, which allowed for producing geraniol.

To test their findings, they engineered a tobacco plant to express FPP, and found that it resulted in production of both enzymes, proving their theory. The group concludes that engineering cross-bred roses in similar ways could restore their famous aroma.

More information: Corentin Conart et al, A cytosolic bifunctional geranyl/farnesyl diphosphate synthase provides MVA-derived GPP for geraniol biosynthesis in rose flowers, *Proceedings of the National Academy of Sciences* (2023). DOI: 10.1073/pnas.2221440120