

Plant researchers locate transporter used for nicotine metabolism

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The next time you take aspirin for a headache, thank a willow tree. Salicylic acid, a compound chemically similar to aspirin, is found in willow tree bark and is made by the plant as a chemical defense against pathogens. By mimicking the chemical production processes of plants, scientists have been able to synthetically produce and engineer many important alkaloid drug products, including caffeine, atropine (an anti-spasmodic used to treat heart arrhythmia), nicotine, morphine and quinine.

The trick, however, is to understand how a plant produces these compounds and then transports them through the plant. A team of Virginia Tech and Purdue University scientists have identified a distinct transporter used by tobacco plant cells for [nicotine](#) metabolism. The research appears in the Oct. 17 online before print issue of the [Proceedings of the National Academy of Sciences](#) (*PNAS*) in the article, "[A tobacco nicotine uptake permease effects alkaloid metabolism](#)."

The transporter, called nicotine uptake permease (NUP1) allows [alkaloids](#) — nitrogen-containing compounds — to pass into plant cells. The transporter is a tubular structure found in the outer boundary of the [plant cell](#), known as the plasma membrane. Passage of alkaloids from one cell to another in an assembly line fashion is crucial to the biosynthesis of many medicinal plant alkaloids. However, prior to the study, it was not known exactly how the alkaloids were able to move either in or out of the cell.

"We knew that the general process of going in and out is important for alkaloid metabolism, but we didn't know the details," said John Jelesko, associate professor of plant pathology, physiology, and weed science at Virginia Tech. "The NUP1 transporter is very specific for nicotine — other closely related alkaloids don't use this transporter. That degree of specificity is rather unusual."

Identification of the transporter is a first step in understanding details about how the [tobacco plant](#) manages nicotine transport processes. So far, it is known that the chemical is made in the roots of tobacco plants, as a response to a pathogen attack. When ingested by insects and other organisms, it is a powerful neurotoxin, causing paralysis. Once produced in the roots, it is transported up through the rest of the plant by tube-like passageways called xylem and accumulates in the leaves. Tobacco farmers harvest nicotine by collecting the plant's leaves.

The scientists were able to locate the transporter using a "guilt by association" tactic, Jelesko said. The NUP1 gene was identified by looking for genes that were turned up or down in concert with known nicotine biosynthesis genes. The discovery of the transporter helps scientists gain new insight into the overarching field of medicinal alkaloid production in plants, Jelesko said. Understanding the complete process could enable bioengineering of medicinal plants to produce an optimal amount of compounds beneficial for treatment.

Provided by Virginia Tech

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