Down-Regulation of the Caffeic acid *O*-methyltransferase Gene in Switchgrass Reveals a Novel Monolignol Analog

U.S. DEPARTMENT OF ENERGY | Office of Science

Background:

Down-regulation of the caffeic acid 3-*O*-methyltransferase (COMT) gene in the lignin biosynthetic pathway of switchgrass (*Panicum virgatum*) resulted in cell walls of transgenic plants releasing more constituent sugars after pretreatment by dilute acid and treatment with glycosyl hydrolases from *Clostridium* (*C.*) *thermocellum*. However, fermentation of both wild-type and transgenic switchgrass after milder hot water pretreatment with no water washing showed that only the transgenic switchgrass inhibited *C. thermocellum*.

Approach:

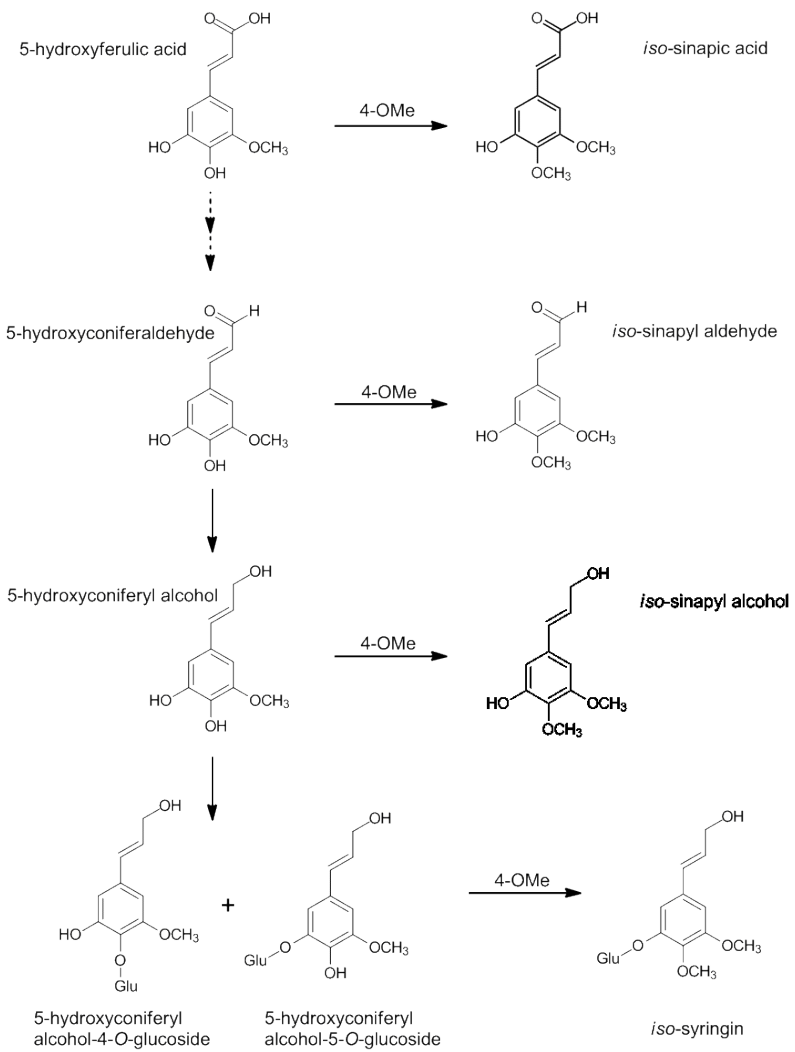
BESC researchers at Oak Ridge National Laboratory, Georgia Institute of Technology, The Samuel Roberts Noble Foundation, and The University of Tennessee undertook a study to determine the underlying cause of the microbial inhibition in growth and fermentation, and identified a novel mono-lignol analog and a new pathway.

Outcomes:

- Mass spectrometry-based metabolomic analyses of the transgenic biomass revealed elevated concentrations of a number of phenolic acids and aldehydes of the lignin pathway that are known microbial inhibitors.
- Additionally, a novel monolignol-like metabolite, identified as trans-3, 4-dimethoxy-5-hydroxycinnamyl alcohol (*iso-sinapyl* alcohol) was detected in transgenic biomass, as well as several related metabolites, including its glucoside, *iso-syringin*, *iso*-sinapic acid and *iso*-sinapyl aldehyde.
- The accumulation of *iso*-sinapyl alcohol likely results from the *para*-methylation of lignin precursors related to 5-hydroxyconiferyl alcohol.

Significance:

- The more facile breakdown of cell walls of COMT-deficient plants is associated with increased concentrations of phenolic acid and aldehyde inhibitors of microbial fermentation, and a monolignol analog of sinapyl alcohol that is not integrated into the cell walls.



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