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Synthesis of Phenylpropanoid-Esters and -Amides in *Arabidopsis thaliana* to Engineer a Cleavable Lignin

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The development of alternative transportation fuels that can meet future demands while reducing global warming is critical to the national, environmental, and economic security of the United States. Currently, biofuels are produced largely from starch, but there is a large, untapped resource (more than a billion tons per year) of plant biomass that could be utilized as a renewable, domestic source of carbon-neutral, liquid fuels. However, significant roadblocks hamper the development of cost-effective and energy-efficient processes to convert lignocellulose biomass into fuels. Lignin is a very strong phenolic polymer, which embeds cellulose and hemicellulose, and its recalcitrance to chemical and biological degradations inhibits the conversion of cell wall polysaccharides (cellulose and hemicellulose) into fermentable sugars. Unfortunately, lignin provides such compressive resistance to plant cells that it cannot simply be genetically removed without incurring deleterious consequences on plant productivity. Alternative strategies to significantly reduce lignin recalcitrance would be modifying its composition and deposition. We are currently developing an alternative strategy, which is focusing on the partial replacement of the "hard bonds" (e.g. ether, carbon bonds) in the lignin polymer with "easily cleavable" ones (e.g., amide or ester bonds). For this propose, we are rerouting part of the lignin biosynthesis towards the synthesis of phenylpropanoid-derived molecules such as hydroxycinnamic acid amides and esters in order to partially replace conventional lignin monomers in the cell wall. Biosynthetic pathways and preliminary data for de novo synthesis in Arabidopsis of selected phenylpropanoid-derived compounds are presented.

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