Pathway Engineering and Re-targeting Boosts Production of High-Value Bioproducts in Plants

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Leveraging synthetic biology approaches, engineered plants offer a sustainable production platform for high-value chemicals and other bioproducts. Squalene, a C30 hydrocarbon, is a biofuel candidate and the precursor to high-value triterpenoids, a diverse class of natural products with applications in the health, cosmetic, and other biotechnological industries. In this work, two strategies have been developed to increase plant production yields of squalene and triterpenoids by hijacking existing cell structures or building novel structures to sequester products within cells. First, the optimized biosynthetic pathways can be re-targeted to plastids, natural intracellular compartments, where biosynthesis can occur separate from native competing enzymes (Figure 1, right). The second strategy re-engineers lipid droplets as synthetic storage organelles with biosynthetic enzymes anchored to the surface, synthesizing and storing products in the same location (Figure 1, left). Both strategies are being implemented in poplar, a biofuel feedstock, to increase overall crop value through the addition of squalene bioproduction. These strategies demonstrate effective metabolic engineering approaches to further develop plants as platforms for production of high-value bioproducts.

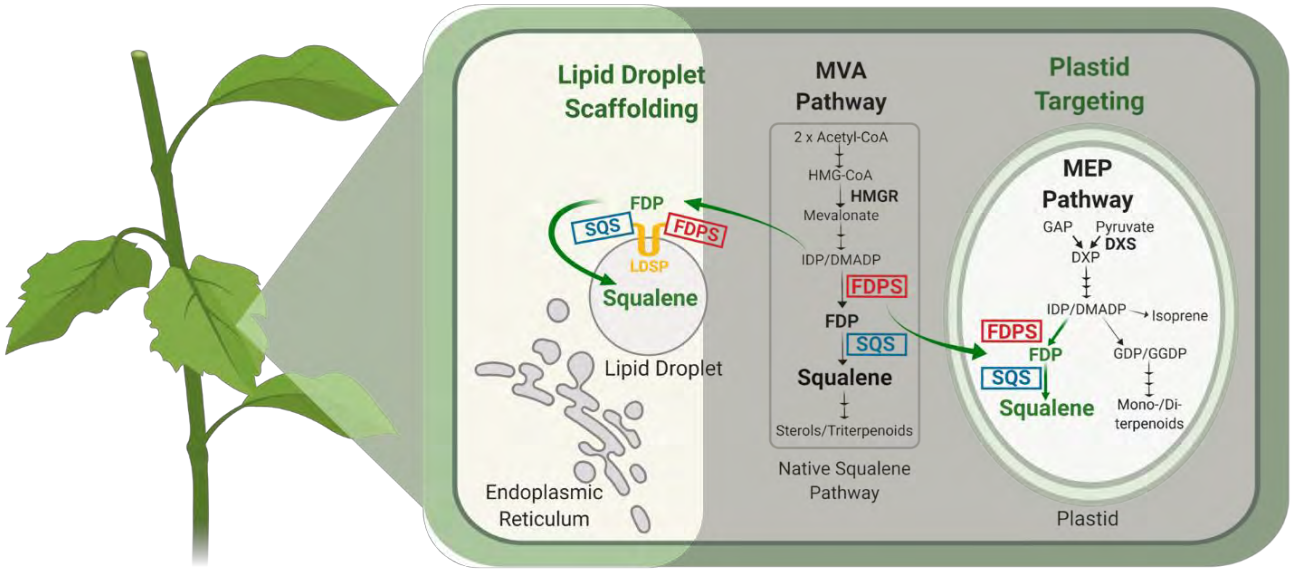

Figure 1: Strategies of re-targeting key squalene biosynthetic enzymes from the native pathway (center) to either plastids (right) or anchored to synthetic lipid droplets (left).

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