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Microbial Production of Fatty Acid-Derived Fuels and Chemicals in *Escherichia Coli*

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Increasing energy costs and environmental concerns have emphasized the need to sustainably produce renewable fuels and chemicals. Major efforts to this end are focused on the microbial production of high-energy fuels through cost-effective “consolidated bioprocesses”. Fatty acids are composed of long alkyl chains and represent nature’s “petroleum,” being a primary metabolite class used by cells for both chemical and energy storage functions. These energy rich molecules are today isolated from plant and animal oils for a diverse set of products ranging from fuels to oleochemicals. A more scalable, controllable, and economic route to this important class of chemicals would be through the microbial conversion of renewable feedstocks, such as biomass-derived carbohydrates. Here we demonstrate the engineering of *E. coli* to produce structurally tailored fatty acid ethyl esters (biodiesel), fatty alcohols, and waxes directly from simple sugars and the further engineering of the biodiesel-producing cells to secrete hemicellulases, a step toward producing these compounds directly from hemicellulose, a major component of plant-derived biomass¹. Although this complete production scheme has been demonstrated, increases in titer, productivity, and yield are necessary for industrial transition. Strategies employed for increasing yields of biodiesel include balancing the enzymes in the pathway, condensing the pathway onto a triple-operon, single-plasmid system, and subsequent chromosomal integration. These efforts guided towards understanding fermentation scalability, pathway stability, and balancing pathway enzymes for biodiesel production have resulted in higher yields.

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¹ Steen EJ, Kang Y, Bokinsky G, Hu Z, Schirmer A, McClure A, del Cardayre SB, Keasling JD. “Microbial production of fatty acid –derived fuels and chemicals from plant biomass.” *Nature* (2009) accepted for publication.

