Using Engineered *Streptomyces* for Production of Fatty Acids and Isoprenoids from Lignocellulosic Biofuel Conversion Residue

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Project Goals:

- **Construct reporter systems to assess metabolic flux toward fatty acid (melanin) and isoprenoid (lycopene) in *Streptomyces* species**
- **Conjugate these reporter systems into a phylogenetically diverse *Streptomyces* strain collection**
- **Screen for growth on lignocellulosic biofuel conversion residue and production of the reporter metabolites**
- **Conduct transcriptomic analyses to identify genetic elements enabling each of these properties and recombine in an ideal host strain**
- **Produce target fatty acid and isoprenoid compounds from conversion residue using these strains**

The process of lignocellulosic bioethanol fermentation leaves behind a substantial portion of the energy-containing organic material, called conversion residue (CR). This CR can contain up to two-thirds of the chemical oxygen demand for biomass hydrolysates produced from AFEX-treated corn stover. Using microbes to convert this CR to value-added bioproducts instead of burning the CR to generate electricity or use of CR in animal feed would increase the value of CR and improves the economics of lignocellulosic biorefineries. Members of the genus *Streptomyces* represent good candidates to fill this role as they are genetically tractable, catabolically versatile, and produce a wide variety of compounds of the types that would be industrially useful, e.g. fatty acids and isoprenoids. Using our transferable reporter systems, we screened a diverse strain collection of *Streptomyces* spp. for their ability to grow on CR and to produce these compounds at high levels. Using comparative transcriptomic analysis, we aim to identify genetic elements that distinguish the high performers in this screen and use genetic and metabolic engineering to optimize their abilities to catabolize CR and to shift more metabolic flux toward fatty acids or polyketides. Using these genetic elements and the identified host strains, we will target high-value fatty acid and isoprenoid for production, chosen in accordance with technoeconomic analysis.

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