Lignin Manipulation in Feedstocks Towards Lignin Valorization and Bioproducts

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Project Goals: The most abundant organic material on earth is lignocellulosic biomass or non-food plant material. JBEI's mission is to convert biomass to biofuels and bioproducts. The goal is to provide the nation with clean, renewable transportation fuels and chemicals. Building a successful lignocellulosic biofuels industry depends, in part, on developing specialized bioenergy crops or feedstocks that are optimized for deconstruction and conversion.

Lignin, along with cellulose and hemicellulose, comprises the majority of plant cell wall. To improve the quality of biomass for conversion into biofuels or bioproducts, genetic manipulation mostly focused on lignin engineering. At JBEI, we propose novel approaches for lignin valorization by manipulating lignin to reduce biomass recalcitrance and produce bioproducts without growth penalties. To achieve our goal, we apply JBEI's synthetic biology tools to introduce new genes/pathways utilizing the shikimate and phenylpropanoid pathways. Four strategies were chosen for tailoring feedstocks including: 1) Reduction of the biomass recalcitrance and increasing the yield of biomass; 2) Reduction of the degree of polymerization (DP) of lignin; 3) Manipulation of lignification by overproducing a native monolignol precursors, *p*-coumarate (p-CA), and incorporate it into lignin polymer; 4) Lignin Valorization for accumulation of bioproducts such as 4-hydroxybenzoic acid (HBA), protocatechuic acid (PCA), and muconic acid (MA). All the possible pathways for reducing biomass recalcitrance, manipulating lignification and producing bioproducts are introduced to model and bioenergy feedstocks, including *Arabidopsis*, *Brachypodium*, sorghum, tobacco and poplar.