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Molecular tools to engineer cyanobacteria for industrial biotechnology

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Cyanobacteria as a sustainable chassis

• Prokaryotes - simple organisms, rapid growth, small genomes, easily transformed
• Photosynthetic - minimal input, therefore cheap feedstock and lower risk of contamination
• Extremely diverse - habitat, morphology, metabolism, wide range of natural products

…but the engineering toolbox is still limited

Introducing foreign DNA

• Plasmid vectors for stable integration to neutral sites in the genome
• BioBrick compatible

Controlling translation initiation

• Forward engineering of synthetic ribosome binding sites based on in silico calculators

Controlling growth kinetics

• Defined conditions, extensive RNAseq analysis

Growth-responsive transcription

• Induced in the late exponential phase

Nutrient-responsive transcription

• Induced under specific nutrient limitations

Enhanced product synthesis

• Better tools make for better titres

Summary

• A comprehensive toolkit has been established for rapid, rational design of cyanobacteria
• Control at various levels of the production process: culture growth, transcription, translation and ultimately product synthesis
• Novel conditions to modulate growth kinetics identified and transcriptomic responses analysed
• Novel growth phase- and nutrient-responsive promoters developed