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Metabolic engineering for understanding and harnessing nature's biosynthetic potential

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Abstract:

Nature produces many valuable compounds that can be used as alternative fuel or drug candidates. For example, plant natural products exhibit great pharmaceutical significance due to their structural complexity and chemical diversity. Sourcing compounds from their native producers is extensively used for valuable biochemical discovery and manufacturing. However, this approach may be crippled by cost and efficiency. Advances in metabolic engineering and synthetic biology have enabled efficient production of valuable microbial or plant natural products in heterologous hosts, mostly microorganisms. Moreover, recent progress in plant genomics lays the foundation for advancing our understanding of how nature achieves complex compound synthesis. Therefore, the combination of metabolic engineering, synthetic biology, and genomics provides a promising alternative approach for natural compound production and discovery. In this talk, I will discuss (1) the development of a systematic metabolic engineering approach in yeast for efficient bioethanol production and optimization, (2) complete biosynthesis of the opium poppy-derived medicinal alkaloid noscapine and related derivatives, and (3) discovery of a novel tomato natural product by establishing a genomics-driven plant natural product discovery pipeline in yeast. These studies highlight the potential for integrated synthetic biology, metabolic engineering, and genomics approaches to advance plant natural product-based drug discovery and development.