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A pathway for every product? Tools to discover and design plant metabolism

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Abstract

The vast diversity of plant natural products is a powerful indication of the biosynthetic capacity of plant metabolism. Synthetic biology seeks to capitalize on this ability by understanding and reconfiguring the biosynthetic pathways that generate this diversity to produce novel products with improved efficiency. Here we review the algorithms and databases that presently support the design and manipulation of metabolic pathways in plants, starting from metabolic models of native biosynthetic pathways, progressing to novel combinations of known reactions, and finally proposing new reactions that may be carried out by existing enzymes. We show how these tools are useful for proposing new pathways as well as identifying side reactions that may affect engineering goals.

Keywords: Cheminformatics, Metabolic modeling, Pathway design, Plant specialized metabolism

1. Introduction

2 Synthetic biology is a diverse field that seeks to redesign biological sys-
3 tems using a range of engineering principles. To date, much of the synthetic
4 biology efforts in plants have focused either on the introduction of heterol-
5 ogous metabolic pathways into a plant host (such as the beta-carotene syn-
6 thesis pathway to produce Golden Rice)[1, 2] or the manipulation of existing
7 pathway regulation[3, 4, 5]. A number of plant pathways have also been
8 transferred into microbial hosts to produce complex natural products[6, 7, 8]

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