Last advances in pathway engineering
Metabolic engineering and synthetic biology
Ignasi Granero Moya
Tutor: Pau Ferrer Alegre

What is Pathway engineering?
The use of biological knowledge to design or re-design microorganisms’ biochemical pathways to obtain biochemical or biofuels in a more sustainable way.

Metabolic engineering
Improvement of cellular processes by the modification of specific reactions and functions within the cell, or the introduction on new ones with recombinant DNA technology.

Synthetic biology
Design and engineering of biologically based pathways, novel devices and systems as well as redesigning existing, natural biological systems.

Rational design of a synthetic Entner–Doudoroff pathway for improved and controllable NADPH regeneration

Organism: Escherichia coli
Goal: NADPH cofactor regeneration rate improvement, which is a rate limiting compound in many anabolic reactions

Production of fatty acid-derived oleochemicals and biofuels by synthetic yeast cell factories

Organism: Saccharomyces cerevisiae
Goal: Free fatty acid production (for olive oil and fatty alcohol production)

References

Figure 1 & 2 are reprinted from Metabolic engineering. Vol. 29, Ng, C. V., Farasat, I., Maranas, C. D., & Salis, H. M. Rational design of a synthetic Entner–Doudoroff pathway for improved and controllable NADPH regeneration, 66-86. Copyright 2015, with permission of Elsevier.
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Figure 1
Heterologous enzyme screening for efficient pathway

Figure 2
Pathway with lower ATP production ⇒ more exergonic

Open Calculator creates a drop-in module

RBS library calculator

Figure 3
Production of fatty acid-derived oleochemicals and biofuels by synthetic yeast cell factories

From basic metabolism to specific product

Pathway monitored and modified to avoid intermediate metabolite accumulation

Failed enzyme fusion (CAR-ADH substrate channeling) due to low enzyme activity

Native promoters used

Integration in the genome

Figure 2
MAGE (multiplex automated genome Engineering) targets many loci on the chromosome for modification in a single cell or across a population of cells.

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