

MICROFLUIDICS IN PROTEIN AND METABOLIC ENGINEERING

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➤ Acceleration of the Design-Build-Test-Learn cycle for optimization of enzymatic cascades by coupling microfluidics with mathematics.

Metabolic Engineering

- Design enzyme cascades for important biotechnological reactions.

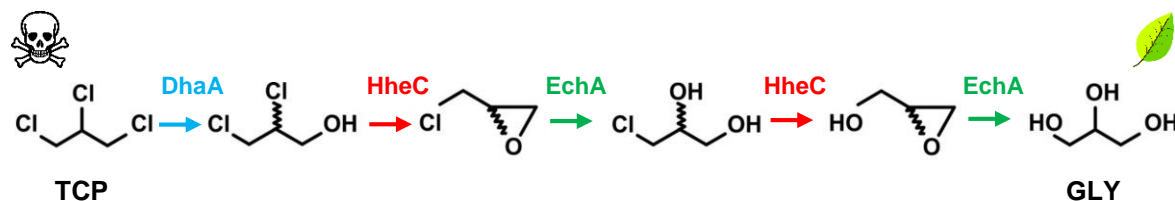


Fig. 1 Model metabolic pathway: Synthetic enzymatic cascade for degradation of 1,2,3-trichloropropane (TCP) to produce harmless glycerol (GLY). [1]

Protein Engineering

- Improve enzyme properties by altering protein structure.

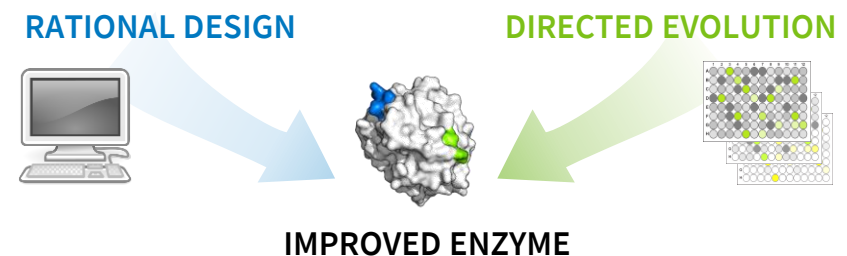


Fig. 2 Protein engineering approaches: Rational design and directed evolution are the major methodologies of enzymes improvement. Both approaches were used to increase efficiency of TCP pathway. [2]

Mathematics

- Data processing and feedback loop for microfluidic platform based on kinetic modelling and black-box optimization.

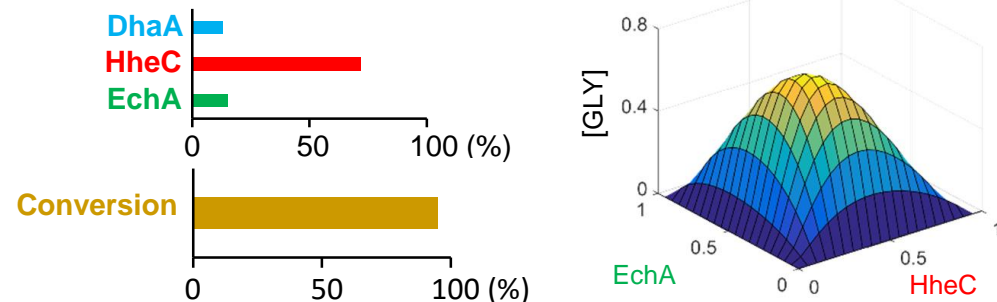


Fig. 3 Expected results: Optimum enzyme ratios to reach maximum conversion.

Design

Build

Learn

Test

Microfluidics

- Capillary droplet microfluidic platform [3,4] utilized for multiparameter optimization of enzyme cascade.

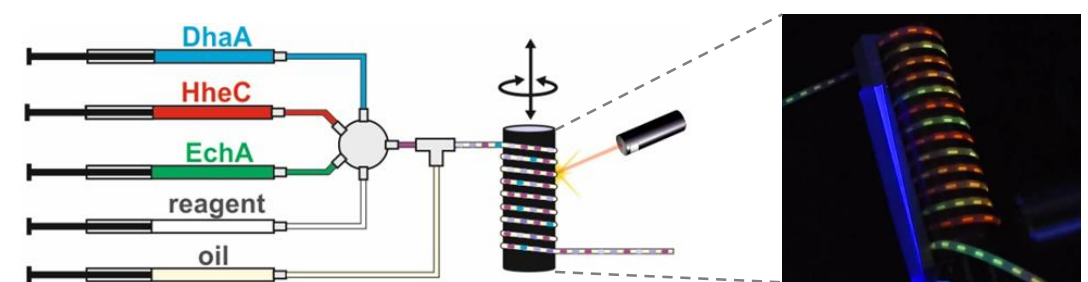


Fig 4. Experimental design: Changing flow rates of microfluidic pumps enables high-throughput assessment of thousands of conditions within the enzyme cascade.

Perspectives

- Validation of microfluidic optimization on TCP degradation pathway
- Utilization of this platform for other enzyme cascades, e.g., synthesis of provitamin A - Lycopene within the H2020 project Rafts4Biotech

References

- [1] Dvořák *et al. Environ. Sci. Technol.*, 2014, 48, 12, 6859-6866. [Link](#).
- [2] Pavlová *et al. Nat. Chem. Biol.*, 2009, 5, 727-733. [Link](#).
- [3] Buryška & Vašina *et al. Anal. Chem.*, 2019, 91, 15, 10008-10015. [Link](#).
- [4] Vašina & Vaňáček *et al. Method. Enzymol.*, 2020, 643, XXX-XXX (*in press*)