TECHNOLOGY OFFER

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Method for Shuttling Photosynthetic Redox Equivalents to Fuel Extracellular Biocatalytic Reactions

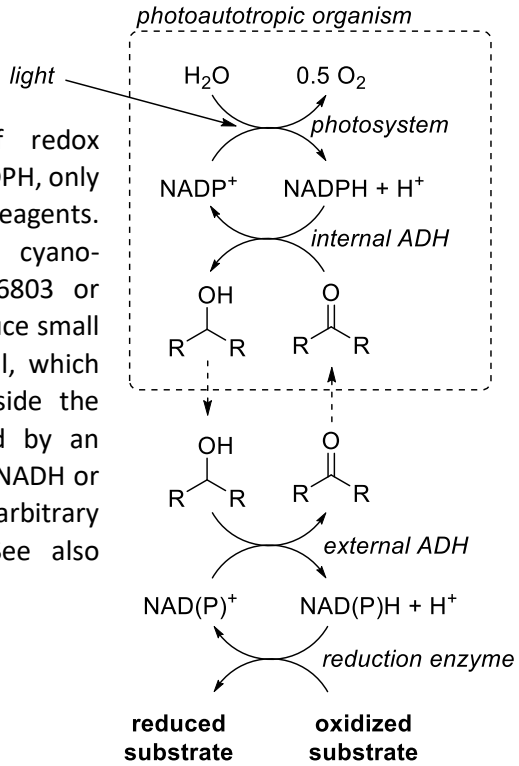
The technology offers a general possibility to provide reduced cofactors (NADH, NADPH) just at the expense of water and light for any enzyme of choice added to the reaction solution. The reducing equivalents generated in photoautotrophic organisms, such as cyanobacteria, are shuttled via small organic molecules from inside the cell to the outside of the cell available then for the added enzyme. The advantage is, that the additional enzymes required do not need to be expressed in cyanobacteria. The system may, among other applications, be used for the (asymmetric) biocatalytic reduction of activated C=C double bonds.

BACKGROUND

NADH and NADPH are commonly needed for many biocatalytic redox reactions. In general, they are recycled using sacrificial reagents. Phototrophic organisms are able to generate them with light from water just with O_2 as co-product. However, to bring the reagent to the enzyme may be a challenge. Until now, the enzyme was tried to be co-expressed within the phototrophic organism which caused severe troubles (expression level, cloning). This technology overcomes these challenges by bringing the reagent to the enzyme in solution.

TECHNOLOGY

This technology allows recycling of redox equivalents in the form of NADH and NADPH, only with water and light as stochiometric reagents. Photoautotrophic organisms such as cyano-bacteria (e.g. *Synechocystis* sp. PCC 6803 or *Synechococcus elongatus* PCC 7942) reduce small shuttles, such as acetone to 2-propanol, which then drive biocatalytic reductions outside the living cell, where they are re-oxidized by an alcohol dehydrogenase (ADH) providing NADH or NADPH for further utilization by any arbitrary chosen enzyme requiring NAD(P)H. See also figure.



ADVANTAGES

- Reducing equivalents provided at the expense of just water and light.
- O_2 only side product.
- Issues associated to substrate toxicity are reduced.
- Both, NADH and NADPH can be recycled.
- Any redox enzymes requiring the reduced cofactors NADH and NADPH can be coupled.
- Enzyme may just be added to the reaction.
- No cloning or expression in phototrophic organisms required.

KEYWORDS:
NADH
NADPH
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Cofactor recycling
Photocatalysis
Photobiocatalysis
Reduction
Photoautotrophic organism
Cyanobacteria
Ene-reductase
Alcohol dehydrogenase

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