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In Vitro one-opt production of 3-hydroxypropanal from C1 and C2 chemicals using two biocatalysts

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PURPOSE OF THE ABSTRACT

One- or two-carbon compounds are attractive substrates, which have been used for biotechnological production of value-added products such as 3-hydroxypropanal (3-HPA), 3-hydroxypropionic acid (3-HA), and 1,3-propanediol (3-PDO) that are used as starting materials to produce biocompatible plastic and polytrimethylene terephthalate. Methanol-derived formaldehyde (C1) and ethanol-derived acetaldehyde (C2) can be converted to 3-HPA (C3) via aldol condensation, which can also be utilized for 3-HA and 3-PDO synthesis. In this study, we optimized the reaction conditions for 3-HPA production from formaldehyde and acetaldehyde using deoxyribose-5-phosphate aldolase from Thermotoga maritima (DERATma), which showed the maximal activity at pH 7.0 and 40 °C. Under these optimized conditions, DERATma produced 7 mM 3-HPA from 25 mM formaldehyde and acetaldehyde for 60 min with a productivity of 520 mg/L/h. To investigate the one-pot production of 3-HPA from methanol and ethanol, we used methanol dehydrogenase from Lysinibacillus xylanilyticus (MDHLx), which converts methanol and ethanol to formaldehyde and acetaldehyde, respectively. One-pot cascade reaction with MDHLx and DERATma was performed under optimized reaction conditions to produce 3-HPA from alcohol-derived compounds (formaldehyde and acetaldehyde). To best of our knowledge, this is the first report on 3-HPA production from inexpensive alcohol substrates (methanol and ethanol).

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FIGURES

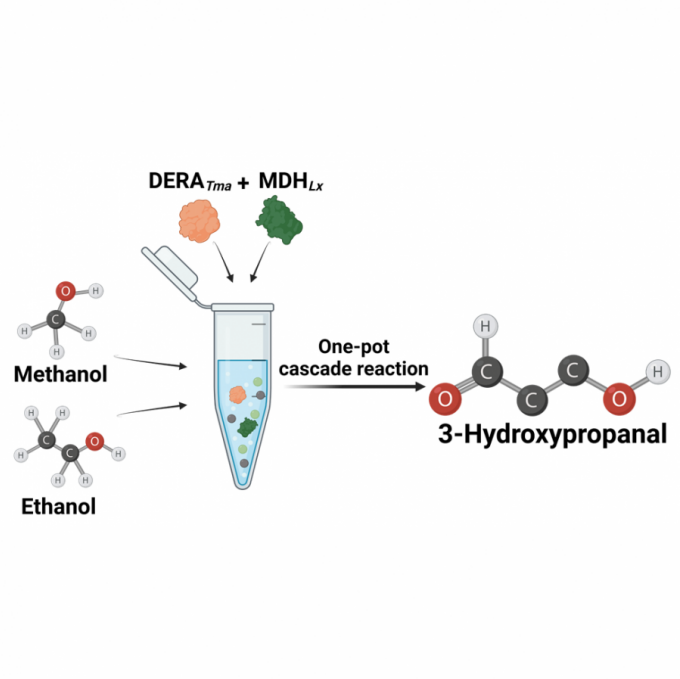

FIGURE 1

Scheme of the synthetic pathway of 3-hydroxypropanal from methanol (C1) and ethanol (C2) using two biocatalysts

3-Hydroxypropanal can be produced from methanol-derived formaldehyde and ethanol-derived acataldehyde with DERA from Thermotoga maritima and MDH from Lysinibacillus xylanilyticus.

FIGURE 2

KEYWORDS

deoxyribose-5-phosphate aldolase | methanol dehydrogenase | 3-hydroxypropanal | cascade enzymatic bioconversion

BIBLIOGRAPHY