BRC Science Highlight
August 2021

Complete and Efficient Conversion of Plant Cell Wall Hemicellulose into High-Value Bioproducts by Engineered *Saccharomyces cerevisiae*

Background/objective

The hydrolysates from plant cell walls contain not only sugars but also substantial amounts of acetate, a fermentation inhibitor that hinders bioconversion of lignocellulose. Despite the toxic and non-consumable nature of acetate during glucose metabolism, we focus on detoxifying acetate in cellulosic hydrolysates by exploiting its consumption to enhance acetyl-CoA supply in yeast to produce value-added products.

Approach

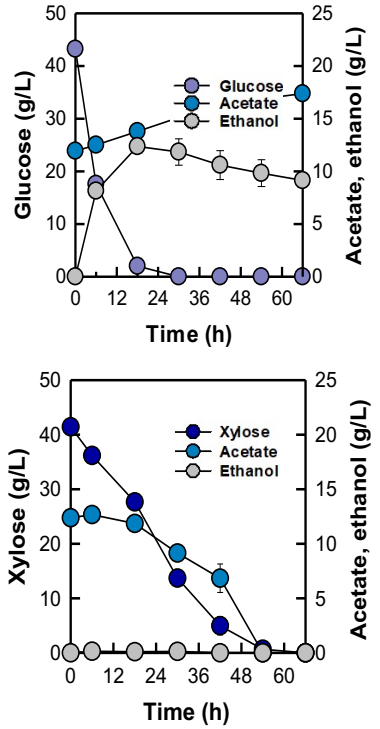
- We applied RNA sequencing analysis to reveal the underlying mechanisms of detoxification and co-consumption of acetate with xylose in yeast.
- Our xylose-fermenting yeast was further engineered to produce triacetic acid lactone (TAL) and other acetyl-CoA-derived bioproducts.

Results

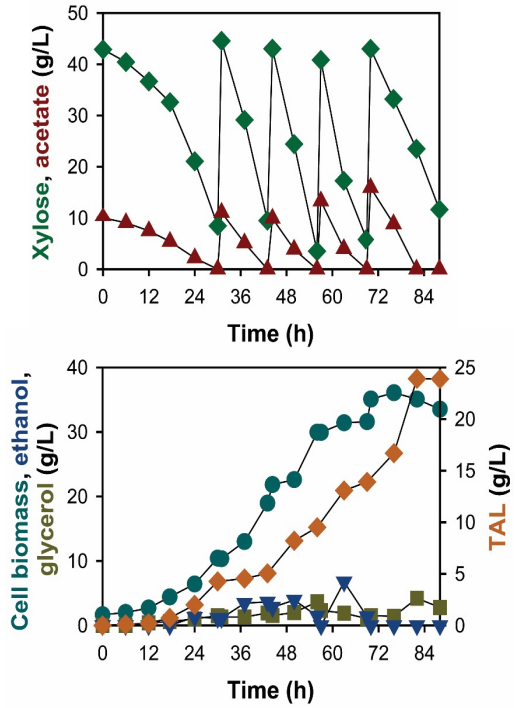
- In contrast to the hampered acetate consumption by glucose, up to 12 g/L of acetate is rapidly assimilated by engineered yeast in the xylose cultures.
- Co-feeding acetate and xylose leads to a metabolic re-configuration that boosts the synthesis of acetyl-CoA derived bioproducts, including TAL and vitamin A.
- The engineered strain produces 23.91 g/L TAL with a productivity of 0.29 g/L/h in bioreactor fermentation when co-feeding xylose and acetate. This strain also completely converts a hemicellulose hydrolysate of switchgrass into 3.55 g/L TAL.

Significance

Acetate can be rapidly co-consumed with xylose by engineered *S. cerevisiae*, which detoxifies acetate into a valuable substrate, expands the capacity of acetyl-CoA supply in *S. cerevisiae*, and enables conversion of plant cell wall hydrolysates into acetyl-CoA derived bioproducts.



Co-utilization of xylose and acetate by the xylose-fermenting yeast.



Fed-batch culture with xylose and acetate co-feeding for the production of TAL.

*Sun, L., et al., 2021. "Complete and Efficient Conversion of Plant Cell Wall Hemicellulose into High-Value Bioproducts by Engineered Yeast." **Nature Communications** 12, 4975. DOI: 10.1038/s41467-021-25241-y.*

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