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All You Can Eat Yeast: Simultaneous Utilization of Sugars in Renewable Feedstocks by Engineered Yeast

Background/Objective

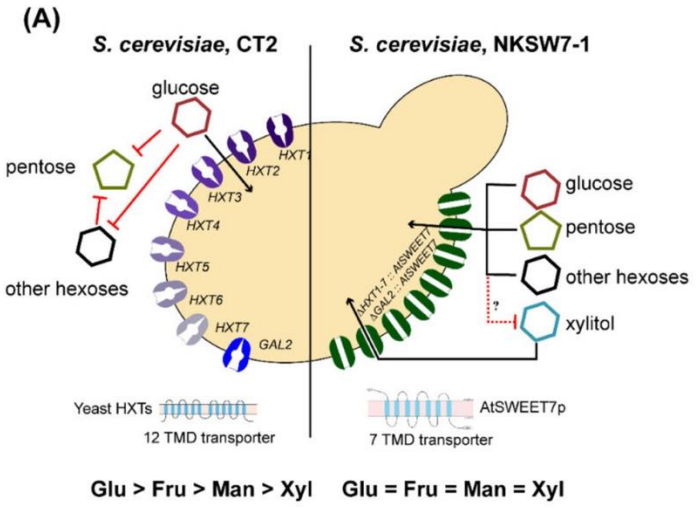
Native yeast sugar transporters (HXT1-7) have a strong preference for glucose. This prevents simultaneous utilization of non-glucose sugars (like xylose) found in lignocellulose biomass, creating a bottleneck for efficient biochemical production. Through expression of promiscuous sugar transporter AtSWEET7p from *Arabidopsis thaliana*, we aimed to develop a *Saccharomyces cerevisiae* strain capable of simultaneous sugar co-consumption.

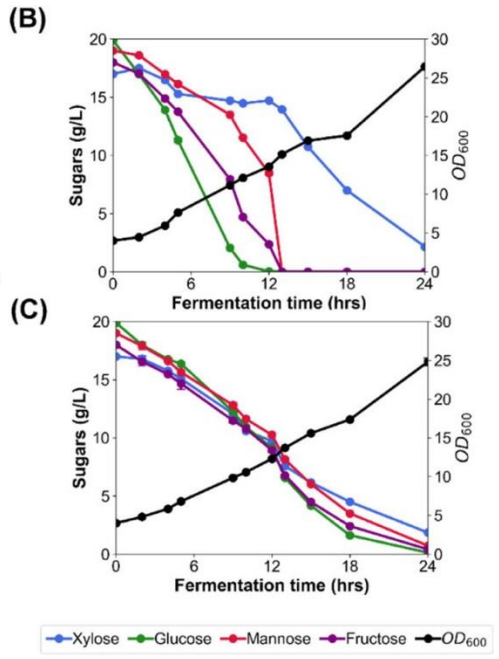
Approach

We systemically replaced HXT1-7 and GAL2 in an optimized xylose-fermenting yeast strain (CT2) with AtSWEET7p, generating strain NKSW7-1. Transcriptomic and metabolomic analysis of NKSW7-1 was conducted, in addition to fermentation of sugar cane juice and bagasse hydrolysate. Continuous culture experiments were used to assess sugar preference and consumption rates under steady-state conditions.

Results

NKSW7-1 successfully co-fermented glucose, mannose, fructose, and xylose. NKSW7-1 also gained the ability to rapidly consume xylitol as a sole carbon source. Transcriptomic and metabolomic analyses revealed that substituting HXTs with AtSWEET7 led to systemwide reprogramming of central carbon metabolism and the alleviation of glucose repression.





(A) Comparison of CT2 and engineered NKSW7-1 strains. (B) Quadruple sugar flask fermentation profiles.

Significance/Impacts

This work demonstrates a breakthrough in overcoming the glucose preference of *S. cerevisiae*, enabling simultaneous sugar conversion in complex feedstocks. AtSWEET7 also enables more efficient utilization of industrial byproducts like xylitol and acetate. The broad transport capacity of AtSWEET7p especially holds promise for continuous fermentation processes in microbial cell factories for biofuel production.

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