BRC Science Highlight
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A SWEET Surprise: Anaerobic Fungal Sugar Transporters and Chimeras Enhance Sugar Uptake in Yeast

Background/objective

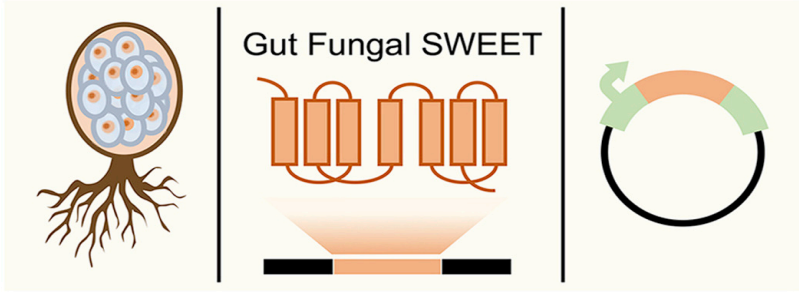
Membrane-embedded transport proteins, which mediate the movement of molecules across the cellular membrane, transport sugar poorly in *Saccharomyces cerevisiae*. This limits efficient co-utilization of glucose and xylose, which is necessary for the economic fermentation of commodity chemicals such as bioethanol. Here we demonstrate that genes that are naturally adept at lignocellulosic hydrolysate fermentation, part of the Sugars Will Eventually be Exported Transporter (SWEET) superfamily from a non-model organism, are a promising source of transporters and were functionally screened in *S. cerevisiae* to enhance glucose and xylose co-utilization.

Approach

- Identified and functionally screened genes from three strains of early-branching anaerobic fungi (*Neocallimastigomycota*) from the SWEET superfamily into *S. cerevisiae*.
- Identified novel sugar transporters with different kinetic properties using a xylose-fermenting and hexose transporter deficient *S. cerevisiae* strain.
- Identified chimera transporters exhibiting enhanced growth rate on glucose, fructose, and mannose, which are prevalent sugars in cellulosic hydrolysate.

Results

- Transporter NcSWEET1 demonstrated broad activity on hexose sugars and xylose, which was improved by forming chimeras with other anaerobic fungal SWEETs.
- Wild-type NcSWEET1 and the best performing chimera derived from it, NcSW1/PfSW2:TM5-7, supported the simultaneous co-utilization of glucose and xylose sugars.
- NcSWEET1 utilized 40.1% of both sugars, exceeding the 17.3% utilization demonstrated by the control strain HXT7(F79S).



Engineered fungal sugar transporter capable of co-transporting glucose and xylose

Significance

This is the first study to evaluate the utility of SWEETs in engineering *S. cerevisiae* sugar transport in general and to facilitate xylose transport specifically. The study showed that SWEETs from anaerobic fungi are beneficial tools for improving xylose uptake and enhancing glucose and xylose co-utilization, which can potentially be used to engineer *S. cerevisiae* for increased biofuel output.

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