Engineering *Saccharomyces cerevisiae* for increased utilization of xylose from biomass

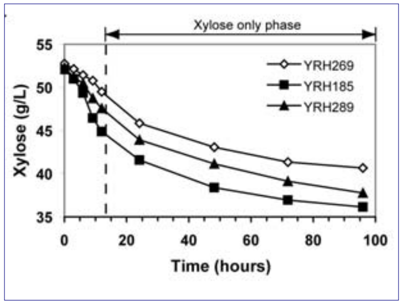
A. What is this technology?
We have developed a *Saccharomyces cerevisiae* strain with improved xylose transport and consumption for conversion of biomass substrates to renewable products such as ethanol.

B. What problem does it address?
- Biomass feedstocks are composed of hexose and pentose sugars, locked into a higher-order structure. The most abundant of these sugars are glucose and xylose.
- Glucose is readily fermented to ethanol by *S. cerevisiae*, however, xylose is not. Strains have been engineered to utilize xylose by addition of genes from the native xylose-consuming yeast *Pichia stipitis*. These strains do not grow well under aerobic or anaerobic conditions when xylose is the only sugar.
- Xylose uptake into the cell is one of the limitations to efficient xylose utilization. The strain developed here addresses the problem of poor xylose uptake in *S. cerevisiae*.

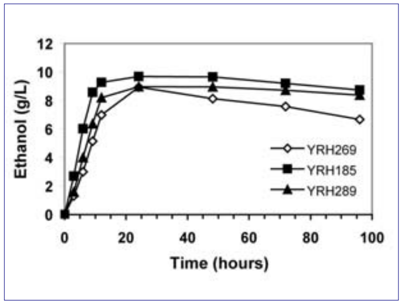
C. What is the significance of this solution?
- Increasing the concentration and rate of transport of xylose allows enzymes for xylose metabolism to work faster.
- With our in-house test strains, increasing xylose uptake resulted in increased xylose consumption and ethanol production.
- Increased productivity and yield directly lower capital costs by decreasing reactor and distillation equipment sizes, and decrease feedstock cost by increasing the convertible sugar in the feedstock.
- For biofuel applications, higher ethanol concentrations also decrease the energy required for product recovery by distillation.

D. Who could use this technology?
We have tested the modified yeast strains for production of ethanol from xylose and glucose mixtures for use in the bio-fuel industry. However, any *S. cerevisiae*-based process that uses biomass as a feedstock for the production of renewable products may benefit from the use of these strain modifications.

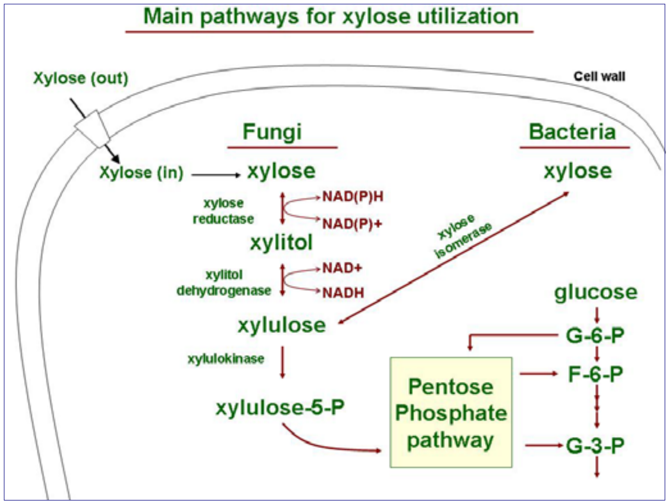
E. How is this technology unique?
All of the strains currently available import xylose poorly through transporters meant for importing glucose into the cell. As such, currently-available strains do not consume significant amounts of xylose when glucose is present. Our strain improvements increase intracellular xylose concentration due to expression of a non-*Saccharomyces* xylose transporter. These strains show an increase in the amount of xylose consumed when glucose is present.



Time course of xylose consumption. Strains engineered for increased xylose uptake (YRH185 and YRH289) show increased xylose consumption compared to a strain lacking expression of the heterologous xylose transporters (YRH269).



Time course for ethanol production. Ethanol productivity is increased in strains engineered for increased xylose uptake (YRH185 and YRH289) compared to a strain lacking expression of the heterologous xylose transporters (YRH269).



Stage of Development
An invention disclosure has been filed (ARS docket # 123.08)

Moving Forward
This technology is ready for transfer to industrial *Saccharomyces* sp. strains. To make use of this technology, a strain that is engineered to utilize xylose either by reduction/oxidation or the isomerase pathway is required.

PARTNERSHIP OPPORTUNITY

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