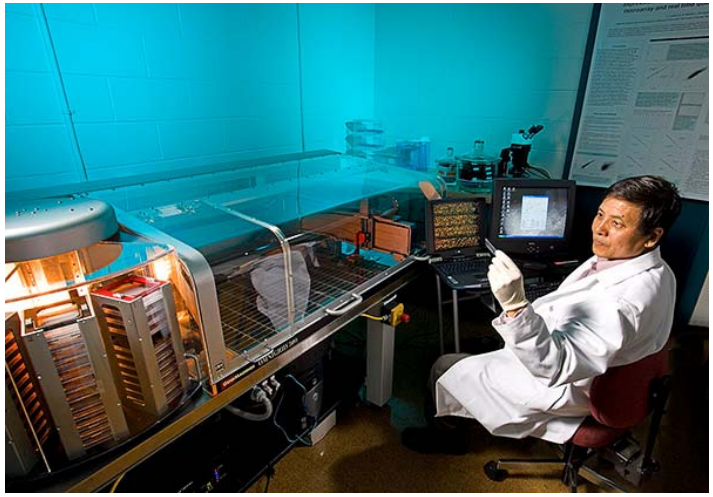
Tolerant yeast detoxify biomass fermentation inhibitors



A. What is this technology?

- The newly-developed ethanologenic yeast *Saccharomyces cerevisiae* NRRL Y-50049 can withstand common inhibitors generated from lignocellulosic biomass conversion process.
- This tolerant strain is able to in situ detoxify inhibitors furfural and 5-hydroxymethylfurfural into less toxic compounds while producing a normal yield of ethanol.

B. What problem does it address?

- During lignocellulosic biomass pretreatment, particularly for economic dilute acid hydrolysis, numerous inhibitory compounds are produced as by-products that interfere with microbial growth and fermentation.
- Under such complex stress conditions, microbes can be completely inhibited, unable to establish cultures, and be killed.

C. What is the significance of this solution?

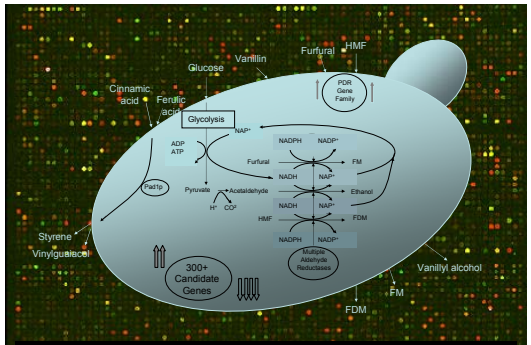
- Fermentation-based biofuel conversion technologies rely extensively on performance of microorganisms.
- Varied physical, chemical, and biological methods have been used to remove inhibitors. However, inhibitor removal methods are selective. Due to high cost, additional processing steps, and loss of fermentable sugars, current technology is not feasible for a sustainable biofuels industry.
- Development of tolerant yeast is the most economic means to overcome inhibitor stress for cost-competitive and sustainable lignocellulosic biomass conversion to ethanol.

D. Who could use this technology?

Companies interested in converting biomass to fuels or chemicals.

E. How is this technology unique?

The new strain is the first available that can be used as an initial culture to detoxify furfural and HMF without any conditional culture procedures.



A schematic diagram showing 2-furaldehyde (furfural) and 5-(hydroxymethyl)-2-furaldehyde (HMF) conversion pathways relevant to glycolysis and potential interactions with other candidate genes in a yeast cell. Furfural is converted into 2-furanmethanol (FM) and HMF into furan-2,5-dimethanol (FDM) coupled with NADH and/or NADPH and catalyzed by multiple enzymes possessing aldehyde reduction activities. Cinnamic acid and ferulic acid are converted into styrene and vinylguaiacol catalyzed by phenylacrylic acid decarboxylase (Pad1p). A shaded upward arrow indicates up-regulated or induced gene expression and an open downward arrow indicates down-regulated or repressed expression for members of pleiotropic drug resistance (PDR) gene family and other candidate genes.

Stage of Development

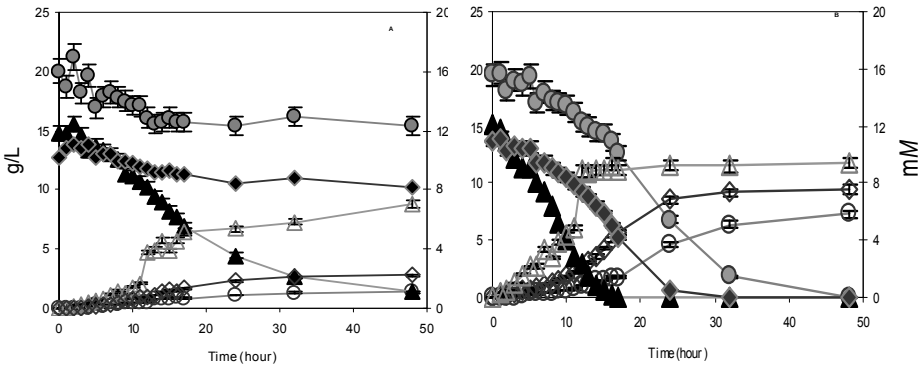
Patent:

- U.S. Patent Application S/N 12/143,965, filed June 23, 2008, Z. Liu, "Inhibitor tolerant *Saccharomyces cerevisiae* strain."

Moving Forward

PARTNERSHIP OPPORTUNITY

A partner is needed for scale-up.



Comparison of metabolic dynamics of *Saccharomyces cerevisiae* NRRL Y-12632 (left) and strain Y-50049 (right) including glucose (●), ethanol (○), HMF (◆), FDM (◇), furfural (▲), and FM (△) in the presence of furfural and HMF at 12 mM each on a defined medium.

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