Development of Recombinant Yeast for Cellulosic Ethanol Production
From Concept to Large-Scale Production

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Composition of cellulosic biomass

- Cellulose 45%
- Hemicellulose 25%
- Lignin 25%
- Other 5%
The xylose metabolic pathway in yeast
pUCHm10
(7.57 kb)

pLNH31, pLNH32, pLNH33, or pLNH34
Cofermentation of Glucose and Xylose by 1400(pLNH32)
Co-fermentation of Glucose and Xylose by Un-transformed Parent strain 1400
1993-1996

Development of stable yeast containing high-copy-number XR, XD, and XK genes integrated into the yeast chromosomes
Co-fermentation of glucose and xylose by 1400 (LNH-ST)
Comparative study of the bench scale (closed symbols and continuous lines) and pilot scale (open symbols and dashed lines) performance of LNH-ST during the SSSF of pretreated corn biomass (batch 2). The symbols represent the concentrations of glucose (◇, ◇), xylose (▲, ▲), and ethanol (◼, ◻).

This experiment was carried out with 1400(LNH-ST) in a 9000-L pilot scale bioreactor.
Large-scale screening for better yeasts with no legal constraints for converting cellulosic sugars (mixed sugars recovered from cellulosic biomass) to ethanol
New stable yeast 424A(LNH-ST) for co-fermentation of glucose and xylose to ethanol
• Fermentation of hydrolysates, prepared by various Methods, with 424A(LNH-ST)
Fermentation of softwood hydrolysates by yeast 424A(LNH-ST)
Fermentation of Cellulosic wastes from a paper factory by 424A(LNH-ST)
Expression profile of *S. cerevisiae* 424A(LNH-ST) co-fermenting glucose and xylose. Clustering by K-means and measure similarity by Pearson correlation.
Large-Scale Production of Cellulosic Ethanol

Our yeast has been used by Iogen to produce cellulosic ethanol from wheat straw in their demonstration plant in Canada since April 2004

And

Iogen also told ASM News, “Many groups have made recombinant microbes to do this*, but Ho’s yeast is the best we have tested”.

* To convert cellulosic biomass to ethanol
Successful engineering of yeasts capable of producing high-value co-products during grain-ethanol or cellulosic-ethanol production

2002-present
Production of co-product during co-fermentation of glucose and xylose by 424A(LNH-ST)
1995-2000

Genetic engineering of *Saccharomyces*
Yeast for converting glucose or glucose/xylose
to lactic acid
Co-fermentation of glucose and xylose by genetically engineered *Saccharomyces* yeast to lactic acid.
Conversion of SC hydrolyzate to lactic acid by genetically modified *S. cerevisiae*

Conversion of CS hydrolysates to lactic acid by genetically modified *S. cerevisiae*
2000-Present

• Further genetic engineering of the best yeast, 424A(LNH-ST), to improve its xylose fermentation by developing a xylose-specific transport and make it able to ferment two other minor sugars, L-arabinose and galactose, effectively.
Acknowledgement

MAJOR PARTICIPANTS SINCE 1980

Stuart A. Rosenfeld          Zhengdao Chen
Panayiotis E. Stevis          Adam P. Brainard
Sue-Fan Chang                 Miroslav Sedlak

Our early work, prior to 1990, was mostly supported by DOE and USDA. EPA also provided us a grant for three years for screening the most effective yeast for xylose fermentation. Overall, we are most indebted to the NRI program of USDA, particularly its Biobased Products and Bioenergy Research Program, that has persistently supported our research on the development of recombinant yeast since the early 1980s.