# *Heterologous secretory expression of β-glucosidase from* Thermoascus aurantiacus *in industrial* Saccharomyces cerevisiae *strains*

**Izat Smekenov, Marzhan Bakhtambayeva, Kudaybergen Bissenbayev, Murat Saparbayev, Sabira Taipakova & Amangeldy K. Biss[illegible]**

**Brazilian Journal of Microbiology**

ISSN 1517-8382

Braz J Microbiol
DOI 10.1007/s42770-019-00192-1


Springer

Brazilian Journal of Microbiology
https://doi.org/10.1007/s42770-019-00192-1

BIOTECHNOLOGY AND INDUSTRIAL MICROBIOLOGY - RESEARCH PAPER

# Heterologous secretory expression of β-glucosidase from *Thermoascus aurantiacus* in industrial *Saccharomyces cerevisiae* strains

Izat Smekenov[1,2] · Marzhan Bakhtambayeva[1,2] · Kudaybergen Bissenbayev[2,3] · Murat Saparbayev[4] · Sabira Taipakova[1,2] · Amangeldy K. Bissenbaev[1,2]

Received: 27 November 2018 / Accepted: 14 November 2019


## Abstract

The use of plant biomass for biofuel production will require efficient utilization of the sugars in lignocellulose, primarily cellobiose, because it is the major soluble by-product of cellulose and acts as a strong inhibitor, especially for cellobiohydrolase, which plays a key role in cellulose hydrolysis. Commonly used ethanologenic yeast *Saccharomyces cerevisiae* is unable to utilize cellobiose; accordingly, genetic engineering efforts have been made to transfer β-glucosidase genes enabling cellobiose utilization. Nonetheless, laboratory yeast strains have been employed for most of this research, and such strains may be difficult to use in industrial processes because of their generally weaker resistance to stressors and worse fermenting abilities. The purpose of this study was to engineer industrial yeast strains to ferment cellobiose after stable integration of *tabgl1* gene that encodes a β-glucosidase from *Thermoascus aurantiacus* (TaBgl1). The recombinant *S. cerevisiae* strains obtained in this study secrete TaBgl1, which can hydrolyze cellobiose and produce ethanol. This study clearly indicates that the extent of glycosylation of secreted TaBgl1 depends from the yeast strains used and is greatly influenced by carbon sources (cellobiose or glucose). The recombinant yeast strains showed high osmotolerance and resistance to various concentrations of ethanol and furfural and to high temperatures. Therefore, these yeast strains are suitable for ethanol production processes with saccharified lignocellulose.

**Keywords** *Thermoascus aurantiacus* · *Saccharomyces cerevisiae* · β-Glucosidase · Cellobiose · Industrial strains · Ethanol

## Introduction

Biofuels are expected to become some of the major sources of renewable energy and mainly include cellulosic ethanol, biodiesel, and biogas. Significant attention has been diverted to ethanol from abundant renewable lignocellulosic feedstocks because of the low cost and good availability of ethanol [1, 2]. However, this is a very costly process owing to the robust and complex structure of lignocelluloses, which requires multistep operations, including pre-treatment, enzymatic hydrolysis, and fermentation. Upon hydrolysis, lignocelluloses yield a mixture of monomeric hexoses (glucose and galactose) and pentoses (xylose and arabinose). To develop an inexpensive process, a different metabolic engineering strategy has been employed in attempts to enable *Saccharomyces cerevisiae* to simultaneously ferment all available sugars in biomass hydrolysates (Fig. S1). For more efficient conversion of xylose to ethanol, either xylose reductase/xylitol dehydrogenase (XR/

Responsible Editor: Eleni Gomes.

**Electronic supplementary material** The online version of this article (https://doi.org/10.1007/s42770-019-00192-1) contains supplementary material, which is available to authorized users.

✉ Amangeldy K. Bissenbaev
Amangeldy.Bisenbaev@kaznu.kz

[1] Department of Molecular Biology and Genetics, Faculty of Biology and Biotechnology, Al-Farabi Kazakh National University, Almaty, Kazakhstan 050040

[2] Scientific Research Institute of Biology and Biotechnology Problems, Al-Farabi Kazakh National University, Almaty, Kazakhstan 050040

[3] Nazarbayev Intellectual School, Almaty, Kazakhstan 050044

[4] Gustave Roussy Cancer Campus, CNRS UMR8200, Université Paris-Sud, F-94805 Villejuif Cedex, France

Published online: 28 November 2019