Comparative responses of flocculating and nonflocculating yeasts to cell density and chemical stress in lactic acid fermentation

Radityo Pangestu[1], Prihardi Kahar[1], Chiaki Ogino[1], and Akihiko Kondo[1]

[1]Kobe Daigaku Daigakuin Kogaku Kenkyuka Kogakubu

December 18, 2023

Abstract

While flocculation has demonstrated its efficacy in enhancing yeast robustness and ethanol production, its potential application for lactic acid fermentation remains largely unexplored. Our study examined the differences between flocculating and nonflocculating *Saccharomyces cerevisiae* strains in terms of their metabolic dynamics when incorporating an exogenous lactic acid pathway, across varying cell densities and in the presence of lignocellulose-derived byproducts. Comparative gene expression profiles revealed that cultivating a nonflocculant strain at higher cell density yielded a substantial upregulation of genes associated with glycolysis, energy metabolism, and other key pathways, resulting in elevated levels of fermentation products. Meanwhile, the flocculating strain displayed an inherent ability to sustain high glycolytic activity regardless of the cell density. Moreover, our investigation revealed a significant reduction in glycolytic activity under chemical stress, potentially attributable to diminished ATP supply during the energy investment phase. Conversely, the formation of flocs in the flocculating strain conferred protection against toxic chemicals present in the medium, fostering more stable lactic acid production levels. Additionally, the distinct flocculation traits observed between the two examined strains may be attributed to variations in the nucleotide sequences of the flocculin genes and their regulators. This study uncovers the potential of flocculation for enhanced lactic acid production in yeast, offering insights into metabolic mechanisms and potential gene targets for strain improvement.