**Redox potential regulation improves yeast cells productivity and stress tolerance**

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**Abstract**

Redox potential, known as oxidation–reduction potential (ORP), not only indicates the environmental redox capacity, but also reflects the microorganisms metabolic activity. It can be monitored and controlled online for more efficient fermentation operation. In the past decade, we focused on building a redox potential control platform including 1) strain modification by the genetically engineered strains that harbor specific redox potential–regulated genes, and 2) process engineering by using bioelectrical reactors, reagent supplementation, or sparging gases. With these tools, in the starch-based ethanol fermentation under very-high-gravity (VHG) condition, the redistribution of carbon flux and improved tolerance of *Saccharomyces cerevisiae* were observed. Besides, in lignocellulose-based ethanol production, the reactive oxygen species (ROS) caused by diverse stresses was removed under intracellular and extracellular redox potential regulation, which consequently conferred yeast tolerance to inhibitors accumulated during pretreatment of lignocellulosic biomass. Finally, another ethanol producing strain *Zymomonas mobilis* was also investigated under different redox potential-controlled conditions. This bacteria not only showed the similar response as yeast in metabolic flux change and enhanced tolerance, but also was able to producing electricity along with ethanol production, which exhibited the predictable value in bioenergy generation. Redox potential control could be employed to optimize metabolic flux and improve stress tolerance of cells for robust ethanol production, therefore the benefits from the development of new redox potential-controlled fermentation technology are anticipated.

**Brief Biography**

Dr. Chen-Guang Liu received his BS and PhD degrees from the Dalian University of Technology (DUT). He worked at the University of Saskatchewan (Canada) and at the DUT as a Postdoctoral Fellow and an Assistant Professor. He moved to Shanghai Jiao Tong University as an Associate Professor in 2015. His research interests include: 1) Process optimization for the 2$^{nd}$ generation fuel ethanol from lignocellulosic biomass; 2) Redox potential regulation on cell metabolism and stress tolerance. As the PIs, he is now leading research for 3 projects sponsored by the NSFC, MOST, and Shanghai government. Up to date, he has co-authored more than 60 research and review articles, contributed 4 chapters to well-acknowledged academic books and co-edited 1 volume for the Springer book series. He is an editorial board member of several international journals and a guest editor of Biotechnology and Applied Biochemistry.

**Brief CV**

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**Education:**

B.S Biochemical Engineering, Dalian University of Technology, China, 2005

Ph.D. Biological Chemistry, Dalian University of Technology, China, 2011

Visiting Scholar, University of Saskatchewan, Canada, 2009-2010

**Professional Career:**

2011-2013: Dalian University of Technology, China, Postdoctoral Fellow.

2013-2015: Dalian University of Technology, China, Assistant Professor.

2015-Present: Shanghai Jiao Tong University, China, Associate Professor.

**Research Interests:**

1. Bioprocess Engineering
2. Metabolic Engineering

**Selected publications**

1. Liu, C. et al. ***Biotechnol Adv***, 2019, 37:491-504.
2. Mehmood, M. et al. ***Energ Convers Manage***, 2019, 194:37-45.
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6. Li, K. et al.. ***Chem Eng Sci***, 2018, 196:54-63.
7. Li, F. et al.. ***Nat Commun***, 2018, 9:3637.
8. Liu, C. et al. ***Biotechnol J***, 2018, 1700697.
9. Ahmad, M. et al. ***Bioresour Technol***, 2017, 245:491-501.
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