

Cell and process engineering of *Clostridium acetobutylicum* for biobutanol production

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Abstract

Histidine kinases in *C. acetobutylicum* were reported to directly control the phosphorylation state of Spo0A and the histidine kinase engineered strains showed different sporulation frequencies compared to the wild-type strain. However, very little is known about the effect of histidine kinase on metabolic regulation and solvent production. In this study, various histidine kinase genes in *C. acetobutylicum* were knocked-out. Compared to parental strain, the cac3319 knock-out strain produced 49% more butanol, demonstrating the regulatory function of histidine kinase. The cac3319 knock-out strain still appeared rod shape and vegetative throughout the fermentation and the transcriptional analysis revealed that significantly upregulation of sol operon, which caused the mutant a hyper-butanol producing strain. Furthermore, a double knock-out strain showed further improved butanol titer of >18.0 g/L in batch fermentation and butanol titer of >20 g/L in an immobilized fermentation system. Butanol titer of >500 g/L in condensate could be achieved by two-stage gas stripping-pervaporation process integrated with ABE fermentation. In conclusion, our study demonstrated the pleiotropic regulatory effects of histidine kinases on cell differentiation and solventogenesis of histidine kinases and provided a new strategy to improve butanol production.

Brief Biography

Prof. Dr. Chuang Xue received his BSc (2005) and PhD (2010) at Dalian University of Technology (DUT), China, all degrees in Biochemical Engineering. He worked as postdoctor for two years at Ohio State University in the USA. He worked at the DUT School of Life Science and Biotechnology as Assistant Professor (2010-2013), Associate Professor (2013-2016), Professor (2016-) with research interest in development of stress tolerant biofuel producing strain and product recovery techniques. Dr Chuang Xue is the Editorial board Member of Scientific Reports published by Nature Publishing Group with an impact factor of 5.0. He is highly commended finalist for Young Researcher Award in 3rd international symposium on Green Chemistry. His research has been funded by the Natural Science Foundation of China (NSFC). To date, he has more than 40 peer reviewed articles in prestigious international journals including *Biotechnology and Bioengineering*, *Biotechnology Advances*. He also has seven licensed patents about biorefinery.

Brief CV

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Education:

B.S. Biongeering, Dalian University of Technology, China, 2005

Ph.D. Biochemical Engineering, Dalian University of Technology, China, 2010

Professional Career:

2009-2011: Ohio State University, USA, Postdoc/visiting scholar.

2012-2013: Dalian University of Technology, China, Lecture.

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Research Interests:

1. Lignocellulosic Biofuels and Bioproducts
2. Metabolic Engineering and Synthetic Biology
3. Process Engineering

Selected publications

1. Xue, C*. et al. *Nano Letters*, 2018, 18(10):6150-6156.
2. Xue, C*. et al. *Biotechnology Advances*, 2017, 35:310-322.
3. Xue, C*. et al. *Biotechnology and Bioengineering*, 2016, 113: 120-129.
4. Xue, C*. et al. *Green Chemistry*, 2017, 19:660-669.
5. Xue, C*. et al. *Journal of Membrane Science*, 2019, 577:51-59.