Engineered *Escherichia coli* for simultaneous utilization of galactose and glucose and redox optimized n-butanol production

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Microbial production of chemicals and fuels requires not only utilization of multiple carbohydrates and but also efficient production capability to satisfy economic purpose. As galactose, abundant in red seaweed, is not preferred sugar to many microorganisms, its utilization rate is much lower than glucose and catabolite carbon repression limits simultaneous utilization of multiple sugars. On the other hand, one challenging problem in biofuel production is imbalanced cellular redox state (e.g. NAD/NADH) during fermentation process. Here, we engineered an *Escherichia coli* to constitutively utilize galactose in presence of glucose and to optimize cellular redox state for cell growth and n-butanol production. Regulatory elements of enzymes on utilization of galactose and production of n-butanol pathways were totally redesigned for maximum expression with synthetic regulatory parts such as strong constitutive promoters, and optimized 5'-untranslated regions (5'UTR), terminators. And we found the optimal expression level of formate dehydrogenase, contributes to additional NADH supply, to obtain maximum n-butanol productivity.