Effect of overexpression of the gene encoding NAD^+-dependent formate dehydrogenase on the production of 1,3-propanediol in metabolically engineered E.coli

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Current metabolic engineering studies have mostly focused on manipulating enzyme levels through the addition, amplification or deletion of the genes involved in a particular pathway. However, in cofactor-dependent production systems, cofactors play an essential role in the production of a large number of different fermentation products.[1] Hence, their manipulation can be potentially used as a powerful tool in order to achieve high productivity of desired metabolites. We have demonstrated the effect of cofactor manipulation on the production of 1,3-propanediol in metabolically engineered E.coli expressing the dha regulon of K. pneumoniae responsible for 1,3-propanediol production. We have isolated NAD^+-dependent formate dehydrogenase(FDH) from Staphylococcus aureus and overexpressed the gene in metabolically engineered E.coli producing 1,3-propanediol, which is normally produced from glycerol under more anaerobic conditions due to NADH-dependent 1,3-propanediol dehydrogenase, one of the dha regulon enzymes. The overexpression of NAD^+-dependent FDH induced a shift towards the production of a reduced metabolite, 1,3-propanediol under relatively less anaerobic conditions. This result demonstrates that it is possible to increase intracellular NADH availability through metabolic engineering and produce a more reduced product under aerobic condition.

Reference

1. Susana J. Berrios-Rivera, George N. Bennette, and Ka-Yiu San (2002), Metabolic engineering of Escherichia coli : Increase of NADH availability by overexpressing an NAD^+-dependent formate dehydrogenase, *Metabolic Engineering* **4**, 217-229.