196d Metabolic Flux Analysis and Optimization of Metabolic Networks for Astaxanthin Production by Mixed Culture Systems of Haematococcus Pluvialis and Phaffia Rhodozyma

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Astaxanthin is a high value carotenoid and strong biological antioxidant, which has widespread applications in nutraceutical, cosmetic, food and feed industries. The red yeast Phaffia rhodozyma and the green alga Haematococcus pluvialis are two principal astaxanthin-producing microorganisms. Common strategy for natural astaxanthin production has been focusing on cultivating the two strains separately in pure cultures with lower production levels but higher costs. In our previous study (Dong & Zhao, 2004, Catalysis Today, 98: 537-544), in order to combine CO2 fixation with astaxanthin production, we have mix-cultivated the above two different astaxanthin-producing atrains, the maximum concentrations of biomass and astaxanthin, 5.7 g/l and 12.95 mg/l, were obtained by the mixed culture. In this study, the metabolic flux analysis (MFA) within the cells of H.pluvialis and P. rhodozyma in pure cultures have been done, respectively. The results of MFA show: (1) P. rhodozyma assimilates glucose via EMP pathway, in which, the reaction from pyruvate to acetyl-CoA is inefficient and about 20.2%(in the stable stage) to 48.6%(in the growth atage) of the pyruvate are excreted. (2) In contrast, H. pluvialis catabolizes glucose along PP pathway, and pyruvate is one of the substrates for the synthesis of isopentenyl-pyrophosphate(IPP), a precursor of astaxanthin. If pyruvate flux increase by 1%, then IPP flux increase 0.8%. Based on the MFA and the optimization of the metabolic networks and operation conditions for the mixed culture of P. rhodozyma and H. pluviialis, the maximum astaxanthin production of 285 mg/l was obtained in the mixed culture experimental systems. These results are very useful for further metabolic engineering and commercial production of natural astaxanthin with higher yield at lower cost.