Accurate precursor rebalancing for isoprenoid production by fine-tuning of gapA in Escherichia coli

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To use the 1-deoxy-D-xylulose-5-phosphate (DXP) pathway for isoprenoid production requires equimolar glyceraldehyde 3-phosphate and pyruvate to divert flux toward the isoprenoids. Here, we show that precursor balancing is one of the most important steps for the production of isoprenoids in Escherichia coli. Initially, the synthetic lycopene production pathway as a model system, the amplification of the original DXP pathway were accomplished by using synthetic constitutive promoters and redesigned 5′-untranslated regions (5′-UTRs). Next, phosphoenolpyruvate synthase (PpsA) or glyceraldehyde 3-phosphate dehydrogenase (GAPDH) are tuned to precisely balance the precursors. The results showed that lycopene content in optimal gapA and ppsA variants increased up to 97% and 37% respectively, compared to that of the parental strain. Our results indicate that gapA is the optimal target for precursor balancing to increase biosynthesis of isoprenoids.