Whole-cell conversion of L-glutamic acid into γ-aminobutyric acid via an engineered strain overexpressing glutamate decarboxylase from Priestia flexa

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Abstract

Gamma-aminobutyric acid (GABA) is widely applied in the food and pharmaceutical industries, and glutamate decarboxylase (GAD) is the core enzyme for the biosynthesis of GABA. GAD exhibits high activity but poor stability under acidic conditions, and low activity under neutral conditions. In this study, GAD from *Priestia flexa* (*Pf*GAD) with high activity was screened out and characterized, and a variant with significantly improved stability was obtained through molecular modification strategies. We constructed an engineered strain that coexpressed *Pf*GAD and a transporter protein for GABA and L-glutamic acid. Furthermore, the consumption of GABA was suppressed by knocking out the *pepD* gene, confirming a novel downstream metabolic pathway of GABA in *Escherichia coli*. The continuous accumulation of GABA in the engineered strain led to a yield of 154.7 g·L $^{-1}$, with a conversation rate of 100%, meanwhile the cell growth was remained normal. The problem of the trade-off between cell growth and GABA accumulation was solved, which was one of the urgent problems according to previous reports. Our study provides important insights into the optimization of GABA production through enzyme engineering and strain modification, which could have significant implications for the industrial application of GABA.

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