Efficient Production of a Natural Blue Pigment Indigoidine using Metabolically Engineered *Corynebacterium glutamicum* for Sustainable Fabric Dyes

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Current industrial production of dyes for textiles mainly involves toxic chemicals, causing severe water pollution. For this, indigoidine has attracted attention as an alternative natural blue dye, but it is necessary to achieve a high-level production to compete with synthetic blue dyes. Here, we report a metabolically engineered *Corynebacterium glutamicum* capable of producing indigoidine to a high titer and productivity. First, *bpsA* gene from *Streptomyces lavendulae* was expressed in *C. glutamicum*. Production performance of this base strain, already producing 7.3 ± 0.3 g/L indigoidine from flask, was further improved by strengthening glucose uptake system, channeling carbon fluxes toward indigoidine biosynthesis and its precursors, and minimizing byproducts formation. The final strain produced 49.30 g/L indigoidine with the productivity of 0.96 g/L/h from fed-batch fermentation, the highest titer and productivity to date. Finally, indigoidine from the fed-batch fermentation was used to dye white cotton fabrics to examine its color and performance. This study demonstrates the potential of producing dyes in a sustainable manner by using a metabolically engineered bacterium.