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Research article

Biosynthesis of β-Arbutin via In Situ UDPG regeneration and glycosyltransferase engineering

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Abstract: β-Arbutin is a widely used skin-lightening agent in the cosmetology industry. However, the high cost of uridine diphosphate glucose (UDPG) and the low activity of glycosyltransferase have limited its practical biosynthesis. In this study, we constructed a UDPG regeneration system using sucrose synthase (SuSy) to reduce UDPG consumption and enhanced glycosyltransferase efficiency through site-directed mutagenesis. The single-point mutant A343V increased the hydroquinone (HQ) conversion efficiency by 1.25-fold. Under optimized conditions, the β-arbutin yield reached 98%, and the in situ UDPG regeneration cycles reached 39 times. This work demonstrates that the bi-enzymatic cascade reaction with UDPG regeneration and enzyme engineering provides an efficient and environmentally friendly method for β-arbutin biosynthesis.

Keywords: β-arbutin; biosynthesis; UDPG regeneration; glycosyltransferase; mutation

Supplementary

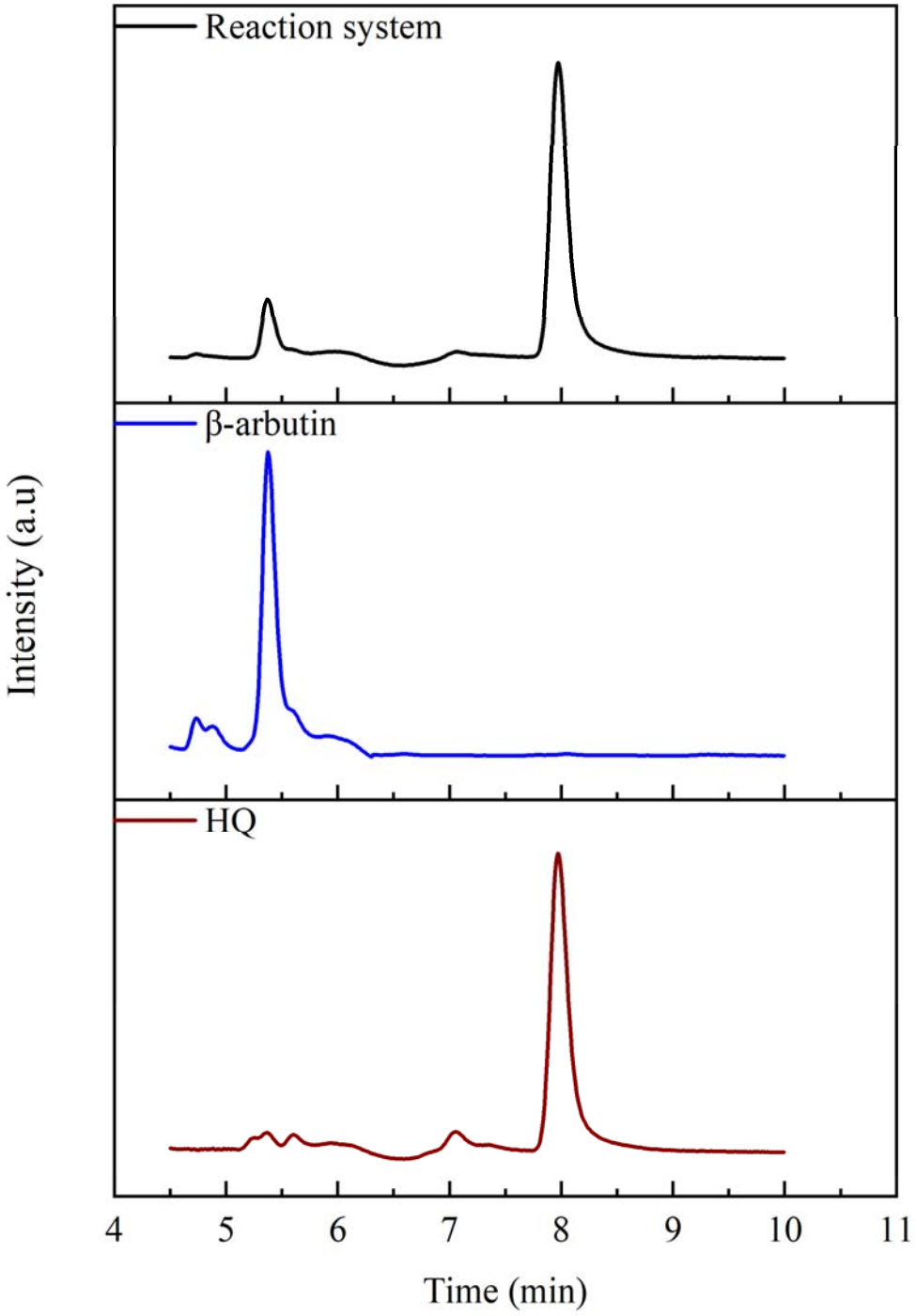


Figure S1. HPLC chromatograms of the HQ standard, the β-arbutin standard, and the products of the AS/SuSy-catalyzed cascade reaction.

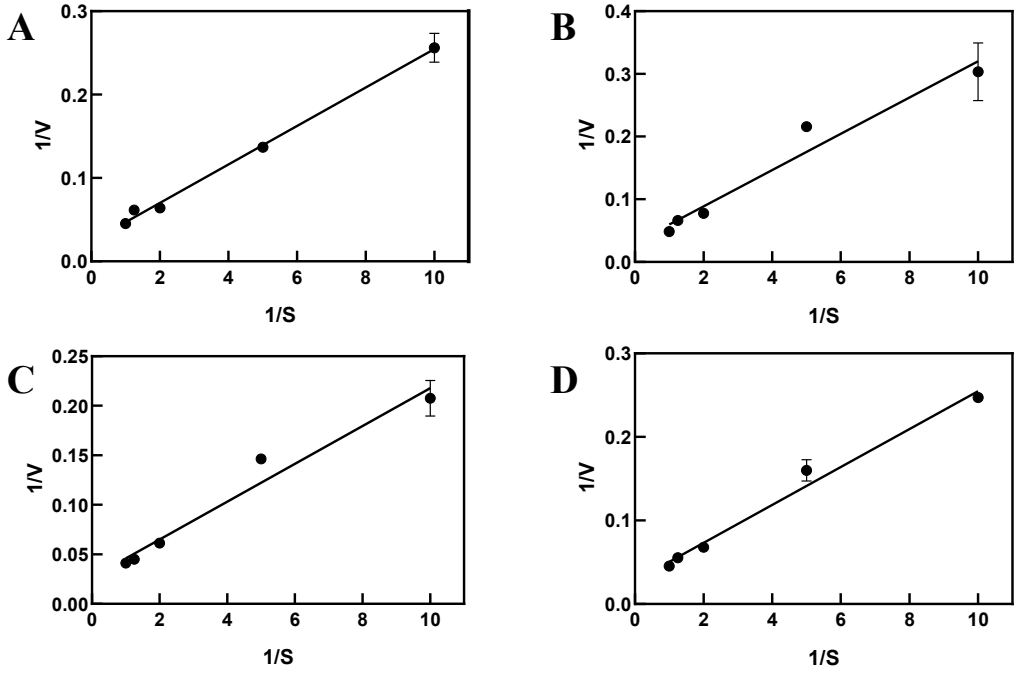


Figure S2. Michaelis–Menten plots for the glycosylation of HQ and UDPG catalyzed by AS and the A343V variant. (A) HQ kinetic profile with AS; (B) UDPG kinetic profile with AS; (C) HQ kinetic profile with A343V; (D) UDPG kinetic profile with A343V.

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