An efficient whole-cell catalyst for one-pot D-allulose production from glycerol

Hui Zhang[1], Anqi Zhao[1], Lingbo Qu[1], Wenlong Xiong[1], Md. Asraful Alam[1], Jixing Miao[1], Weigao Wang[1], Jingliang Xu[2], and Yongkun Lv[2]

[1]Affiliation not available
[2]Zhengzhou University

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Abstract

D-Allulose has many health-benefiting properties, physiological functions, and sustainable applications in food, pharmaceutical, and nutrition industries. The aldol reaction based route is a very promising alternative to Izumoring strategy in D-allulose production. Remarkable studies have been reported in this field, but still suffer from by-product formation and costly purified enzyme involvement. In the present study, we explored the glycerol assimilation, alditol oxidase, alcohol dehydrogenase, aldolase, and dephosphorylation pathways, and modularly designed, assembled, and optimized the D-allulose synthetic cascade in Escherichia coli envelop. We achieved an efficient whole-cell catalyst that produces only D-allulose from cheap glycerol feedstock, eliminating the involvement of purified enzymes. Detailed process optimization improved the D-allulose titer by 1500.00%. Finally, the production was validated in 3-L scale using a 5-L fermenter, and 5.67 g/L D-allulose was produced with a molar yield of 31.43%. This study provided a facile approach to produce D-allulose from glycerol feedstock.

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