World Academy of Science, Engineering and Technology
International Journal of Biotechnology and Bioengineering
Vol:19, No:02, 2025

Biosynthesis of L-Xylose from Xylitol Using a Dual Enzyme Cascade in Escherichia coli

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Abstract : L-xylose is an important intermediate in the pharmaceutical industry, playing a key role in the production of various antiviral and anticancer drugs. Despite its significance, L-xylose is a rare and costly sugar with limited availability in nature. In recent years, enzymatic production methods have garnered considerable attention due to their benefits over conventional chemical synthesis. In this research, a dual enzyme cascade system was developed to synthesize L-xylose from an inexpensive substrate, xylitol. The study involved cloning and co-expressing two key genes: the L-fucose isomerase (L-fucI) gene from Escherichia coli K-12 and the xylitol-4-dehydrogenase (xdh) gene from Pantoea ananatis ATCC 43072 in Escherichia coli. The resulting recombinant cells, engineered with the PET28a-xdh/L-fucI vector, were able to effectively convert xylitol to L-xylose. The system showed optimal performance at 40°C and a pH of 10.0. Moreover, Zn^{2+} (7.5 mM) enhanced the catalytic activity by 1.34 times. This approach yielded 52.2 g/L of L-xylose from an initial 80 g/L xylitol concentration, with a 65% conversion efficiency and a productivity rate of 1.86. The study highlights a practical method for producing L-xylose from xylitol through a co-expression system carrying the L-fucI and xdh genes.

Keywords : l-fucose isomerase, xylitol-4-dehydrogenase, l-xylose, xylitol, co-expression
Conference Title : ICBBB 2025 : International Conference on Bioscience, Biotechnology, and Biochemistry
Conference Location : Toronto, Canada
Conference Dates : February 10-11, 2025