L-阿拉伯糖異構酶生產 D-塔格糖的特性及固定化條件探討

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12/3/2014

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摘要

D-塔格糖為 D-半乳糖之異構物，其甜度為蔗糖的 92%，熱量只有蔗糖的 38%，在食品上可作為甜味劑，可減輕第二型糖尿病、高血壓、貧血、血友病等症狀，近年來，多以酵素法生產 D-塔格糖。L-阿拉伯糖異構酶 (L-arabinose isomerase；L-AI；EC 5.3.1.4) 是一種胞內酵素，可將 D-半乳糖 (D-galactose) 轉變為 D-塔格糖 (D-tagatose)。源自 *Lactobacillus fermentum* CGMCC2921 之 L-AI 可在 pH 值 6.5 時具最高的酵素活性，且在 1 mM 的 Mn^{2+} 中，D-半乳糖轉換成 D-塔格糖的轉換率為 55%。固定化方面，將含有 L-阿拉伯糖異構酶基因的 *L. fermentum* 菌株進行固定化，並進行其特性探討，發現在 50-80 ^{o}C、pH 值 5-7 之間，仍然具有 90% 的相對活性。生產方面，固定化菌體經過反應 192 小時後，仍保有約 90% 的產物產量，使 L-阿拉伯糖異構酶更適用於工業量產。接著利用基因工程技術將 *Geobacillus thermodenitrificans* 來源之 L-AI 進行突變，發現在相同條件下反應 30 分鐘，三突變酵素之產物產率高於雙突變酵素三倍，150 分鐘後，三突變酵素轉換率高於雙突變 24.8%，突變後對 D-塔格糖轉換更為提升。

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