Lacto-N-tetraose Biosynthesis from Lactose via Metabolically Rewired Escherichia Coli

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ABSTRACT

Researchers at the University of California, Davis have developed an engineered Escherichia coli platform for efficiently microbial production of lacto-N-tetraose (LNT), an important human milk oligosaccharide, directly from lactose as the sole carbon source. Through metabolic pathway rewiring, optimized lactose utilization, this technology enables a simple, scalable, and cost-effective fermentation process for industrial LNT production.

FULL DESCRIPTION

This technology enables the production of lacto-N-tetraose (LNT), one of the major core human milk oligosaccharides, using a genetically engineered Escherichia coli strain that utilizes lactose as its sole carbon source. The invention combines precise tuning of β-galactosidase (LacZ) activity with engineered carbohydrate metabolism to efficiently channel carbon from lactose into UDP-sugar biosynthesis and LNT assembly. Compared with conventional chemical, enzymatic, or multi-substrate microbial production methods, this approach simplifies the manufacturing process while improving production efficiency and industrial scalability.

APPLICATIONS

- Production of human milk oligosaccharides for use in infant formula and nutritional supplements.
- Manufacture of LNT as a functional ingredient for foods and nutritional supplements.
- Production of LNT for research, pharmaceutical development, and microbiome studies.
- Platform for commercial microbial manufacturing of complex oligosaccharides.
- Biotechnological platforms for sustainable rare sugar production.

FEATURES/BENEFITS

- Simplifies feedstock inputs by using lactose as the sole carbon source and precursor.
- Improves LNT yield and process efficiency by tuning LacZ expression to precisely control lactose hydrolysis.
- Increases carbon flux toward UDP-sugar biosynthesis and LNT production through metabolic pathway engineering.
- Enables stable, plasmid-free production through chromosomal integration of the biosynthetic pathway.
- Reduces manufacturing costs and improves scalability compared with chemical, enzymatic, or multi-substrate production methods.
- Provides a robust microbial fermentation platform suitable for industrial-scale LNT production.

PATENT STATUS

Patent Pending

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OTHER INFORMATION

KEYWORDS

carbohydrate metabolism, enzyme engineering, fermented biosynthesis, genetically engineered bacteria, human milk oligosaccharides, lacZ modulation, lacto-N-tetraose, microbial fermentation, UDP-sugar biosynthesis, vaccine adjuvants

CATEGORIZED AS

- **Biotechnology**
  - Food
  - Health

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