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

Tech ID: 34825 / UC Case 2026-359-0

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.

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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

PATENT STATUS

Patent Pending

biosynthesis, vaccine

adjuvants

CATEGORIZED AS

- **Biotechnology**
  - Food
  - Health

RELATED CASES

2026-359-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Purification of Glycosphingosines and Glycosphingolipids
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- Synthesis of Capsular Polysaccharides
- Legionaminic Acid Glycosyltransferases for Chemoenzymatic Synthesis of Glycans and Glycoconjugates
- Using Escherichia coli to Produce Human Milk Oligosaccharide Lactodifucotetraose
- Biological Conversion of Ethylene to n-Butanol and Other Chemicals Using E. Coli
- 4-N-Derivatized Sialic Acids and Related Sialosides
- Substrate And Process Engineering For Biocatalytic Synthesis And Facile Purification Of Human Milk Oligosaccharides (HMOs)
- O-Acetyl Glycosphingosines and Gangliosides, as well as Their N-Acetyl Analogs
- Biological Production of Industrial Small Esters
- Stable N-acetylated analogs of Sialic Acids and Sialosides
- Renewable Energy Synthesis System
- Alpha2-6-Linkage-Specific Sialidase Mutants
- Alpha1–2-Fucosyltransferase for Enzymatic Synthesis of Alpha1–2-linked Fucosylated Glycans
- Engineering Pasteurella Multocida Heparosan Synthase 2 (Pmhs2) For Efficient Synthesis Of Heparosan Heparin And Heparan Sulfate Oligosaccharides
- One-Pot Multienzyme Synthesis of Sialidase Reagents, Probes and Inhibitors
- Novel Methods For Chemical Synthesis Of Lactosyl Sphingosines, Glucosylsphingosines, Galactosylsphingosines, And 3-O-Sulfogalactosylsphingosines

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