Microbial Production of Branched, Medium Chain Alcohol 4-Methyl-1-Pentanol from Glucose
Technology #16130

Applications

Branched, medium chain alcohols are as energy dense as petroleum-derived gasoline and have a superior octane rating. As such, they provide an environmentally sustainable alternative to gasoline for use in spark ignition engines. 4-methyl-1-pentanol (4MP), in particular, can also be used as an organic solvent for a variety of reactions and extractions.

Problem Addressed

Economic and environmental concerns about petrochemical usage have led to increased interest in biofuels. Alcohols with medium to long carbon chains (C5 or greater) are attractive biofuels with a high energy density, but are not naturally produced in microorganisms. Previous metabolic engineering efforts have generally produced an insufficient yield for commercial purposes, especially due to large amounts of related byproducts. As yet, no large-scale production of 4MP in particular has been achieved. The novel synthesis route described within is capable of producing 4MP with high selectivity for industrial synthesis, and can be altered to synthesize a variety of branched, medium chain alcohols.

Technology

This technology describes a method of metabolic engineering for the microbial production of branched, medium chain alcohols. The proposed metabolic pathway is composed of enzymes from multiple organisms and pathways, recombinantly expressed in E. coli. In one iteration of the process, two precursors (isobutyryl-CoA and acetyl-CoA) are generated from glycolysis, condensed to form a branched intermediate, and reduced to the final product, 4MP, in six steps. The pathway can be modulated based on enzyme expression to produce a variety of branched, medium chain alcohols.

Advantages

- Highly selective biosynthetic route to 4MP for large-scale production
- Utilizes glucose as an inexpensive carbon source
- Branched, medium chain alcohols (e.g., 4MP) have a high energy density and improved octane rating
- Branched, medium chain alcohols (e.g., 4MP) exhibit low water solubility, allowing for relatively easy post-production purification

Categories For This Invention:

Energy
Biofuels (Energy)
Life Sciences
Biomaterials
Chemicals
Synthetic Biology
Bacterial

**Intellectual Property:**

Microbial production of branched medium chain alcohols, such as 4-methylpentanol
Issued US Patent

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**Publications:**

Retro-biosynthetic Screening of a Modular Pathway DesignAchieves Selective Route for Microbial Synthesis of 4-Methyl-Pentanol
Nature Communications
September 24, 2014

**External Links:**

Prather Group
http://web.mit.edu/prathergroup/

**Image Gallery:**

![Image of metabolic pathways and molecules]