Non-Oxidative Glycolysis For Production Of Acetyl-CoA Derived Compounds

Tech ID: 29008 / UC Case 2013-461-0

SUMMARY

The Liao group at UCLA has constructed a Non-Oxidative Glycolysis pathway for the synthesis of biofuel precursors with a 100% carbon conversion rate.

BACKGROUND

The use of a petroleum-based fuel infrastructure has been sustained in the last hundred years by the balance of supply and demand. However, with the development and growth of countries and populations, the demand for fossil fuels has begun to exceed the natural supply, threatening worldwide energy security. The production of synthetic fuels from biomass feedstock presents an attractive alternative to lessen dependence on petroleum based fuels as well as reducing greenhouse gas emissions. Alternative fuels such as bioethanol are produced by fermentation, converting simple sugars to alcohol through the glycolysis pathway. In this pathway, simple sugars are broken down into pyruvate, decarboxylated to acetyl-coenzyme A (CoA), and further processed into ethanol. This decarboxylation step represents a major source of carbon loss that greatly impacts the overall economy and efficiency of biorefineries. While carbon fixing methods help mitigate these losses, these added processes incurs additional energetic costs. As such, alternative synthesis pathways are needed to increase yields of biosynthesis to more economically sustainable levels.

INNOVATION

The Liao group at UCLA has constructed a cyclic non-oxidative glycolysis (NOG) pathway based on enzyme mediated carbon rearrangements. The NOG novel pathway is capable of splitting glucose into three molecules of acetate, achieving 100% yield. Acetate is an important chemical feedstock that can be further processed into ethanol or butanol. Feasibility of NOG in producing acetyl-CoA intermediaries for the efficient production of bioethanol has been demonstrated both in vitro with enzymes in buffer as well as in vivo using genetically engineered E. coli bacteria.

APPLICATIONS

- This technology may be used to improve the synthesis of biofuels such as ethanol and butanol.
- This technology can be used to generate chemical acetyl-CoA derived chemical feed stocks.

ADVANTAGES

- The NOG pathway may increase yields in the production of fuels and chemicals derived from acetyl-CoA by achieving 100% carbon conversion from carbohydrate to alcohols.
- The NOG pathway can make use of a variety of starting sugar and C1 (methane, methanol, CO2) inputs.

STATE OF DEVELOPMENT

The Liao group has demonstrated the feasibility of acetate production without carbon loss using the NOG pathway in both in vitro and in vivo systems.

RELATED MATERIALS

- Bogorad, IW, Lin, TS, Liao, JC. Synthetic non-oxidative glycolysis enables complete carbon conservation. Nature. 502, 693-7 (2013).

PATENT STATUS

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OTHER INFORMATION

KEYWORDS

Biofuel, non-oxidative glycolysis, NOG, glycolysis, biosynthesis, aceyl-CoA, acetate, carbon fixing, carbon rearrangement, bioethanol, biobutanol, ethanol, butanol, genetic engineering, modified bacteria

CATEGORIZED AS

- **Biotechnology**
  - Industrial/ Energy
- **Energy**
  - Bioenergy

RELATED CASES

2013-461-0

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,266,831	04/23/2019	2013-461
United States Of America	Issued Patent	10,006,033	06/26/2018	2013-461
United States Of America	Issued Patent	9,518,278	12/13/2016	2013-461

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Novel Enzymes Enabling Microbial Fermentation of Sugar into Long Chain Alcohols

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