UCLA Researchers Produce Liquid Fuel Isobutanol

Product Design & Development

New approach avoids need for biomass deconstruction making it more efficient.

In California, researchers from the UCLA Henry Samueli School of Engineering and Applied Science have genetically modified cyanobacteria to produce the liquid fuel isobutanol directly from carbon dioxide and sunlight.

The announcement mirrors a breakthrough by Joule Biotechnolgies, which announced last month it had produced, in its lab, diesel-equivalent fuels from sunlight and CO2.

"This new approach avoids the need for biomass deconstruction, either in the case of cellulosic biomass or algal biomass, which is a major economic barrier for biofuel production," said team leader James C. Liao, Chancellor's Professor of Chemical and Biomolecular Engineering at UCLA and associate director of the UCLA-Department of Energy Institute for Genomics and Proteomics. "Therefore, this is potentially much more efficient and less expensive than the current approach."

The technical approach: using Synechoccus elongatus (a cyanobacterium) the team first genetically increased the quantity of the CO2-fixing enzyme RuBisCO. Then they spliced genes from other microorganisms to engineer a strain that intakes carbon dioxide and sunlight and produces isobutyraldehyde gas. The low boiling point and high vapor pressure of the gas allows it to easily be stripped from the system.

According to the researchers, the engineered bacteria can produce isobutanol directly, but researchers say it is currently easier to use an existing and relatively inexpensive chemical catalysis process to convert isobutyraldehyde gas to isobutanol, as well as other useful petroleum-based products.

The team said that a project, using the technology, could be placed next to power plants and convert CO2 into transportation fuels. The team said that they are working on improving the rate and yield of the production, addressing the efficiency of light distribution and reducing bioreactor costs." The group reported their results in the current issue of Nature.

Joule Background

Last month, at the BIO Pacific Rim Summit, Joule Biotechnologies announced that it has achieved direct microbial conversion of CO2 into hydrocarbons via engineered organisms, powered by solar energy.

Joule's Helioculture process mixes sunlight and CO_2 with highly engineered photo synthetic organisms, which are designed to secrete ethanol, diesel or other products.

However, unlike algae and other current biomass-derived fuels, the Helioculture process does not produce biomass, requires no agricultural feedstock and minimizes land and water use. It is also direct-to-product, so there is no lengthy extraction and/or refinement process. The breakthrough was made possible by the discovery of unique genes coding for enzymatic mechanisms that enable the direct synthesis of both alkane and olefin molecules â?? the chemical composition of diesel. Production was achieved at lab scale, with pilot development slated for early 2011.

Because its organisms are being engineered to directly secrete hydrocarbon molecules, Joule will avoid costly steps such as large-scale biomass collection, energy-intensive degradation, or other downstream refinement. In addition, Joule's process requires just marginal, non-arable land, no crops and no fresh water.

More From Nature

Ergobalance reported that the January 2008 issue of Nature published an article in which "appreciable yields of isobutanol (IB) and other higher chain alcohols (1-butanol, 2-methyl-1-butanol, 3-methyl-1-butanol and 2-phenylethanol), can be produced by fermenting glucose with genetically modified E.coli."

More On Isobutanol

Companies pursuing the commercial-scale production of biobutanol include Gevo and Cobalt Biofuels. According to Gevo, isobutanol "has a higher energy content per gallon than many first generation biofuels; does not absorb water; can be transported through the existing oil and gas distribution infrastructure, and can be used in gas-powered vehicles without modification or blending."

SOURCE [1]

Source URL (retrieved on *02/01/2015 - 3:58am*):
http://www.ecnmag.com/news/2009/12/ucla-researchers-produce-liquid-fuel-isobutanol

Links:
[1] http://www.pddnet.com/news-ucla-researchers-produce-liquid-fuel-isobutanol-121109/