Clean Technology

Recombinant High-Lipid Microbe for Bioproduct & Biofuel Production

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in an industrial bacterium genetically modified for enhanced production of lipids and associated bioproducts.

Researchers have achieved cells that contain fatty acid at 33 percent of their dry cell weight and produce fatty acids at 24 percent of maximum theoretical yield.

Overview

Lipids derived from microorganisms, including bacteria, yeast and microalgae, offer a promising source of renewable fuels and chemicals. Oleaginous microbes – defined as those accumulating more than 20 percent of their dry cell weight (DCW) as lipid – are attractive candidates for microbial oil production.

However, to become cost-competitive with petroleum products, concentration and yield must be increased. UW–Madison researchers led by Profs. Timothy Donohue and Daniel Noguera look to exploit the native metabolic and regulatory pathways of a robust industrial bacterium, *Rhodobacter sphaeroides*, in an effort to increase lipid production to oleaginous levels.

The Invention

By combining genetic and bioreactor engineering, the researchers have developed *R. sphaeroides* strains capable of producing and secreting lipids at levels found in oleaginous microbes. In the process they isolated and characterized 10 different high-lipid strains.

Following a single genetic alteration, the best performing strain produced 1.3 g/L fatty acids, corresponding to 33 percent of DCW. The researchers are not aware of any previous examples of a microbe accumulating more than 20 percent of its biomass as phospholipid (triacylglycerol or wax esters are typical).

The novel properties of these high-lipid mutants suggest that similar changes in cell envelope structure could be used to increase production of lipids and associated bioproducts from other microbes.

Applications

- Production of lipids, fatty acids and potentially other hydrophobic compounds via genetically modified microorganisms

Key Benefits

- New strains are robust, commercially relevant and capable of growing on complex carbon sources.
- Microbial lipids are energy dense, with many advantages for use as petroleum replacements.
- Advantages of bioproduct secretion include:
    - Increased production beyond the amount that can fit within the cell

- Simplified harvest, separation and processing
- Minimized intracellular toxicity of the compound

Stage of Development

To identify potential high-lipid mutants, the researchers screened a genome-scale mutant library. They identified 10 strains that exhibited a >1.5 increase in fatty acid content per cell when grown at high O_2. Two mutants (HML01 and HLM02) showed a ~6 fold increase in fatty acids compared to the parent strain.

Further increases in lipid productivity have been achieved using fed batch reactors and elevated production of these and other products may be possible with additional metabolic engineering of this host.

Additional Information

For More Information About the Inventors

- Timothy Donohue
- Daniel Noguera

Publications

- Read a news story about this technology

Tech Fields

- Clean Technology : Biobased & renewable chemicals & fuels

For current licensing status, please contact Mark Staudt at mstaudt@warf.org or 608-960-9845