Breakthrough in algae biofuel research reported

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Glaucocystis sp. Image: Wikipedia.

ExxonMobil and Synthetic Genomics Inc. today announced a breakthrough in joint research into advanced biofuels involving the modification of an algae strain that more than doubled its oil content without significantly inhibiting the strain's growth.

Using advanced cell engineering technologies at Synthetic Genomics, the ExxonMobil-Synthetic Genomics research team modified an algae strain to enhance the algae's oil content from 20 percent to more than 40 percent. Results of the research were published today in the peer-reviewed journal *Nature Biotechnology* by lead authors Imad Ajjawi and Eric Moellering of Synthetic Genomics.

Researchers at Synthetic Genomics' laboratory in La Jolla discovered a new process for increasing oil production by identifying a genetic switch that could be fine-tuned to regulate the conversion of carbon to oil in the algae species, Nannochloropsis gaditana. The team established a proof-of-concept approach that resulted in the algae doubling its lipid fraction of cellular carbon compared to the parent – while sustaining growth.

"This key milestone in our advanced biofuels program confirms our belief that algae can be incredibly productive as a renewable energy source with a corresponding positive contribution to our environment," said Vijay Swarup, vice president for research and development at ExxonMobil Research and Engineering Company. "Our work with Synthetic Genomics continues to be an important part of our broader research into lower-emission technologies to reduce the risk of climate change."

"The major inputs for phototropic algae production are sunlight and carbon dioxide, two resources that are abundant, sustainable and free," said Oliver Fetzer, Ph.D., chief executive officer at Synthetic Genomics. "Discoveries made through our partnership with ExxonMobil demonstrate how advanced cell engineering capabilities at Synthetic Genomics can unlock biology to optimize how we use these resources and create solutions for many of today's sustainability challenges – from renewable energy to nutrition and human health."

Algae has been regarded as a potential sustainable fuel option, but researchers have been hindered for the past decade in developing a strain that is high in oil content and grows quickly – two critical characteristics for scalable and cost-efficient oil production. Slower growth has been an adverse effect of previous attempts to increase algae oil production volume.

A key objective of the ExxonMobil-Synthetic Genomics collaboration

has been to increase the lipid content of algae while decreasing the starch and protein components without inhibiting the algae's growth. Limiting availability of nutrients such as nitrogen is one way to increase oil production in algae, but it can also dramatically inhibit or even stop photosynthesis, stunting algae growth and ultimately the volume of oil produced.

The ability to sustain growth while increasing oil content is an important advance. Algae has other advantages over traditional biofuels because it can grow in salt water and thrive in harsh environmental conditions, therefore limiting stress on food and fresh water supplies.

Oil from algae can also potentially be processed in conventional refineries, producing fuels no different from convenient, energy-dense diesel. Oil produced from algae also holds promise as a potential feedstock for chemical manufacturing.

"The SGI-ExxonMobil science teams have made significant advances over the last several years in efforts to optimize lipid production in algae. This important publication today is evidence of this work, and we remain convinced that synthetic biology holds crucial answers to unlocking the potential of algae as a renewable energy source," said J. Craig Venter, Ph.D., Synthetic Genomics co-founder and chairman.

Since 2009, ExxonMobil and Synthetic Genomics have been partners in researching and developing oil from algae to be used as a renewable, lower-emission alternative to traditional transportation fuels. Swarup said that while the breakthrough is an important step, the technology is still many years from potentially reaching the commercial market.

More information: Imad Ajjawi et al. Lipid production in Nannochloropsis gaditana is doubled by decreasing expression of a single transcriptional regulator, *Nature Biotechnology* (2017). DOI:

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