Oil from algae closer to reality through studies by unique collaboration of scientists

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A team of researchers that has been working on getting fuel-grade oil out of algae may be within four years of a near-commercial-scale production level. The team, with a combined expertise from agriculture to engineering, has received a two million dollar National Science Foundation grant to help hasten the process, according to Dr. Tim Devarenne, a Texas A&M AgriLife Research biochemist and collaborator on the project. Credit: Texas AgriLife Research photo by Kathleen Phillips

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The challenge is to help the oil-laden alga, Botryococcus braunii, live up to its potential, Devarenne said.

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Known by scientists for more than 100 years, B. braunii is the shirker of the algae world, seemingly floating aimlessly in bubbling tanks of water in no hurry to grow up and be pressed into oil. Other algae go through life as self-starters on a fast-track to success but don't produce oil like B. braunii. The researchers want the useful traits from each to commingle.

"We're interested in taking the genetic information out of the slow-growing alga – the genetic information for producing the hydrocarbons – and transferring that into a faster growing alga," Devarenne said. "Then maybe we can more economically produce these oils."

For his part of the study, Devarenne will study the B. braunii's molecular biology to find out what genes are responsible for production of the oil. His lab will also try to understand the function of those genes and how they contribute to the production of the oil.

"By understanding the molecular mechanisms, we can maybe manipulate the algae to produce more or better oil," he said.

Another key aspect to these studies is encouraging B. braunii to live life

in the fast lane, Devarenne explained, using a device invented by Dr. Arum Han, lead researcher on the project and a professor of electrical engineering at Texas A&M University.

Called a "microfluidic lab-on chip," the device is about the size of a business card but has hundreds to thousands of microscopic wells, Devarenne said.

"These little wells can each hold an individual alga cell, and we can treat each well differently in terms of media compositions or light amounts, for example," he explained. "So we can see how different parameters affect growth rate, oil production and biomass accumulation.

"In that little microfluidic device, we can screen hundreds to thousands of different growth conditions at once and do in a week's time what in a normal lab atmosphere would take probably a year to screen," Devarenne added. "So essentially we can miniaturize everything and screen high volumes of algae to find optimal growth conditions to make the best amount of oil." In addition to providing an alternative fuel source to power conventional combustion engines, fuels derived from algae would be easier on the environment, Devarenne said.

"If we harvest algae and process them into fuels, we don't emit any excess carbon into the atmosphere that is currently being emitted from petroleum fossil fuels," he said.

When the fast-growing traits have been combined with the hydrocarbon-producing capabilities in one alga, team member Dr. Tzachi Samocha with AgriLife Research in Corpus Christi will help determine how to grow it on a large scale.

Upon completion of those studies, Devarenne said, the team may work with the fuel industry to scale up production even farther.

"If we can produce an alga that produces high amounts of oil and grows fast," he said, "an industry partner could grow large amounts of it, extract the oil, convert that oil into gasoline or diesel fuel and sell it just like at a normal gasoline pump."

The product could also be doubly helpful for the environment, he said.

"What is somewhat beneficial about growing algae is that you can use municipal wastewater to grow algae and they'll clean up the wastewater," Devarenne noted. "A lot of people have an idea of growing their algae ponds next to coal-burning power plants where they'll take the CO2 emissions from the power plant and feed it to the algae.

"Algae take CO2 out of the atmosphere to make the oil and then when we burn the oil as fuel, we just put that CO2 back into the atmosphere," he added. "That is different from petroleum because the CO2 from petroleum has been stored underground for hundreds of millions of years and then we release that into the atmosphere when we burn fuels created from petroleum."

Provided by Texas A&M University