

Biotech

In focus



Cooperative Extension Service
Biotechnology Outreach Program
College of Tropical Agriculture and Human Resources
University of Hawai'i at Manoa

August 2015

Issue 37

Genetically Engineered Algae: A Source of Sustainable Biofuel?



This week's Biotech in Focus came from a paper written by Megan Manley, a University of Hawaii at Manoa student who recently enrolled in TPSS 416 (Introduction to Social, Ethical, and Political Issues Associated with Biotechnology). Designed for non-majors, this class is offered by the Department of Tropical Plant and Soil Sciences in UH Manoa's College of Tropical Agriculture and Human Resources.



Fossil fuels like petroleum and coal come from living matter that died long ago and then transformed by geological processes such as extreme pressure and heat. In contrast, biofuels are produced from organisms that are alive today and therefore can be abundant, renewable, and potentially sustainable sources of energy. These biofuels can be used directly by burning and converted to liquid fuels.



Biofuels come from many different types of biomass (living or recently dead material). Sources for biofuel include products and residues from agriculture or forestry, animal and human wastes (e.g., manure), and algae. Most commonly, chemicals are first extracted from the biomass and then further refined to generate liquid biofuel as a final product. Some biofuels are liquids. These include ethanol, which results from the fermentation of sugars or starches, and biodiesel, made from fats and oils. Other biofuels are gases such as methane, that can be produced from any type of biomass.



The human population is growing, with many countries becoming industrialized. A common desire among people across the world is to achieve improved standards of living. These changes drive an increased demand for energy worldwide. Sustainable biofuels for transportation, power generation, heating, and other important uses could benefit our global population by helping us meet our energy needs while alleviating demand for non-renewable fossil fuels.



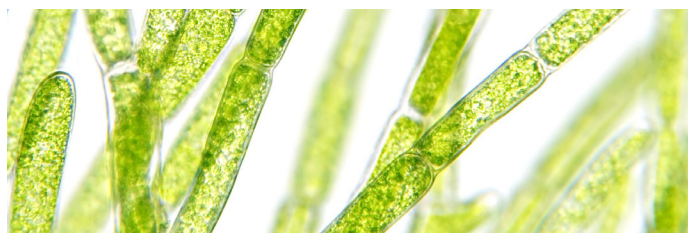
Ania Wiczorek, PhD

Professor
Department of Tropical Plant
and Soil Sciences
College of Tropical Agriculture
and Human Resources
University of Hawai'i at Manoa
Honolulu, HI 96822
ania@hawaii.edu

Thank you to Carol Oshiro for web design, Jessica Radovich for graphics and Kathleen Vickers for text editing.

The Algae Advantage

Interest in photosynthetic microalgae as a potential source of biofuel has increased significantly in recent years because these organisms offer many advantages. Algae are among the most efficient producers of biomass. Even under unfavorable growth conditions, a variety of algae can generate many products with multiple uses, including lipids (oils) for biodiesel, carbohydrates for ethanol, and gases that can be used as biofuels (e.g., hydrogen gas and methane-rich biogas), as well as protein for human and animal consumption.



Rapid Growth



Many algae have a rapid growth rate and can be cultivated in areas that are not suitable for agriculture. Some can be cultivated in brackish coastal water and seawater. Algae have uptake mechanisms that can import mineral nutrients from human and animal wastes and can make use of carbon dioxide from industrial sources.

Optimization

Research is underway to develop genetically modified (GM) organisms that generate biofuels directly or produce chemical intermediates that can be converted into biofuels. Some algae have been genetically engineered to allow for the modification or optimization of processes that make the production of biofuels faster, more efficient, or more stable.



Future Energy Source



Algae are anticipated to become one of the most significant sources of sustainable and renewable energy in the future, and genetic engineering offers tools to improve the efficiency of algal production of biofuels.