

PROJECT FACTS

UNIVERSITY OF KENTUCKY CENTER FOR APPLIED ENERGY RESEARCH

PARTICIPANTS

University of Kentucky
Center for Applied Energy
Research
2540 Research Park Drive
Lexington, KY 405011

SPONSORS

Sapphire Energy

PROJECT VALUE

\$ 124,000

CONTACT

Mark Crocker
UK CAER
2540 Research Park Dr.
Lexington, KY 40511
Tel.: (859) 257-0295
Fax: (859) 257-0220
Mark.Crocker@uky.edu



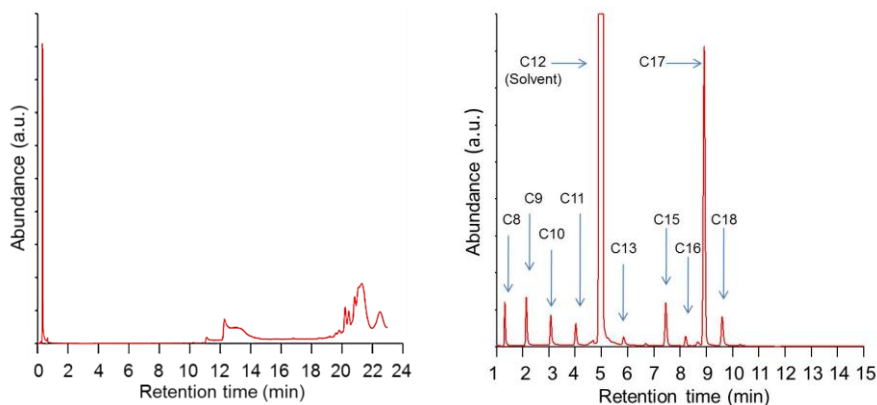
BIOFUELS & ENVIRONMENTAL CATALYSIS

Upgrading Algae Oil to Hydrocarbon Fuels

One approach for controlling CO₂ emissions from fossil fuel combustion involves the use of algae to capture and utilize CO₂ by conversion to biomass. Algae are the fastest growing photosynthesizing organisms on the planet, while also possessing higher oil content per mass than other sources of biomass; indeed, some species consist of over 50% oil by weight. This coupling of fast growth rate and high oil content renders algae a potentially ideal source of bio-derived oil. Furthermore, the production of valuable liquid transportation fuels from algae may benefit the overall economics of algae-mediated CO₂ capture.

In principle, algae oil can be converted to transportation fuels via either transesterification (to afford the corresponding fatty acid methyl esters) or catalytic upgrading to hydrocarbon fuels. Typically, catalytic upgrading of bio-derived oxygenates utilizes hydrotreating catalysts, such as supported CoMo or NiMo, oxygen being eliminated via hydrodeoxygenation (-H₂O) and decarboxylation (CO₂) reactions. A feature of this technology is the fact that high hydrogen pressures are required (50-150 bar). Consequently, this approach is only suitable for refineries (in which hydrogen is readily available), as opposed to distributed processing. As an alternative to hydrotreating, we have been examining the decarboxylation of vegetable oils, as well as model triglyceride compounds, using supported metal catalysts in the absence of hydrogen. This approach has been successfully demonstrated by Murzin and coworkers for fatty acids and their derivatives [1].

In our work, we have demonstrated that triglycerides can indeed be converted to hydrocarbons in the transportation fuel range (C₈-C₁₇) via decarboxylation, although low pressures of H₂ are generally required to prevent catalyst deactivation. Moreover, we have shown Ni-based catalysts to be active in this transformation, which is noteworthy given the low cost of Ni with respect to Pd, the metal most commonly used to catalyze this reaction.



GC analysis of the tristearin (left) and the liquid product obtained from its Ni/C-catalyzed deoxygenation (right).

1. Murzin & coworkers, *Energy & Fuels* 2007, 21, 30-41.