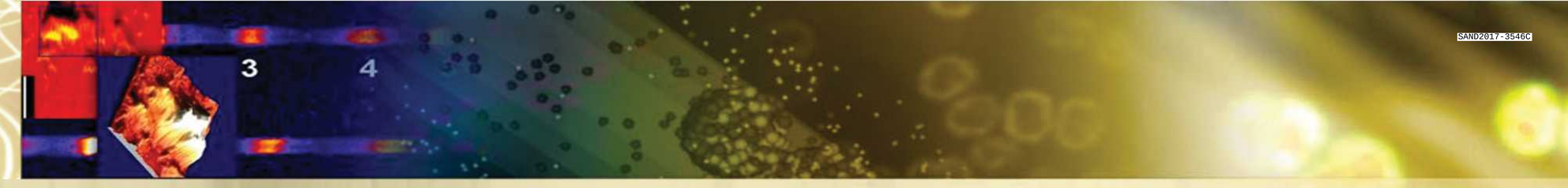
SANDIA BIOSCIENCE



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Production, Blending, and Upgrading of Advanced Renewable Fuels for the Co-optimization of Fuels and Engines

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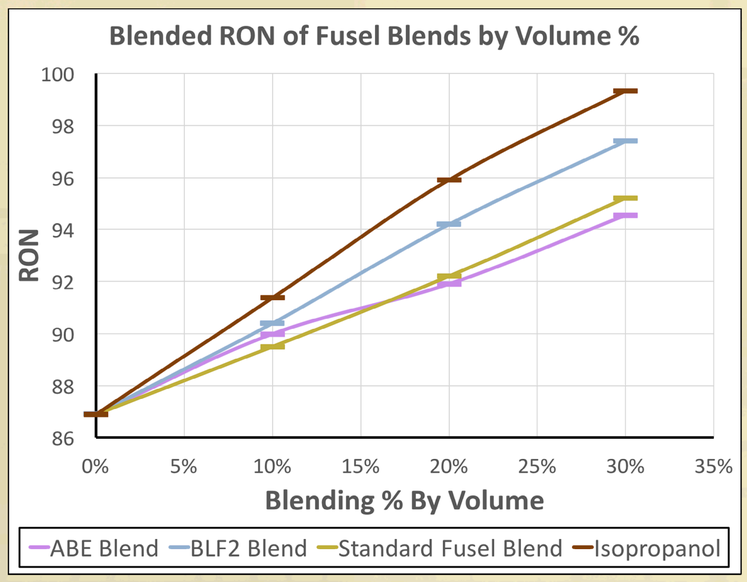
Abstract

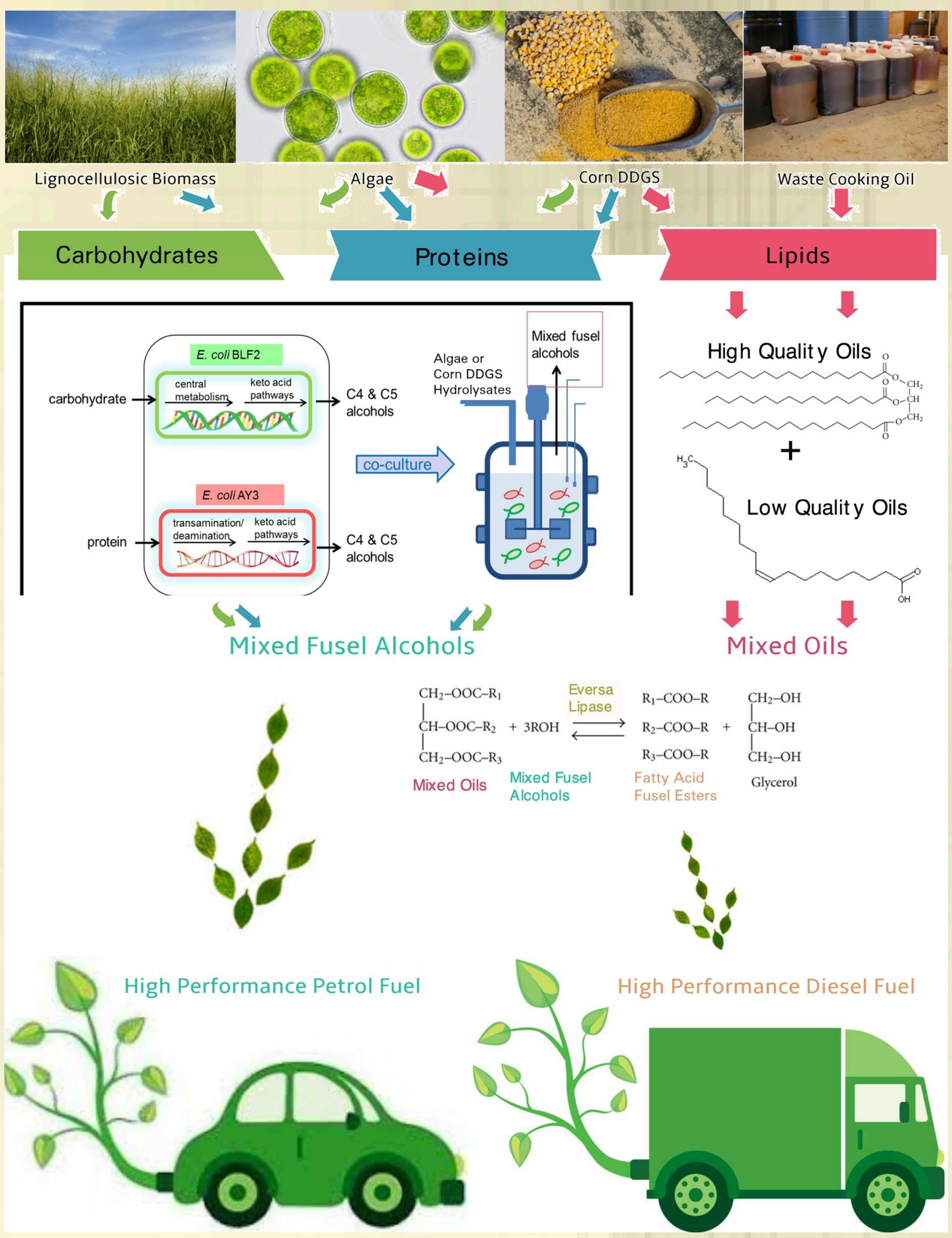
As a greater focus is put on renewable fuels to help reduce the carbon emissions from the transportation fleet, research to optimize fuels simultaneously with engines is underway. To overcome issues related to highly variable feedstock composition, our group has developed strategies for utilization of multiple substrates, including lignocellulosic sugars and amino acids from proteinaceous waste biomass, for bioconversion into branched C4 and C5 alcohols. Our data demonstrate that branched C4 and C5 alcohols show significant potential as blending agents due to their high octane number as well as their low corrosivity and high energy density. Furthermore, our results indicate that these compounds are not only valuable as drop-in fuels for spark ignition engines, but can also be chemically upgraded to fatty acid esters, aceto-esters, and ethers. Our data also shows particular promise for reacting fusel alcohols with low quality lipids for production of fatty acid esters which have higher cetane numbers and improved cold flow properties as compared to traditional biodiesel products. This diversity in fuel products indicates that substantial fuel tunability can be attained from a single renewable product stream.

Blending Agents for Spark Ignition Engines

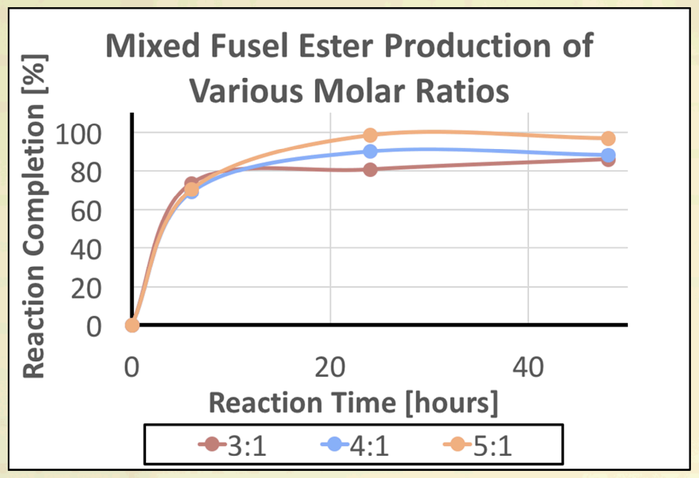


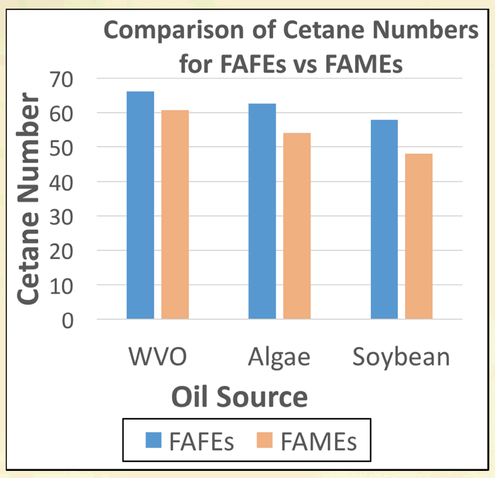
Blend Name	Compound	Volume %
ABE Blend	Acetone	60
	n-butanol	30
	ethanol	10
Standard Fusel Blend	Phenyl Ethanol	25
	Isobutanol	25
	3-methyl-1-butanol	25
	2-methyl-1-butanol	25
BLF2 Blend	Isobutanol	57
	2-methyl-1-butanol	6
	3-methyl-1-butanol	12
	ethanol	10
	phenyl Ethanol	15

- Research Octane Number (RON) boosting ability similar to ethanol and isopropanol
- Energy Density and MPG 33% higher than ethanol
- Significantly less corrosive than ethanol
- Vapor Pressure of 10% blend 10 kPa less than ethanol blends



Upgrading to High Performance Biodiesel

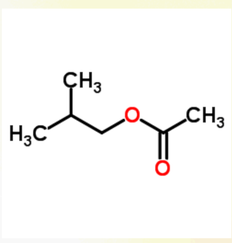




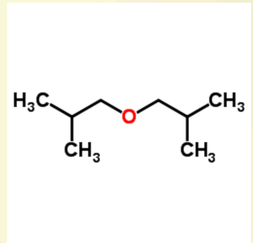
- Demonstrated the use of fusel alcohols as reactants with low quality oil feedstocks for production of biodiesel with improved ignition and cold-flow properties.
- Use of low quality lipids could open up close to 1 billion gallons of additional feedstock currently available and unused.
- Also opens the door to low quality bio-lipids from algae and oleaginous yeast hydrolysates

Future Work

- Upgrading of Fusel alcohols to Aceto-Esters and Ethers



Aceto-Ester



Ether

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