CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
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Project Number
S0598

Project Title
Fields to Fuel: The Transesterification of Vegetable Triglycerides into Fatty Acid Methyl Esters and Glycerin

Abstract

Objectives/Goals
To analyze the characteristics of exhaust emissions from the combustion of fatty acid methyl esters (biodiesel) derived from four different types of vegetable oils and develop a matrix utilizing precursor characteristics of the underlying raw vegetable oils to help identify clean-burning and efficient alternative fuels.

Methods/Materials
1) Measure 1.75g NaOH and 100mL CH3OH 2) Mix until both in solution 3) Add 500mL vegetable oil and mix for 15 minutes 4) Let it sit for 8-24 hours 5) Decant the separated biodiesel off the top and store it in a separate container 6)send samples of each biodiesel fuel and its corresponding vegetable oil to the lab to be tested for flashpoint, density, and energy content 7) Conduct viscosity tests 9) Obtain diesel engine 10) After several test runs, set up engine at a smog check facility and have NOx, CO, CO2, hydrocarbon, and O2 emissions analyzed

Results
My results showed that the peanut biodiesel burned the cleanest, as there were higher levels of CO2 present in the emissions, with corresponding lower levels of CO, hydrocarbons, NOx, and O2. Corn biodiesel was the most inefficient, as there were low levels of O2 and high levels of unburned hydrocarbons present, meaning that the fuel did not combust efficiently.

Conclusions/Discussion
In conclusion, the process of transesterification was conducted to break the bonds of the triglycerides that make up the raw vegetable oils so that the reaction produces free fatty methyl esters (biodiesel) and glycerol molecules. If the viscosity is reduced then the process was effective and a viable biodiesel was produced.

My results showed that the raw peanut vegetable oil had the highest viscosity and high energy content, but after the process of transesterification took place, the resultant peanut biodiesel proved to be the cleanest and most efficient fuel due to its very low viscosity and high energy content.

Corn biodiesel was the most inefficient fuel and had a fairly high viscosity when compared to the other biodiesels, as well as high energy content. The raw corn vegetable oil showed similar characteristics. Therefore it can be determined that the fuel must have high energy content and a low viscosity, and the vegetable oil must have high energy content and a high viscosity.

Summary Statement
To investigate the process of transesterification and identify the cleanest-burning and most efficient biodiesel fuel through lab analysis on flashpoint, energy content, and viscosity as well as diesel engine emissions test results.

Help Received
used the laboratory facilities at Remedy Environmentals in Anaheim; had flashpoint, density and energy content testing conducted at Enviro-Chem Inc. Laboratories; had emissions testing provided by Union 76 gas station in Villa Park; Dr. Mark Soutter from Biofuels Institute helped me understand the