From the Fryer to the Ford:

A Study on the Efficiency of Producing Various Biofuels from Plant Oils

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By
Cody Horton
9th Grade
Tuscumbia High School
Tuscumbia, MO 65082

Ms. Colleen Griswold
Agriculture Instructor

Mrs. Constance Wyrick
Science Research Advisor

Mrs. Tanya Stockwell
Gifted Instructor

Abstract

Name: Cody Horton
School: Tuscumbia High School
Sponsoring Teachers: Mrs. Constance Wyrick Ms. Colleen Griswold
Project Title: From the Fryer to the Ford: A Study on the Efficiency of Producing Biofuels from Plant Oils

Biofuels are renewable fuels derived from biological sources such as plant oils. Many different types of plant materials can be used to produce many different biofuels. In this study, used vegetable oil, safflower oil, soybean oil, peanut oil, and corn oil were used to produce biofuel. Then each biofuel was tested to determine the most efficient. According to this study, the most efficient oil was peanut oil, which used the least amount of oil for the greatest amount of temperature change. The purpose of this experiment was to see which oil would produce the highest quality of fuel. The hypothesis stating that soybean oil would make the highest quality of fuel was rejected. The highest quality of biofuel was produced by peanut oil.

Background

Biofuels are renewable fuels derived from biological sources such as plant oils. Many different types of plant materials can be used to produce many different biofuels. Biofuels can help the environment by reducing air pollution. It can help reduce the amount of carbon dioxide. Biofuels can be produced by cooking oil instead of natural resources and are cheaper to make. Biofuels are also cleaner and more efficient for diesel engines.

Oils

Safflower oil is colorless and flavorless, and nutritionally similar to sunflower oil. It is used mainly as cooking oil and for the production of margarine. It may also be taken as a nutritional supplement.

Peanut oil is obtained by applying pressure to peanuts to squeeze out the oil. This oil is excellent for cooking because it is tasteless and can be heated to very high temperatures before it smokes. Peanut oil can be heated up to 450 degrees F, which is hotter than most oils.

Soybean oil is produced by first, cracking the soybeans, then adjusting for moisture content, then rolling it into flakes, and finally, a solvent, commercial hexane, is added. Soybeans contain many fatty acids. The major unsaturated fatty acids in soybean oil are linolenic acid and triglycerides acid. The acids are formed during the production of soybean oil.

Corn oil is extracted from the germ of corn. Its main use is in cooking, where its high smoke point makes it a popular frying oil. Corn oil has a milder taste and is less

expensive than most other types of vegetable oils. One bushel of corn contains 1.55 pounds of corn oil.

Used vegetable oil is the combination of many types of plants' oils. Used vegetable oil is a by-product of the restaurant industry. As a source of biofuel, used vegetable oil requires a great deal of filtering.

Purpose

The purpose of this experiment was to see which oil would produce the most efficient fuel.

Hypothesis

It was hypothesized that soybean oil would make the most efficient fuel.

Experimental Design

To conduct this study, sodium hydroxide (lye) was obtained from the high school science lab, methanol was purchased from Jefferson City Oil, corn and peanut oil were purchased at Wal-Mart, soybean oil was purchased at the Dutch Market, safflower oil was purchased from 'Natural Resources' Health Food Store, and used vegetable oil was donated from the Red Oak Inn (restaurant).

To begin this study, seven grams of sodium hydroxide (lye) were measured on a beam balance scale. It had to be measured quickly because lye absorbs water from the atmosphere, and water interferes with the biodiesel reaction. Then, 200ml of pure methanol were measured using a graduated cylinder. The sodium hydroxide had to be carefully added to the methanol to make methoxide. As the mixture reacts, heat was given off. It was swirled thoroughly until the lye was completely dissolved in the methanol, which took approximately forty-five minutes. After it was dissolved, peanut oil was preheated to 55º C (130º F). The oil was added carefully to an old blender with the prepared methoxide. The blender was then turned on *stir* for twenty minutes. After twenty minutes, the fuel was poured into a HDPE container and left to settle for 12-24 hours. The glycerin settled to the bottom during this time period. The excess glycerin remained in the bottom of the container, while the biofuel was poured off. The remainder was then washed. The washing process removed any remaining glycerin. This process was repeated with each oil.

The biofuel was then burned off to test the efficiency of each oil. To do this, five coke cans were filled with 60ml of water and the initial temperature of the water was recorded. The burners were filled with 30ml of oil, and then were massed on a beam balance scale. The process of testing began with three, ten minute trials. After each trial, the temperature of the water was again recorded and the burners were again massed on the scale, to determine the change in temperature and the change in mass. The ring stands stood 5cm from the burner with the coke can on top of the ring stands. Data was recorded and analyzed. Conclusions were drawn.

Average Change in Temperature

Used Vegetable Oil	Initial Temperature	Final Temperature	Change in Temperature
Trial #1	15	35	20
Trial #2	14	36	22
Trial #3	14	29	15
Average	**14**	**33**	**19**
Safflower Oil			
Trial #1	18	65	47
Trial #2	15	57	42
Trial #3	16	74	58
Average	**16**	**65**	**49**
Soybean Oil			
Trial #1	15	57	42
Trial #2	18	64	46
Trial #3	18	60	42
Average	**17**	**60**	**43**
Corn Oil			
Trial #1	15	86	71
Trial #2	16	68	52
Trial #3	16	74	58
Average	**16**	**76**	**60**
Peanut Oil			
Trial #1	16	84	68
Trial #2	14	87	73
Trial #3	17	82	65
Average	**16**	**84**	**68**

Average Change in Mass

Used Vegetable Oil	Initial Mass	Final Mass	Change in Mass
Trial #1	107.41	106.43	0.98
Trial #2	106.43	105.83	0.6
Trial #3	105.83	105.22	0.61
Average	**106.56**	**105.83**	**0.73**

Safflower Oil	Initial Mass	Final Mass	Change in Mass
Trial #1	110.22	108.74	1.48
Trial #2	108.74	107.25	1.49
Trial #3	107.25	105.53	1.72
Average	**108.74**	**107.17**	**1.56**

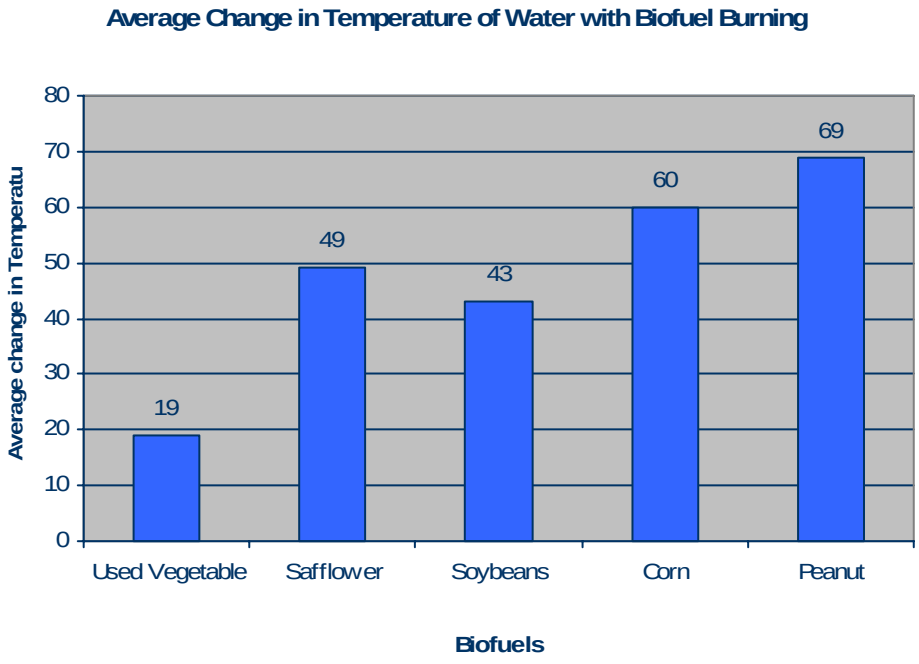
Soybean Oil	Initial Mass	Final Mass	Change in Mass
Trial #1	101.27	99.3	1.97
Trial #2	99.3	98.62	0.68
Trial #3	98.62	97.13	1.49
Average	**99.73**	**98.35**	**1.38**

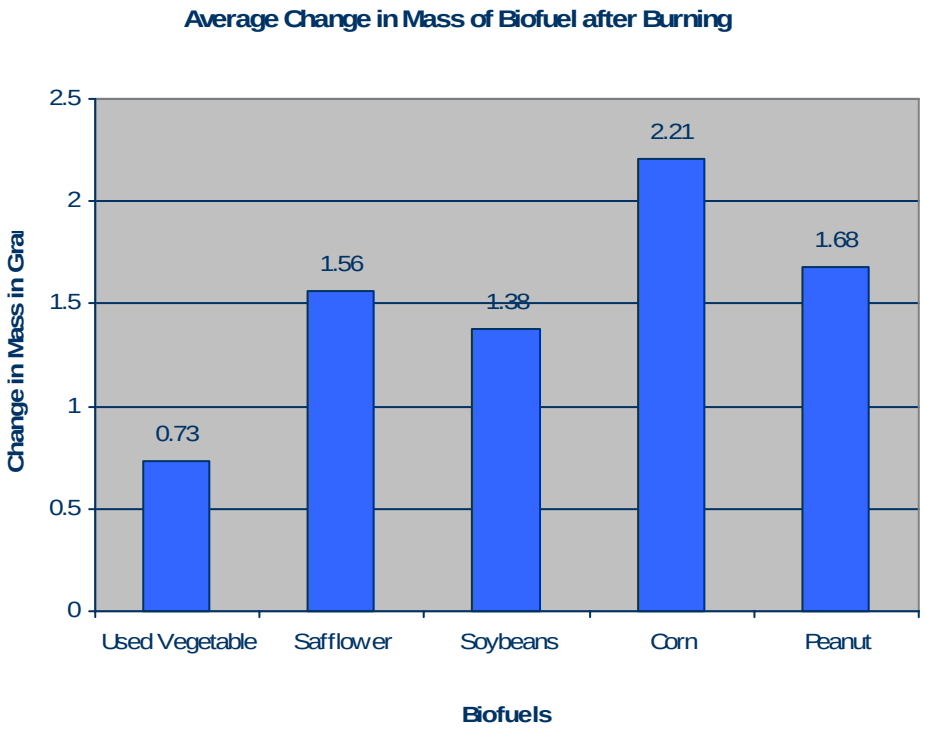
Corn Oil	Initial Mass	Final Mass	Change in Mass
Trial #1	105.26	103.09	2.17
Trial #2	103.09	100.98	2.11
Trial #3	100.98	98.63	2.35
Average	**103.11**	**100.9**	**2.21**

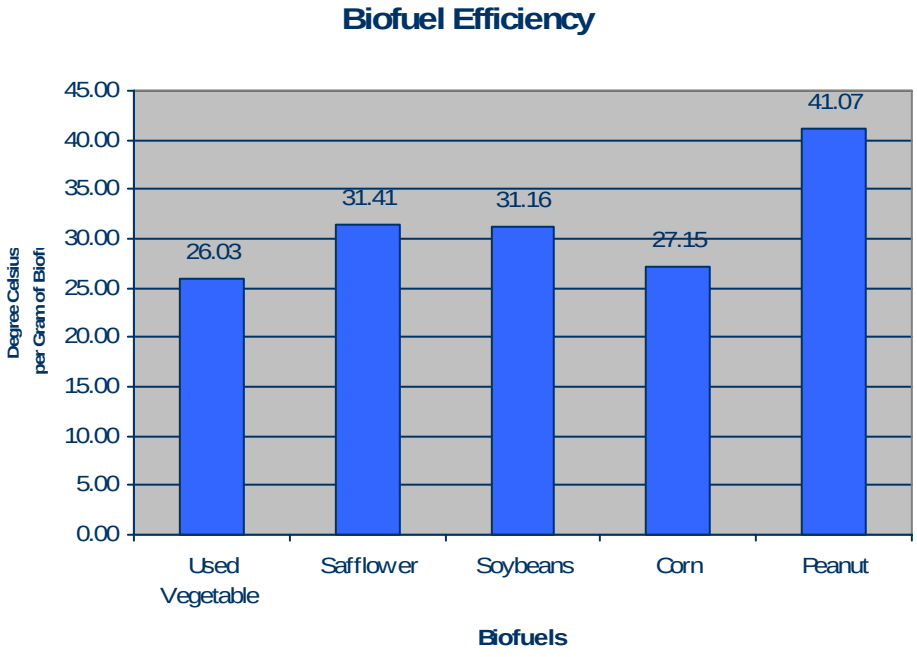
Peanut Oil	Initial Mass	Final Mass	Change in Mass
Trial #1	106.94	105.08	1.86
Trial #2	105.08	103.46	1.62
Trial #3	103.46	101.91	1.55
Average	**105.16**	**103.48**	**1.68**

Efficiency Data Table

Biofuels	Degrees Celsius per Gram of Fuel
Used Vegetable	26.03
Safflower	31.41
Soybeans	31.16
Corn	27.15
Peanut	41.07




Average Change in Mass of Biofuel after Burning
Change in Mass in Gra
2.5
2
1.5
1
0.5
0
0.73
1.56
1.38
2.21
1.68
Used Vegetable
Safflower
Soybeans
Corn
Peanut
Biofuels


Biofuel Efficiency
Degree Celsius per Gram of Biofi
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
26.03
31.41
31.16
27.15
41.07
Used Vegetable
Safflower
Soybeans
Corn
Peanut
Biofuels

Observations

During the study, there were two different stages. Producing biofuel was the first process, and the second was testing the efficiency of the biofuel. During the first stage, it was observed that different fuels were difficult to get the glycerin off of the biofuel. It was difficult to see the glycerin of the used vegetable oil. The excess glycerin was removed from all the oils through the washing process. Most of the glycerin was poured off most of the biofuels and then the washing process was done.

Testing the efficiency of the biofuel was very interesting. During this process, peanut and corn oil produced more soot. Peanut oil was determined the most efficient of the oils.

Conclusion

Based on this study the following conclusion can be drawn:

The hypothesis stating that soybean oil would make the most efficient fuel was rejected. The most efficient biofuel was produced by peanut oil.

Future Study

In the future, it would be interesting to see if adding different chemicals to the oil would make a difference in the efficiency of the biofuel. It would also be interesting to see if a lab could analyze the biofuel and compare it to my results.