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# Biodiesel production from canola oil with KOH by transesterification process

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## Abstract
In this research, biodiesel was produced from low-cost resources such as canola oil in the presence of KOH Nanocatalyst using the transesterification method. In addition, the factors including methanol -to-oil-ratio, catalyst concentration, temperature, and reaction time were elucidated upon the biodiesel production. The optimum condition was attained at the temperature of 95-degree Fahrenheit to 135-degree Fahrenheit, 24 hours reaction time. The highest biodiesel efficiency was found to be 93.69% in optimum condition. The result revealed that the mixture of the produced biodiesel with the proportion of 75% and 100% was found to be the best volume of ratio for blending. The acid number test has performed the ease and reliability of testing the quality of biodiesel. The production of biodiesel is analyzed under the FTIR and UV-Vis spectrophotometry technique for their functional group and specificity. In this research, we get co-product glycerine is also analyzed under the FTIR for their functional group. The overall study explained biodiesel must meet certain specifications and quality in order to meet regulatory standards for use. It is one of the alternative fuels that can be used in a diesel engine, without modifications.

**Keywords:** biodiesel, methanol, KOH, nanocatalyst, low-cost resources

## Introduction
Biodiesel is a renewable biodegradable fuel. It is an alternative fuel similar to fossil fuel which is used in engines and vehicles. When using fossil fuel resources, increases environmental issues like desertification and acid rain. When we compare biodiesel with fossil fuel, biodiesel has low toxicity, lower emission of carbon dioxide it improves air quality and the environment and it provides safety benefits. Biodiesel is produced from different sources like vegetable oil, animal fat. Biodiesel fuel production (Rolando ZANZI Vigorous, 2006). In this study, canola oil plays an important role to produce biodiesel, canola oil is a type of vegetable oil derived from rapeseed. Canola oil is currently one of the healthiest edible vegetable oils and it is a low-cost resource when compared with other vegetable oil. Using canola oil biodiesel as an alternative fuel in diesel engines (Jung Cong Ge, Nag Jung Choi, 2017). The methods of producing biodiesel have chemical methods by using methanol and KOH (potassium hydroxide) as catalysts. Methanol is common alcohol used in the transesterification method for the production of biodiesel. Methanol is also known as methyl alcohol is chemical and simple alcohol with the formula $CH_3OH$. Methanol content in biodiesel is estimated by flash point and electrical properties (Silvia Daniela Romano, 2009). Potassium Hydroxide is used as a catalyst in Biodiesel production it produces a high-quality fuel and is easy to mix with methanol, KOH (Potassium Hydroxide) is mixed with methanol and blended with Canola oil. Biodiesel production from waste cooking oil (Endang Sri Rahadianti, Yerizam, Martha, 2018). The methanol and catalyst slowly mixed with oil. After the complete reaction, the solution needs to be set for a few hours. The end result is biodiesel at the top and glycerine.

## Materials and methods
Canola Oil- 500ml, Methanol-100m, Potassium Hydroxide (KOH)-3.5g, Beaker, Measuring Flask

### Methods for biodiesel production
The most common method for the production of biodiesel is the transesterification method. The first step is to weigh the amount of vegetable oil (canola oil) and allow it to heat up to 95-degree Fahrenheit to 135º Fahrenheit in the second step 100ml of methanol is measured in the measuring container and 3.5g of potassium hydroxide is weighed and mixed inn 100ml of methanol. After the mixing of methanol and potassium hydroxide, it is added in heated canola oil and mixed thoroughly. The methanol and catalyst slowly mixed with oil. After the complete reaction, the solution needs to sit for a few hours. After an hour the biodiesel is settled at the bottom and glycerine is settled at the middle, the oil is settled at the top.

### Chemical analysis (Acid number test)
**Apparatus:** Stirrer, 250ml Beaker, mass scale, titration bulb.

**Chemicals:** Biodiesel, phenolphthalein indicator, isopropanol/water solution 90/10 by volume, 0.1 N alcohol isopropanol/KOH solution.

### Procedure
- Determine appropriate biodiesel sample size (according to a defined method).
- Weigh sample to the nearest 0.1mg into 250ml water.
- Add 110ml of 90/10mixture.
- Add 4-6 drops of phenolphthalein indicator.
- Titrate until phenolphthalein endpoint pink with 0.1N alcohol isopropanol/KOH solution.
- Titrated again for concordant value
- The formula to calculate the Acid Number value is

$$\text{Acid Number} = \frac{(V_{KOH}\text{-a}) * N * 56.1}{W}$$

Where
VKOH = Volume of potassium hydroxide
a = Volume of blank solution
N = Concentration of alcohol (isopropanol) KOH solution
W = mass of sample (g)

**Physical analysis (Instrumentation analysis for biodiesel)**

**FTIR (Fourier Transform Infrared) Spectroscopy:** FTIR spectroscopy is also known as FTIR analysis, it is an analytical method used to identify the functional group of the sample, organic and inorganic materials. This source is used to analyze the functional groups present in Biodiesel and Glycerine.

**UV-Visible spectrometry:** UV-Visible spectroscopy or UV-Visible spectrometry refer to absorption spectroscopy and reflectance spectroscopy. It is used for absorption measurements of a beam light that passes through the sample. It is used in this source to identify the absorption measurement in biodiesel.

**Result and Discussion**

This study illustrates the production of biodiesel from canola oil by the transesterification method. In this method, canola oil mixed with methanol and KOH (potassium hydroxide) gives the major product as biodiesel and coproduct as glycerine.1. Estimation of acid value of biodiesel, 2. FTIR (Fourier Transform Infrared) Spectroscopy, 3. UV – Visible Spectrophotometry

**Steps Involved in biodiesel production**

**Step 1**: The first step for the production of biodiesel is to heat the 500ml of oil up to 135ºF.
**Step 2:** In the second step the 3.5g of Potassium Hydroxide is mixed in 100ml of methanol
**Step 3:** Shake the oil with mixed 3.5g of Potassium Hydroxide in 100ml methanol
**Step 4:** After a few hours the mixed canola oil, methanol, and Potassium Hydroxide. The biodiesel is formed at the bottom of the bottle and glycerine is present at the middle layer and oil is separated at the top of the bottle.
**Step 5:** Biodiesel (Major product) is separated from oil and glycerine
**Step 6:** Glycerine (Coproduct) is separated from oil and biodiesel


**Fig 1:** Shows the Step 5 Biodiesel (Major product)


**Fig 2:** Shows the Step 6 Glycerine (Coproduct)

**Discussion**

500ml of canola oil is heated up to 95º Fahrenheit to 135-degree Fahrenheit and mixed with 100ml of methanol and KOH (Potassium Hydroxide), then thoroughly mixed heated canola oil and methanol with potassium hydroxide, after the complete reaction, the solution needs to be set for a few hours. The end result is biodiesel at the middle glycerine and bottom biodiesel is present.

**Estimation of Acid number of biodiesel**

**Calculation**

$$AN = \frac{(V_{KOH}\text{-a}) * N * 56.1}{W}$$

$$AN = \frac{(2.6-0.3) \times 0.1 \times 56.1}{1}$$

$$AN = 0.917g$$

**Discussion**

The acid number is used to quantify the amount of acid present in this biodiesel. The acid number of biodiesel is 0.917g.

**FTIR for Biodiesel**

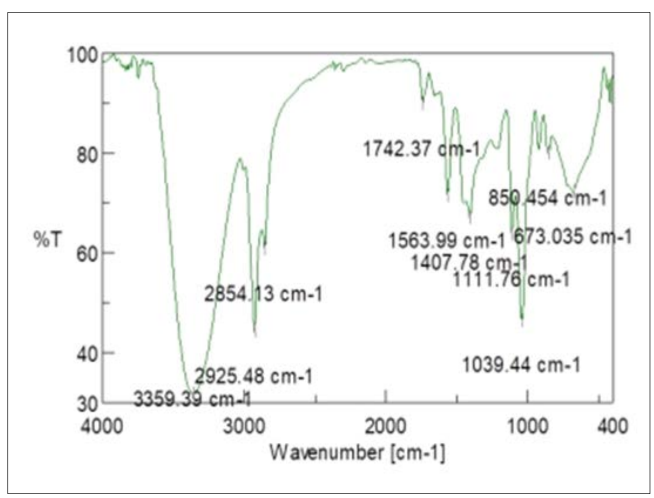


**Fig 3:** FTIR for Biodiesel

**Discussion**

**Table 1:** Shows the FTIR analysis of Biodiesel

| S.NO | Peak | Functional group | Type of Variation | Intensity |
|---|---|---|---|---|
| 1. | 1039.44 $cm^{-1}$ | C –N Amine | Stretch | Medium or Weak |
| 2. | 1742.37 $cm^{-1}$ | C=O Ester | Stretch | Strong |
| 3. | 2854.13 $cm^{-1}$ | C-H Alkane | Stretch | Medium to Strong |
| 4. | 2925.48 $cm^{-1}$ | C-H Alkane | Stretch | Medium to Strong |
| 5. | 3359.39 $cm^{-1}$ | O-H Alcohol | Stretch | Strong |

### FTIR for Glycerin

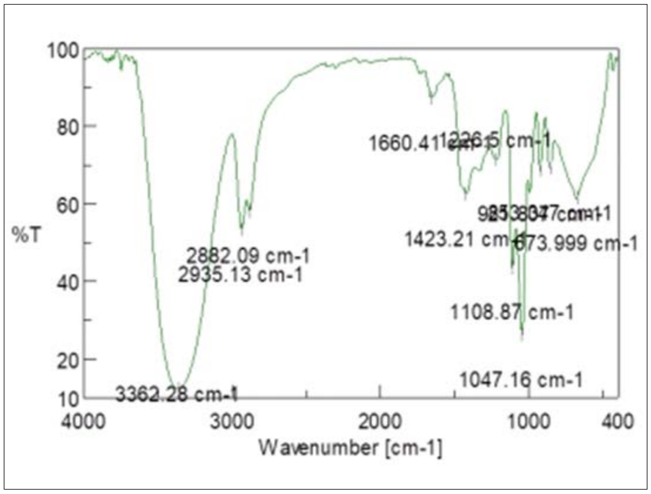


**Fig 4:** FTIR for Glycerine

### Discussion

**Table 2:** Shows the FTIR analysis of Glycerine

| S. No | Peak | Functional Groups | Type of Variation | Intensity |
|---|---|---|---|---|
| 1. | 673.999 $cm^{-1}$ | C-Cl Acyl Chloride | Stretch | Strong |
| 2. | 1226.5 $cm^{-1}$ | -COOH Carboxyl group | Bend | Strong |
| 3. | 2882.09 $cm^{-1}$ | C-H Alkane | Stretch | Medium to Strong |
| 4. | 2935.13 $cm^{-1}$ | C-H Alkane | Stretch | Medium to Strong |
| 5. | 3362.28 $cm^{-1}$ | O-H Hydroxyl group | Stretch | Strong |

### UV-Visible spectrophotometry for Biodiesel

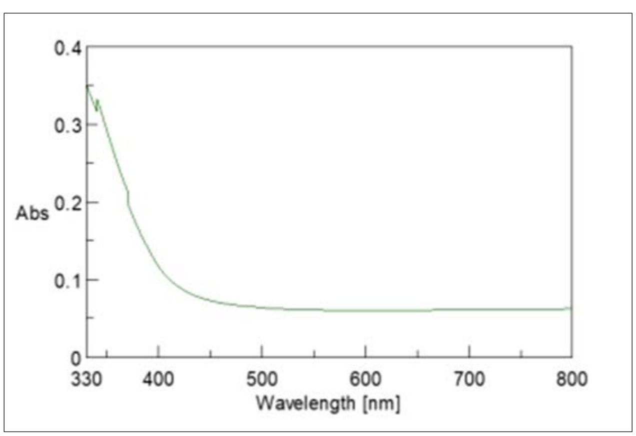


**Fig 5:** UV- Visible Spectrophotometry for Biodiesel

### Discussion

The UV-Visible spectrophotometer can be used to obtain a spectrum color compound. The absorbance spectrum of green color is shown. A plot of the absorbance green color is **330nm,** which is directly proportional to the concentration of the sample.

### Comparative Analysis of Diesel and Biodiesel

**Table 3:** Shows the Comparative Study of Diesel and Biodiesel

| S. No | Characteristics | Diesel | Biodiesel |
|---|---|---|---|
| 1. | Acid Number | 0.5 g | 0.917g |
| 2. | UV-Visible Spectrometer | 250nm | 330nm |
| 3. | pH | 5.5 – 8.0 | 6 – 8 |
| 4. | Boiling Point ºC | 180 to 340 | 315 to 350 |
| 5. | Oxygen | 0 | 11 |

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