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## Synthesis and Characterization of Biodiesel From Coconut Oil by Green Method

Umesh Khandekar<sup>1\*</sup>, Pooja Bhaise<sup>1</sup>, Pooja Verulkar<sup>1</sup>, Rahul Ghongade<sup>1</sup>

*1. Dept of Industrial Chemistry, Arts, Commerce and Science College Kiran Nagar, Amravati  
(Maharashtra), India.*

### ABSTRACT

The biodiesel is quite similar to conventional diesel fuel in its physical characteristics and can be used alone or mixed in any ratio with petroleum based diesel fuel in most existing modern four-stroke combustion ignition diesel engines with very few technical adjustments or no modification. Biodiesel as a neat can be used as a direct substitute for petro diesel and is technically called B100. The reaction is catalyzed by NaOH making this process economically viable for the industrial scale production of biodiesel. Biodiesel is an excellent product as it is environmentally friendly. Chromatogram GC-MS analysis showed 12 peaks were detected as methyl esters of fatty acids in Biodiesel coconut oil but there is only one a prominent peak that has great intensity.

**Keywords:** Biodiesel, FT-IR, GC-MS, NMR

\*Corresponding Author Email: [umesh\\_khandekar2000@yahoo.com](mailto:umesh_khandekar2000@yahoo.com)

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## INTRODUCTION

Fuel and energy crisis and the concern of the society for the depleting world's nonrenewable energy resources led to a renewed interest in the quest for alternative fuels. One of the most promising alternatives fuel is the vegetable oils and their derivatives. The first use of vegetable oil in a compression ignition engine was first demonstrated through Rudolph Diesel who used peanut oil in his diesel engine. The long term use of vegetable oils led to injector coking and the thickening of crankcase oil which resulted in piston ring sticking. Therefore, vegetable oils are not used in diesel engines because of endurance issues<sup>1-2</sup>. To overcome this problem, various modifications of vegetable oils have been employed such as transesterification, micro-emulsion formation and the use of viscosity reducers. Among these, transesterification was considered as the most suitable modification because technical properties of esters are nearly similar to diesel. Through transesterification, these vegetable oils are converted to the alkyl esters of the fatty acids present in the vegetable oil. These esters are commonly referred to as biodiesel. Biodiesel is an alternative fuel that is renewable in the sense that its primary feedstock has a sustainable source.<sup>3-4</sup>. Esterified vegetable oil contains oxygen which can contribute to lower level of particulate matter. Biodiesel is methyl or ethyl ester of vegetable oil<sup>5</sup>. Compatibility of biodiesel with mineral oils allows to combine them in order to obtain a stable fuel mixture. It can be used in the form of pure methyl esters of fatty acids as well as mixed with diesel fuel containing up to 30% of bio-component<sup>6-8</sup>. The basic oil for biodiesel production is rapeseed oil which is the third oil produced in the world mainly by US, Malaysia and China<sup>9</sup>. Biodiesel is called the environmentally friendly biofuel since it provides a means to recycle carbon dioxide. In other words, biodiesel does not contribute to global warming<sup>10</sup>.

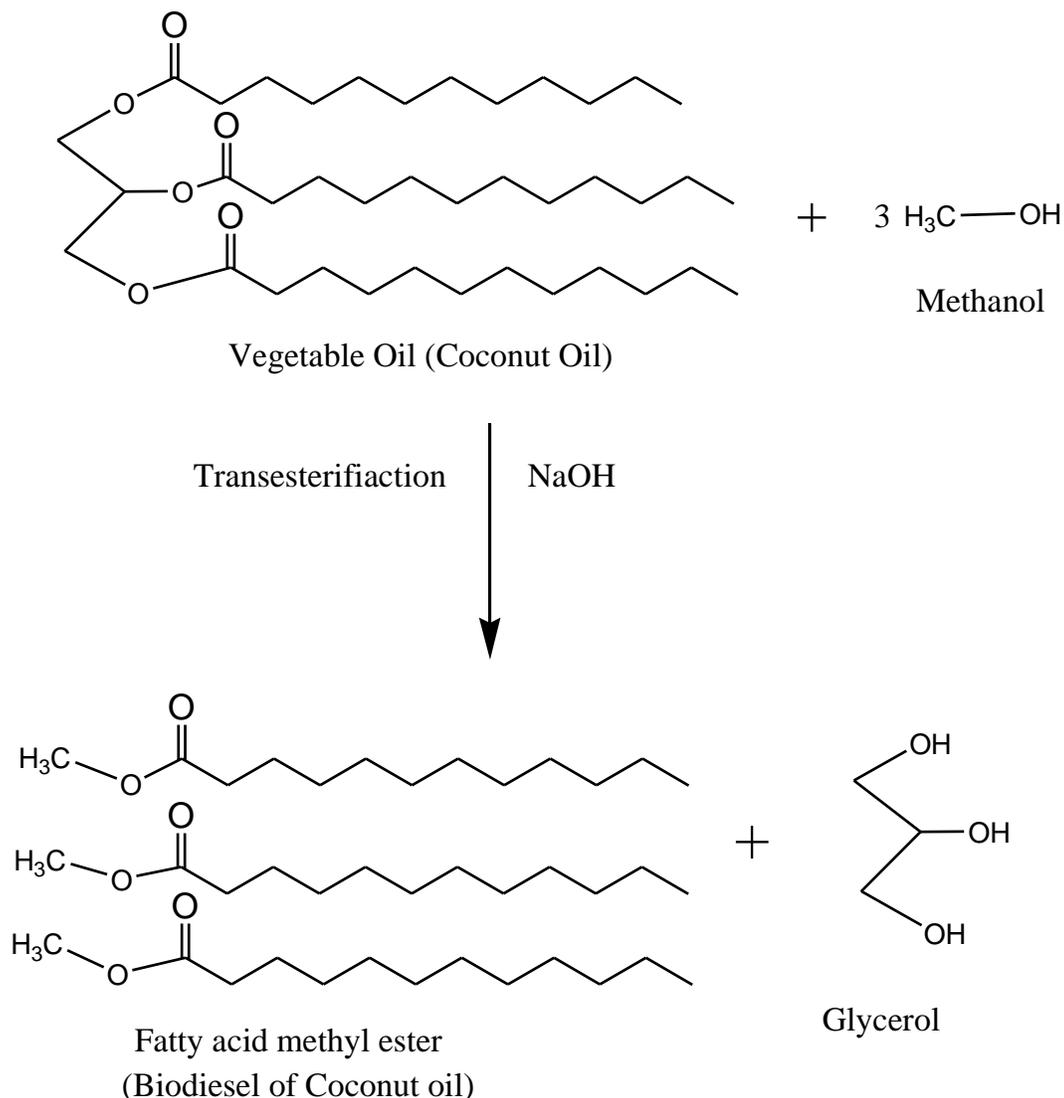
## MATERIALS AND METHOD

### **Synthesis of Biodiesel from Coconut Oil**

The finely ground anhydrous NaOH was added into pure methanol (20ml) in a 250 ml Erlenmeyer flask and stirred vigorously until all the NaOH was dissolved. The pure coconut oil 100ml was warmed to about 40<sup>0</sup>C in a 250 ml beaker. The warmed up oil was poured into a methoxide solution with continuous stirring. At first the mixture would become cloudy but should soon to layers would separate. This was stirred for 15 to 20 minute. The content of the flask where transferred into a 250 ml separatory funnel. The mixture will separate into two different layers. The first is glycerol. The glycerol will fall to the bottom & the methyl ester (biodiesel) will float to

the top. Allow the experiment to sit for an hour. The stopcock of separatory funnel was opened and the glycerol was allowed to drain into a small beaker.

Chemical Reactions as Follows-



### FT-IR Analysis of Biodiesel

FT-IR Analysis of the Biodiesel was carried out on a Carry 630 model Agilent technology having range 650-4000 of resolution 16 cm<sup>-1</sup> at Arts, Commerce and Science college kiran nagar Amravati.

### Nuclear magnetic resonance spectroscopy

Nuclear magnetic resonance spectroscopy, most commonly known as NMR spectroscopy, is a research technique that exploits the magnetic properties of certain atomic nuclei. It determines the physical and chemical properties of atoms or the molecules in which they are contained. NMR Spectroscopy was carried out at SAIF Chandigarh on Bruker Advance II 400 NMR Spectrometer

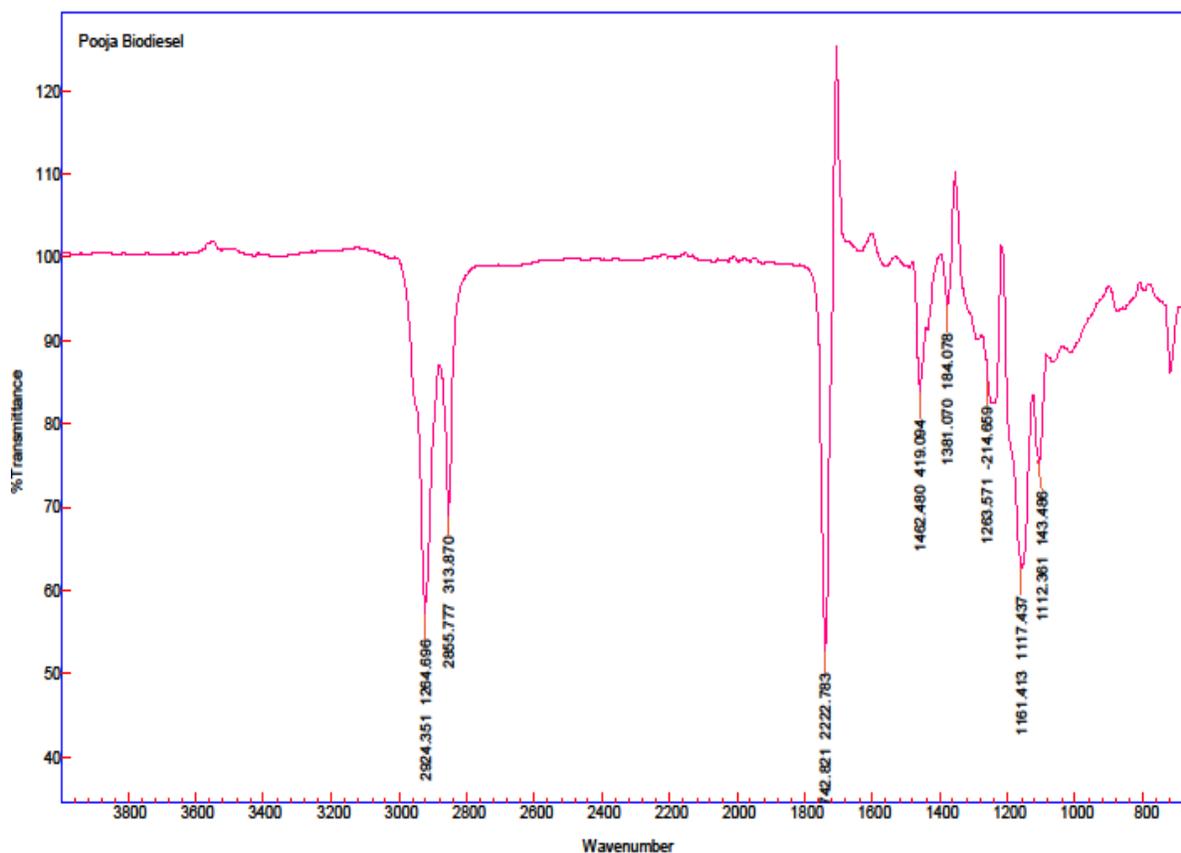
## GC-MS Analysis of Biodiesel

A JEOL GC mate II bench-top double-focusing magnetic sector mass spectrometer operating in electron ionization (EI) mode with TSS-2000<sup>1</sup> software was used for all analyses. Low-resolution mass spectra were acquired at a resolving power of 1000 (20% height definition) and scanning from m/z 25 to m/z 700 at 0.3 seconds per scan with a 0.2 second inter-scan delay. High resolution mass spectra were acquired at a resolving power of 5000 (20% height definition) and scanning the magnet from m/z 65 to m/z 750 at 1 second per scan which carry out at Central Instrumentation Laboratory Chandigarh.

## RESULTS AND DISCUSSION

### FT-IR spectrum of Biodiesel from Coconut oil

FT-IR was carry out on Agilent carry 630 at Narsamma's Arts, Commerce and Science College, Kiran Nagar, Amravati. The following results were obtained.



**Figure 1: The FT-IR Spectral analysis of Biodiesel from Coconut oil**

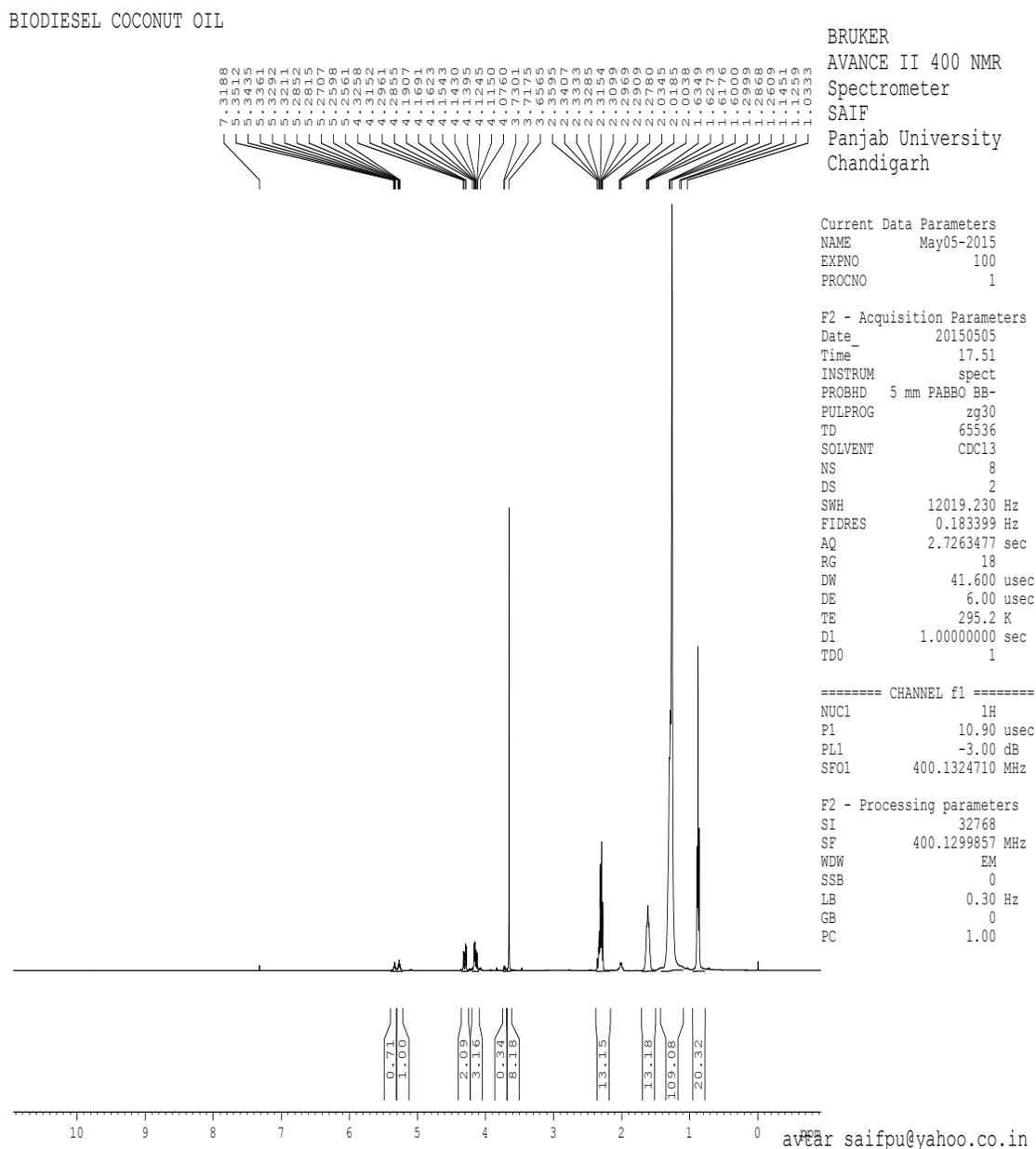
The FT-IR graph shows the following stretching and bending absorption bands which are summarized in the following table number 1

**Table 1: Absorption band of Biodiesel from Coconut oil**

Sr. No.	Absorption $\text{cm}^{-3}$	Assignment for Group	Literature value $\text{cm}^{-3}$
1	2924.35	C-H	2800-3050
2	2855.77	C-H Stretching	below 3000
3	1742.81	C=O	1750-1770
4	1112.36	C-O	1050-1150
6	1263.57	C-C	1200-1350

**NMR spectrum of biodiesel coconut oil**

NMR Spectroscopy was carried out at SAIF Chandigarh on Bruker Advance II 400 NMR Spectrometer. The spectrum shows the following results.

**Figure 2: NMR Spectral analysis of Biodiesel from Coconut oil**

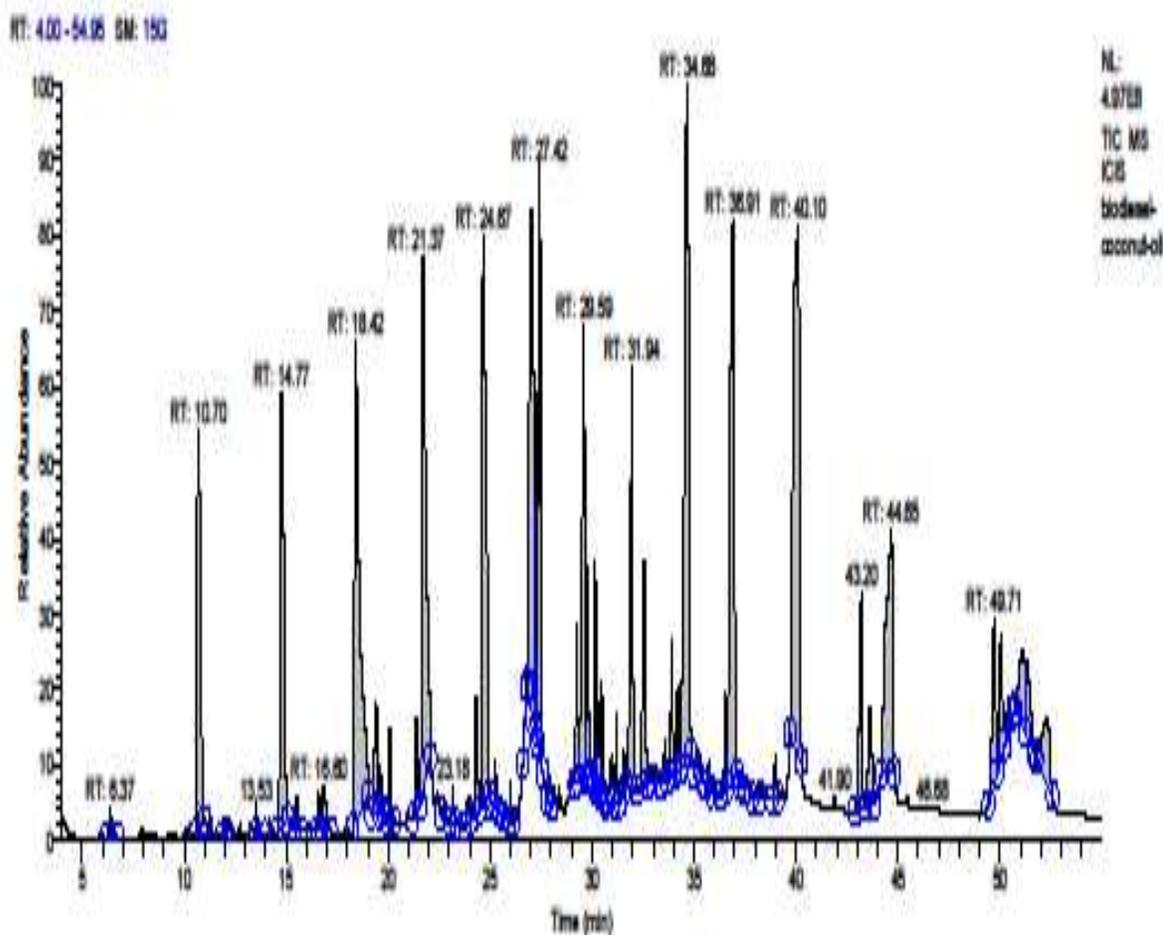
The  $^1\text{H}$  NMR Spectrum analysis of Biodiesel from Coconut oil Shows following peak the chemical shift can be correlated as below.

**Table 2: NMR Chemical Shift of Biodiesel from Coconut oil**

Sr. No.	Signal Position ( $\delta$ -ppm)	No. of H-atom	Multiplicity	Assignment of Protons
1	0.96	3H	t	-CH <sub>3</sub>
2	1.29	16H	m	-CH <sub>3</sub> -CH <sub>2</sub> -CH <sub>2</sub>
3	1.63	2H	m	-CH <sub>2</sub> -
4	2.31	2H	t	-CH <sub>2</sub> -C=O
5	11	1H	s	-COOH

### GC-MS of biodiesel of coconut oil

A JEOL GC mate II bench-top double-focusing magnetic sector mass spectrometer operating in electron ionization (EI) mode with TSS-2000<sup>1</sup> software was used for all analyses. The following observations was made on the basis of spectrum.



**Figure 3: GC-MS of Biodiesel from Coconut oil**

### Chemical Composition of biodiesel coconut oil

From Gas Chromatograph the following chemical constituents were found to present in the Biodiesel of coconut oil

**Table 3: Chemical Constitutes of Biodiesel from Coconut oil**

Sr. No	Retention Time	Name of chemical constituent	Molecular Formulae	Peak Area %
1.	10.70	Octanoic acid methyl ester	C <sub>9</sub> H <sub>18</sub> O <sub>2</sub>	3.95
2.	14.77	Decanoic acid methyl ester	C <sub>11</sub> H <sub>22</sub> O <sub>2</sub>	4.40
3.	18.42	Dodecanoic acid methyl ester	C <sub>13</sub> H <sub>26</sub> O <sub>2</sub>	7.15
4.	21.70	n-Caprylic acid isobutyl ester	C <sub>12</sub> H <sub>24</sub> O <sub>2</sub>	6.38
5.	27.03	9Octadecenoic acid methyl ester	C <sub>19</sub> H <sub>36</sub> O <sub>2</sub>	6.20
6.	27.42	Heptadecanoic acid, 14methyl, methyl ester	C <sub>19</sub> H <sub>38</sub> O <sub>2</sub>	4.05
7.	29.59	Tetradecanoic acid, 2,3dihydroxypropyl ester	C <sub>17</sub> H <sub>34</sub> O <sub>4</sub>	3.46
8.	31.94	Hexadecanoic acid, 2hydroxyl(hydroxymethyl) ethyl ester	C <sub>19</sub> H <sub>38</sub> O <sub>4</sub>	3.05
9.	34.68	Dodecanoic acid,	C <sub>15</sub> H <sub>30</sub> O <sub>4</sub>	7.98
10.	36.91	N-Butyl laurate	C <sub>16</sub> H <sub>32</sub> O <sub>2</sub>	6.91
11.	<b>40.10</b>	<b>Lauric acid methyl ester</b>	<b>C<sub>13</sub>H<sub>26</sub>O<sub>2</sub></b>	<b>8.96</b>
12.	44.65	Dodecanoic acid, 1(hydroxymethyl) 1,2ethanediyl ester	C <sub>27</sub> H <sub>52</sub> O <sub>5</sub>	4.53

## CONCLUSION

The reaction is catalyzed by NaOH making this process economically viable for the industrial scale production of biodiesel. Biodiesel is an excellent product as it is environmentally friendly. Chromatogram GC-MS analysis showed 12 peaks were detected as methyl esters of fatty acids in Biodiesel coconut oil but there is only one a major peak of Lauric Acid that has great intensity.

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