Production of FAME Using Waste Papaya seeds by Different Experimental Conditions in a Batch System

Kamini A. Patel¹, Milap G. Nayak²

Department of Chemical Engineering, Vishwakarma Government Engineering College, Chandkheda, India¹
Department of Chemical Engineering, Vishwakarma Government Engineering College, Chandkheda, India²

Abstract—An increase in the price of the petroleum, Biodiesel is one of the alternative fuels to diesel engines that could be moderately or fully replace or reduce the use of petroleum diesel fuel and produced from renewable biological sources. The seeds are generally discarded in order to make more efficient use of Papaya. It is important investigating the use of seeds as source of oil. Mechanical extraction technique is used to extract oil. There are four primary ways to produce biodiesel, direct use and blending, Microemulsion, thermal cracking (pyrolysis) and transesterification. The most widely used method is transesterification reaction Because of Trans-esterification reaction is reducing the viscosity during the production of biodiesel. The purpose of this method is to reduce the viscosity of oil using base catalyst in the presence of methanol. So, Tran-esterification reaction is use to produced Fatty acid methyl ester (FAME) from papaya seeds oil at different experimental conditions. The parameters are; mass ratio of ethanol to oil, reaction temperature, catalyst concentration, and reaction time. Analyzed papaya seeds oil and FAME. Fatty acid methyl ester Properties are found and that close to diesel fuel and also meet the specifications of ASTM standards.

Key words—Biodiesel Feedstock, Oil Extraction & Production of FAME, Analysis of oil & FAME sample, Characteristics of FAME.

I.  INTRODUCTION

The main important for protecting global environment and long term energy security, necessary to develop alternative fuels and those properties comparable to petroleum based fuel. Biodiesel based fuels are renewable, non-toxic and safe to store, because of their oxygen content, the combustion is more complete and less carbon monoxide emission. There is a number of nonedible tree based oil seeds available in many countries around the world and from that biodiesel can be produce [1]. There are different ways to produced biodiesel with different kinds of raw materials likes refine crude or frying oils. Also there are different types of catalyst, basic ones such as sodium or potassium hydroxides, acids such as sulfuric acid, ion exchange resins, lipases and supercritical fluids. One of the advantages of this fuel is that the raw materials used to produce it are natural and renewable. All these types of oils come from vegetables or animal fat, making it biodegradable and nontoxic [2]. High emissions of CO₂, NOx, SO₂, particulate matter, poly aromatic hydrocarbons and hydro-carbons are produced during the using of fossil fuel and creating environmental problems. These facts have converged in the search for renewable energy sources, such as biofuels- bioethanol and biodiesel [3].

1.1. Advantage of Biodiesel

Biodiesel is the only alternative fuel that runs in any conventional, unmodified diesel engine. Maintain the payload capacity and range of conventional diesel engines. Diesel skilled mechanics can easily attend to biodiesel engines. Exhaust emissions are lower. Biodiesel fuel is non-toxic and biodegradable.

1.2. Disadvantage of Biodiesel

Quality of biodiesel depends on the blend thus quality can be tampered. Biodiesel has excellent solvent properties. There may be problems of winter operability. Spills of biodiesel can decolorize any painted surface if left for long.

II. MATERIAL AND METHODS

2.1. Food Waste

Food Waste is an inheritable consequence of the food industry. Food industry produces large volumes of wastes, both solids and liquid because of production, preparation and consumption of food. These wastes increasing disposal and potential severe pollution problems and signify a loss of valuable biomass and nutrients. The wastes contain valuable components such as: sucrose, glucose, fructose and other Nutrients. Fruit pulp wastes after extracting juices are one of the major byproducts of food processing industries. Byproducts of food processing plant represent a major disposal problem for the industry concerned, but they are also promising sources of biomaterials. These biomaterials can be used as substrates for bioethanol production [4].

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2.2. Feedstock: Papaya seeds
Carica papaya originated in Central America. It contains many biologically active compounds. Two important compounds are chymopapain and papain, which are supposed to aid in digestion. Carica papaya could be a rich source of dietary fiber which can have beneficial effects. Papaya is important for its fruit and it is only recently that it has been cultivated purpose. Seeds of papaya fruits are discarded, because of bad experiences when they are consumed by humans or animals. The papaya seed oil contained 10.3% free fatty acid [5]. The papaya seed is currently a waste product as it is often discarded after eaten the papaya fruits due to its very limited uses at the moment. Papaya seed are recently gaining importance due to its medicinal value. The seed had recently been linked to curing sickle cell diseases, poisoning related renal disorder, and as an antihelminthes. There are scarce information’s on this relatively underutilized seed despite its importance [6].

2.3. Use of Papaya seeds:
2.3.1. Prevents from Parasites:
The seeds of papaya fruit contain high levels of proteolytic enzyme just like papain which protects the body from parasites and their eggs as well as breaks down the protein wastes.

2.3.2. Kills Parasitic Worms:
Papaya seeds also have an anthelmintic alkaloid known as carpaine which can kill the parasitic worms and amoebas.

2.3.3. Treats Liver Cirrhosis:
Papaya seeds help to treat the liver cirrhosis (a disease caused by the excessive consumption of alcohol). Liver becomes hard and shrink and unable to remove toxins from the body which in turn cause serious health problems. Grinded papaya seed (four or five) can be taken by mixing with a tablespoon of lime juice for a month and twice a day to get relieve from the symptoms of liver cirrhosis. If taken regularly, helps in liver detoxification and improve its vital functioning.

2.3.4. Kills Harmful Bacteria:
Papaya seeds have antibacterial and anti-inflammatory effects on digestive system by killing harmful bacteria like Salmonella, Staphylococcus, E. coli and others causing hazardous infections.

2.3.5. Prevents from Kidney Failure:
Seeds of papaya protect the kidney from kidney failure caused by the toxins [7].

2.4. Oil Extraction:
Papaya seeds are discarded after eaten the papaya fruits. The seeds were collected from the different households as one discards the seeds after consuming the fruit. The collected seeds were dried. Dry Papaya seeds are raw material for extract of oil using mechanically hand press expeller.

2.5. Trans-esterification Reaction:
Papaya seeds Oil is used into trans-esterification reaction and that reaction carried out in a batch system. In this experiment, Methanol as an alcohol and NaOH as a catalyst. First mix catalyst in alcohol upto NaOH dissolve into methanol. At that moment preheat the oil-bath upto constant temperature reached. Therefore, Add oil into 3-neck round bottom flask and mixture of methanol plus NaOH and provide continuous stirring using magnetic stirrer. Allow the reaction mixture to react for different time interval. After completion of Reaction take out mixture from 3-neck round
bottom flask and pour into the separating funnel and take a time to settle. When two layers are appeared, in which upper layer is Biodiesel and lower layer is Glycerol. Collect both layers and Find out the yield of biodiesel.

The trans-esterification reaction carried out at different Experimental conditions. For different alcohol to oil molar ratio 3:1, 6:1, 9:1, 12:1, reaction temperatures are 50, 55 & 60°C and reaction times are 60-90-120min and catalyst concentrations are 0.5, 1, and 1.5%. Various experiments perform and Find Yield. Perform the Experiment and concluded that 2% and 4% of NaOH catalyst concentration used at that time Soap formation occurs and difficult to Separate Two phase of Biodiesel and glycerol.

III. RESULTS AND DISCUSSION

3.1. Trans-esterification reaction:
Different experiment performed at different conditions to give best yield and that condition: 0.5% catalyst concentration, 120min reaction time, Temperature 60°C and 9:1 alcohol to oil molar ratio to obtain best yield is 96.7%.

3.2. Analysis of papaya seeds Oil and FAME:
3.2.1 FTIR Analysis:
The FTIR spectra of papaya seed oil and the optimal biodiesel fuel were measured for two purposes; the first is for the qualitative determination of some of the obtained characteristic bands, the second is for the quantitative determination by monitoring the Trans-esterification reactions. The main differences observed between the infrared spectra of papaya seed oil and the produced biodiesel fuel are a small displacement of the stretching C=O band and stretching C–H band as well as the C–H bonding band of the biodiesel to the lower energy. This is attributed to the substitution of the glycerol by the methoxy radical (Fig 4-5).

3.2.1. GC-MS Analysis:
Gas chromatography is used to separate mixtures into individual components using temperature controlled capillary column and Mass spectroscopy used to identify the various components from their mass spectra and each compound has a unique mass spectrum that can be compared with mass spectral database and thus identified. Shown GC-MS Analysis in below Fig 5.Figure in which Molecular formula and Formula name and Mol % are obtain GC-MS graph of FAME from Library-NIST11s.lib.

![Figure 3. GC-MS data for FAME Sample](image)
Characteristics Properties of FAME:
Characteristics Properties are found using ASTM Method and Properties value related to standard so we can use as Biodiesel.

Table 1: Characteristics Properties of FAME

<table>
<thead>
<tr>
<th>Sr No</th>
<th>Properties</th>
<th>Value</th>
<th>Unit</th>
<th>Test Name</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Acid value</td>
<td>0.03</td>
<td>mg KOH/g</td>
<td>ASTM D664</td>
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<tr>
<td>2</td>
<td>Kinetic viscosity</td>
<td>3.57</td>
<td>mm²/s</td>
<td>ASTM D445</td>
</tr>
<tr>
<td>3</td>
<td>Flash point</td>
<td>389</td>
<td>K</td>
<td>ASTM D93</td>
</tr>
<tr>
<td>4</td>
<td>Density</td>
<td>0.82</td>
<td>gm/ml</td>
<td>ASTM D4052</td>
</tr>
</tbody>
</table>

CONCLUSION

Biodiesel is a mono-alkyl esters of fatty acids derived from vegetable oil or animal fat. Biodiesel is much less polluting than petroleum diesel, resulting in much lower emissions of every pollutant like carbon dioxide, sulfur oxide, particulates, carbon monoxide, air toxics and unburned hydrocarbons. Papaya seeds are discarded after eaten papaya. Mechanical method is relatively low yield obtain compared to chemical method but purity of oil is high compared to chemical method to extract oil. Best Yield Conditions is 0.5% catalyst concentration, 120 min reaction time, Temperature 60°C and 9:1 alcohol to oil molar ratio to obtain best yield 96.70 %. Characteristics Properties are relevant to standard Biodiesel B100. Finally we concluded that Biodiesel of papaya seeds are Suitable for replacement of petrodiesel without any change of diesel engine.

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REFERENCE


