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The Studying of Production Biodiesel From Poultry Fats As An Alternative Fuel Than Traditional Petroleum Diesel Fuel

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Abstract: The demand for fossil fuels as an energy source in recent decade has been dramatic. In fact, many hydrocarbons reservoirs are depleted every day around the world. Indeed, the utilizing of fossil fuels for instance, petroleum, natural gas and coal as an energy source are emitted huge quantities of carbon dioxide to our environment & contributed in global worming phenomenon. Therefore, the passive environmental consequences of fossil fuels and the bother about fossil fuel supplies have encouraged the investigation for renewable biofuels for example, biogas & biodiesel[1]. Biodiesel may consider as quite reliable fuel due to several advantages for example, reduces engine wear, reduce the global worming phenomenon, reduces carbon dioxide emissions up to 80% than petroleum diesel. Sustainable energy source and cheaper than petroleum diesel[2]. Indeed, biodiesel could be obtained from many biological resources for instance, vegetable oil & alga. Therefore, this study is aimed to produce a reliable biodiesel from poultry fats for instance, chicken. People nowadays are quite health conscious and therefore many people tend to dispose the fats from the chicken. In the present investigation an attempt has been achieved to utilized chicken fat as low cost renewable feed stock to produce biodiesel. Moreover, the study has investigated several process parameters for instance, amount of catalyst & amount of methanol on biodiesel production yield. The produced biodiesel is also subjected into several laboratory tests for example, density, cloud point, pour point and cetane value and the results have been compared well with ASTM standards.
Keywords: Biodiesel, biofuel, renewable energy, chicken fat, process optimization.

Introduction

Biodiesel is considered one of the most important sustainable energy in recent decade as well as the future. It could be considered as an alternative fuel for diesel engines. In fact, many oil reservoirs are depleted every day. Moreover, petroleum diesel engines are emitted huge amounts of greenhouse gases every moment that contributed in global worming phenomenon[3,4] . Therefore, many researchers and oil companies tried to find out new energy sources that can be used as alternative fuel for viruses uses. Indeed, biodiesel received huge attention worldwide to be used as alterative fuel for delis engines. Moreover, it possesses several advantages over petroleum delis for example, reduces the demand of petroleum fuels, nontoxic and reduces the global climate changes and environmental pollution. Furthermore, it has many advantages compared to diesel fuel as it has higher cetane number than diesel fuel, contains no aromatics, almost no sulfur and 10- 12% oxygen by weight. Biodiesel fuelled engines produce less CO, HC and particulate emissions than petroleum diesel fuelled engines. Indeed, biodiesel could be used directly in some specific delis engines[5,6]. However, it should be blended with petroleum diesel, if it required to be used in normal delis engine. As a result, biodiesel blends can be used in diesel engines without any major modification. Many researchers have indicated that the biodiesel is quite close to diesel fuel. Indeed, biodiesel could be produced from vegetable oils and animal fats as well. Moreover, almost biodiesel is produced from rapeseed oil and waste cooking oil[2,5]. By using high quality virgin oils makes biodiesel more expensive than diesel fuel[7]. Indeed, it is quite important to use low cost t feedstock are needed. Moreover, the use of vegetable oil leads to shortage of food while use of animal fat for human consumption is a health hazard[7]. Indeed, biodiesel could be produced by transesterification reaction that is a three step reversible reaction that converts the initial triglycerides into a mixture of Fatty acid methyl ester and glycerol in the presence of a catalyst usually homogeneous or heterogeneous. alcohol for example, ethanol and methanol can be used in the transesterification reaction[8,9]. Furthermote, several types could be utilized in this reaction for example, sulphuric, hydrochloric acid and sodium hydroxide and potassium hydroxide[10]. Indeed, acid catalyst is quite slow to be suitable for converting effective at converting free fatty acids to esters. Moreover, animal fats and restaurant waste oils are appealing feedstock to produce biodiesel. Indeed, if the free fatty acid level is less than 15% it is called yellow grease and if it is above 15% it is called brown grease[7,10]. Moreover, the cost of virgin vegetable oil is about two times more than that of animal fat. Therefore the price of feedstock can be reduced about 50% with using low grade animal fat[7]. Moreover, in some cases animal fats could be obtained for free at slighter houses. Moreover, they usually content significant amounts of free fatty acids[8,9]. The fats with high FFA cannot be converted to biodiesel using alkaline catalysts which have been used with good results for vegetable oils[10]. The free fatty acids react with an alkaline catalyst and thus soaps are produced. Moreover, many investigations have shown that chicken fat is a promising feedstock for biodiesel production[7,10]. Therefore, optimization of the transesterification reaction has investigated with different methanol/oil ratio and catalyst amount. The obtained ester was characterized by determining its fuel properties according to standard test methods.

Research methodology

The chicken fat has been obtained & collected from a local butcher shop at Koya city in Iraqi Kurdistan region. Moreover, the fat has been washed and cleaned with deionized water. Moreover, the solid fat has been melted at (65 -70) °C [4,10]. The melted fat has been filtrated to remove any suspended particles and impurities. Indeed, it quite important to determine the free fatty acid (FFA) of the chicken fat in order to uses the accurate catalyst amount at the transesterification reaction. Furthermore, the free fatty acid (FFA) has been determined and found to be 1.8 mg of KOH/gm of the chicken fat. Indeed, many researchers have indicated that the prettification step is not needed if the acid value is lower than 2% [10]. Therefore, the preesterification step has been ignored because the acid value of the melted chicken fat is below 2%. Hence alkali was used for the transesterification of chicken fat. Moreover, the experiment has achieved in a laboratory that considered of 250ml flasks. The flasks were kept in an water bath maintained at 60°C. This temperature keeps the methanol below its boiling point temperature. Alkali transesterification reaction has been adopted to produce the biodiesel from meted chicken fat. The calculated amount of KOH has been dissolved with the needed amount of methanol. This liquid has been poured into the melted chicken fat in a specific flask. The reaction has been done at 60°C and for 30 min [10]. After the reaction was completed for melted chicken fat, the reaction mixture was allowed to be separated into two layers by using a separator funnel. After a wile of time, tow materials has been separated from each other. At the bottom of separator, a red color that content the impurities and glycerol. The esters obtained at the upper layer of the separator funnel. Then, the produced biodiesel has been washed tow times by hot water.

Results and discussion

Transesterification reaction has been achieved by utilizing a fat sample that possesses an acid value of 1.8 mg KOH/g for chicken fat. Moreover, this process is achieved yield about 80%. Table 1 shows some physical properties of produced biodiesel.

Table 1: physical properties of produced biodiesel.

Properties	Produced biodiesel	ASTM Standers for Biodiesel
Density 15°C kg/m^3	883	860- 900
Viscosity 40°Cmm^2/s	5.885	1.9 – 6
Cetane Number	74	40 min
Flash point °C	106	54 min

Indeed, the methanol/oil ratio may consider one of the most important parameters that affect the reaction and biodiesel yield. Therefore, the process optimization for biodiesel production has been achieved by adopting several methanol/ oil ratios. Figure 1 shows the relationship between several methanol/ oil ratio and the yield percent of the biodiesel. It seems from figure 1 that the yield percentages increase by increasing the amount of methanol. However, the reaction reaches equilibrium at methanol/oil ratio about 7:1. It also seems from figure 1 that the maximum conversation to ester could be achieved at methanol: oil ratio about 7:1. As a result, it could be argued that adopting molar ratio of methanol/oil ratio between (6:1 to 7:1) could achieve the optimal molar ratio.

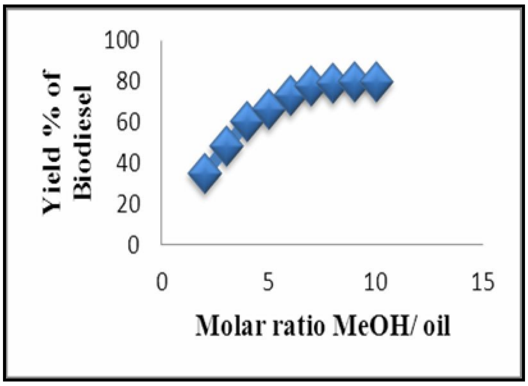

Figure 1: The relationship between the molar ratio of MeOH/oil and biodiesel yield% at 30 min reaction time.

In this study KOH has been obtained as a catalyst. Indeed, catalyst amount is also an important process parameter. Therefore, the process is also optimized by adopting several catalyst amount with a range between (0.34 – 0.41) gms of KOH and the molar ratio of MeOH/oil molar ratio 6:1. Moreover, the reaction time and temperature as 60 min and 60 °C respectively. Figure 2 shows the relationship between several KOH catalyst amounts and the ester yield percentage. It seems from figure 2 that the reaction could be achieved in all catalyst amounts. However, the adopting of KOH amount about 0.38 gm could achieve high ester yield about 80%. Moreover, the increasing of catalyst amount above 0.38gm will decrees the reaction yield.

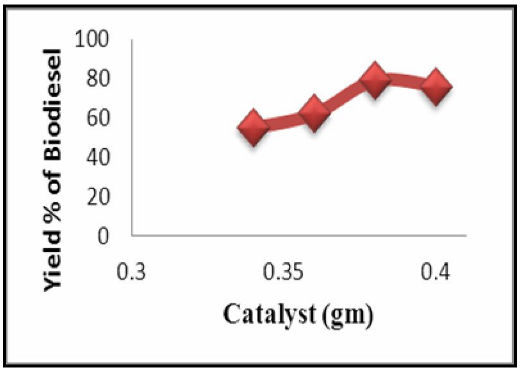

Figure 2: The relationship between the amount of catalyst and biodiesel yield% at 30 min reaction time & 60°C.

Conclusion

In conclusion, this study is attempted to investigate and produce biodiesel from chicken fat. It could be argued that it quite possible to produce biodiesel from chicken fat by adopting transesterification reaction method. Therefore, it quite recommended that utilizing waste chicken fats at slaughterhouse as a promised feedstock for biodiesel production. Moreover, the process optimization is also achieved for several process parameters for example, catalyst amount & amount of methanol. It could be argued that adopting methanol/ oil ratio about 7:1 could achieved good biodiesel yield about 80%. Moreover, it could be also argued that using 0.38 gm KOH catalyst could achieved good biodiesel. As a result, any additional excess catalyst could lead to reduction in ester yield. Furthermore, the biodiesel production could be incomplete if the methanol amount is less than the optimal value. However, it quite recommended that to achieve more studies and process optimization before installing biodiesel plant for commercial production.

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