

BIODIESEL PRODUCTION FROM GROUNDNUT OIL, SESAME OIL AND COTTON OIL BY TRANSESTERIFICATION REACTION

Abstract

The present study is to get high yield of fuel which are utilise as energy resources. Energy resources are renewable and non-renewable so as a solution of shortage of fossil fuel in future production of non-renewable energy source biodiesel, which is another helpful energy source like hydropower, wind and solar energy. And it works as fossil fuel without harm environment. Sources of biodiesel are petro crops, it's seed oil have characteristics of fuel. Petro crops mostly included *Jatropha* Spp. and algal species can be convert into biofuel or synthetic Petroleum. This research shows different experiments of biodiesel production from groundnut oil sesame oil and cotton oil.in the modified transcification method different amounts of methanol or NaOH used in the reaction, it affects directly to production rate it gives 2 to 3% less production compared to normal method. groundnut and cotton oil alternate its density after converting into biodiesel. sesame oil density is not change after converting into biodiesel,conclusion is groundnut biodiesel and cotton biodiesel's quantity is 6 to 7% better than its oil formHence, now these oil have more characteristics of the biodiesel as compared to sesame biodiesel. Sesame oil and biodiesel both are remain same. so it has less characteristics of biodiesel.

Keywords: Biodiesel, groundnut oil, sesame oil, cotton oil, transesterification, Purification, glycerol

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I. INTRODUCTION

One of the most crucial resources for humanity's sustainable progress is energy. The energy crisis is one of the major problems facing the world today. Because they can be burned to create a considerable amount of energy, fuels are very important. Fuels are essential to many elements of daily life, particularly the movement of people and things. The primary energy sources are fossil fuels including gasoline, coal, and natural gas. 80 percent of the world's energy demands are met by fossil fuels. Diesel machines are typically used in production in most industries. Private cars, buses, trucks, and ships all utilize a lot of diesel and gasoline in the transportation industry.

- 1. Resources for Renewable Energy:** Today, the vastness of energy is undeniable. Every aspect of life requires it. Energy resources can be broadly divided into renewable and non-renewable categories. Renewable energy is abundant, dependable, and could eventually be very affordable. Solar, wind, biomass, geothermal, hydropower, and tidal energy are the main sources of this energy. Compared to non-renewable energy sources like coal, natural gas, and oil, these are less expensive. Benefits of renewable energy providers produce much lower amounts of carbon emissions, which contribute to better climate change than burning fossil fuels. Though relatively stable in the earth's environment, these nevertheless have a number of disadvantages. Seasonal and meteorological variations have an effect on solar energy. large initial costs for use that is productive (Shahzad U.2012). solar systems don't function properly at night, but the battery bank that stores energy throughout the day can be utilized. as well. The generation of power from wind energy is affected by the wind's inconsistency in speed and high investment requirements.
- 2. Non-renewable Energy sources:** Coal, natural gas, oil, and nuclear energy are examples of non-renewable energy sources. the fact that we now rely on these resources to provide the majority of our energy needs makes the fact that they cannot be replenished after they are depleted a serious issue for humanity. renewable resources can naturally regenerate themselves, whereas non-renewable resources cannot. This is how these two types of resources vary from one another. this translates to the fact that non-renewable resources are scarce and cannot be used responsibly. oil, natural gas, coal, and nuclear energy are the four main categories of non-renewable energy. fossil fuels are a term that refers to coal, natural gas, and oil together. the term "fossil" refers to the fact that fossil fuels were created within the Earth over millions of years from dead plants and animals. they are located under layers of rock and sediment. pressure and heat worked together to transform the plant and animal remains into crude oil (also known as petroleum), coal, and naturalgas. crude oil is a liquid fossil fuel that is mostly used to make gasoline and diesel fuel for cars, as well as to manufacture polymers. it is discovered in rocks beneath the Earth's surface and is pumped out via wells. natural gas is commonly utilized in cooking and heating homes. it is largely composed of methane and is found near oil resources beneath the Earth's surface. natural gas can be extracted using the same wells that are used to produce crude oil. Coal is a solid fossil fuel that is used to heat homes and generate electricity. it can be found in fossilized marshes buried behind layers of sediment. Because coal is solid, it cannot be mined in the same way that crude oil is

natural gas; it must be dug up from the ground.

- 3. Drawbacks:** We rely on fossil fuels because they are high in energy and relatively inexpensive to produce. A fundamental issue with fossil fuels, aside from their scarcity, is that burning them emits carbon dioxide into the atmosphere. Each year, fossil fuels account for over 80% of total world energy use. The major cause of global warming is an increase in Earth's temperature, where the majority of the coming difficulties are tied to present energy sources. The following are the key areas of environmental effect: water contamination, land use and siting implications, radiation and radioactive decay, solid waste disposal, dangerous pollutants in the air, environmental pollution, acid rain, depletion of ozone and global environmental degradation (greenhouse effect). The depletion of fossil fuels has also been mentioned as a potential problem. This is not a sustainable fuel. We can solve these problems by producing biodiesel from seeds of plants or fats from animals (Hook, M. *et al.*, 2013).
- 4. Chemical Components:** The alternative fuel should be found to compensate the future fuel demand and reduce the pollution. The vegetable oil or animal fat has a high energy density to meet the energy compensation, but its properties are not favorable for better atomization so can be converted into biodiesel. Generally, four methods are used to produce biodiesel from vegetable oils and animal fat. The biodiesel production method such as direct use, blending, transesterification process, pyrolysis and micro emulsion. (Mohamed Chaker Ncibi; *et al.*, 2013). The biodiesel is the mono alkali ester which is derived from the animal fat or vegetable oil. The carbon will be neutral when biodiesel is used as a fuel, because during the combustion process, the amount of carbon emission is equal to an animal or plant absorbed during its whole life time. So the emission will be low in green combustion of biofuel.
- 5. Importance:** Biodiesel is a clean-burning, sustainable alternative to petroleum diesel that is manufactured in the United States. Using biodiesel as a car fuel improves air quality and the environment while also providing safety benefits. If spilled or discharged into the environment, biodiesel in its pure, unblended form causes significantly less damage than petroleum fuel. It is less flammable than petroleum diesel and hence safer. The flashpoint of biodiesel is greater than 130°C, whereas petroleum diesel has a flashpoint of roughly 52°C. Biodiesel is non-hazardous to handle, store, or transport. For more information about handling, storing, and transporting. Biodiesel is defined as a monoalkyl ester of long chain fatty acids produced from vegetable oils, seeds, or fats from animals. Biodiesel, which is made from vegetable oil or animal fat, offers several environmental advantages, including being nontoxic, emitting less pollution, and being sustainable (Lee S; Shah, Y., 2012). The most prevalent is that the esters, that form part of the biodiesel makeup, are so methyl that they are referred to as the methyl group of fatty acids ester. The physicochemical qualities of biodiesel may differ according to the source of the fatty acid combination, and the method of the transesterification and separation efficiency procedure. Hydrocarbon chain length, branching, and degree of saturation all impact their composition; hence, monitoring of quality is essential to ensure combustion (Pinzi S.G. *et al.*, 2009).
- 6. Characteristics of Biodiesel:** Biodiesel is a long chained fatty acid generated from a monoalkyl ester of vegetable oils, seeds, or animal fats. Biodiesel generated from

vegetable oil or animal fat provides major environmental advantages, such as being nontoxic, less emulsified, and renewable (Ramchandran *et al.*, 2013). Because the ester is the most prevalent component of biodiesel, it is known as fatty acid methyl ester (FAME). The characteristics using biodiesel as a fuel vary based on its chemical composition, and to minimize negative environmental and ignition effects, the fuel used must be strictly controlled. The starting delay in the process of combustion is the most essential aspect in combustion efficiency, and it is influenced by the compression ratio used. The physicochemical qualities of biodiesel may differ depending on the oil source from which the fatty acid mixture was derived via the transesterification and separating process. Composition of emulsions that ensure combustion efficiency and lower atmospheric emissions is influenced by elements such as hydrocarbon chain, length, branching, and degree of saturation. These evolutionary qualities are extremely important since they practically define the utility of the fuel (Fuentes *et al.*, 2018). The majority of biodiesel manufacturing uses raw vegetable oils, used cooking oils, yellow grease, and animal fats as feedstock in the transesterification process. Vegetable oils are the primary feedstock for biodiesel manufacturing, although additional feedstocks for biodiesel production include waste animal fats from processing industries, as well as recovered cooking oil and yellow grease from restaurants. (V.K. Bhatia, *et al.*, 1983). Sunflower oil, rapeseed oil and palm oil are major feedstocks for biodiesel production. Algae is also a potential source for biodiesel production, algae have fat that help them to float. This fat can be collected and processed into biodiesel. Soybean and palm oil also common plants used in biofuel production. The use of algae and cyanobacteria as source of biodiesel holds promise but it is difficult to develop economically. Some algal species have up to 40% lipids by weight, which can be converted into biofuel or synthetic Petroleum. According to some estimates algae and cyanobacteria could yield between 10 and 100 times more fuel per unit area than plant-based biofuels (Hosseinzadeh B. *et al.*, 2022). While examining the possibility of using renewable plant materials as sources of hydrocarbons, indigenous lactiferous plants belonging to the families of Asclepiadaceae, Apocynaceae, Moraceae and Convolvulaceae have been evaluated. These family's species are latex-bearing plants. Which have hydrocarbon in particular amount. So extraction of the hydrocarbon and utilize in biodiesel production (Chen H. *et al.*, 2021) But majority of biodiesel production achieved by seed plants. *Jatropha* plant species have the best characteristics of fuel so, by increasing cultivation of *jatropha* Spp. for large-scale production of biodiesel in many countries now a day (V.K. Bhatia, *et al.*, 1983).

- 7. Advantages and Disadvantages of Biodiesel:** Provides a domestic, renewable energy supply. Biodiesel is carbon neutral because the balance between the amount of CO₂ emissions and the amount of CO₂ absorbed by the plants producing vegetable oil is equal. Biodiesel can be used directly in compression ignition engines with no substantial modifications of the engine. Blending of biodiesel with diesel fuel increases engine efficiency. The higher flash point of biodiesel makes its storage safer. Biodiesel is non-toxic. Biodiesel degrades four times faster than diesel. CO, CO₂ and UBHC, PAH, soot and aromatics emissions are reduced in biodiesel and its blends than in fossil diesel because biodiesel is oxygen in structure and it burns cleanly all the fuels. It is biodegradable (Parawira W. 2010). Disadvantages are including more expensive due to less production of vegetable oil blends of biodiesel above 20% can cause engine maintenance problems and even sometimes damage the engine in the long term.

- 8. Glycerol:** Crude glycerol generated from biodiesel production is impure and of little economic value. In general, glycerol makes up 65% to 85% (w/w) of the crude stream (Gonzalez-Pajuelo *et al.*, 2005). The wide range of purity values can be attributed to different glycerol purification methods or different feedstocks used by biodiesel producers (Mu *et al.*, 2006). In addition to methanol and soaps, crude glycerol also contains a variety of elements such as calcium, magnesium, phosphorous, or sulfur (Thompson & He; *et al.*, 2006). Reported that the elements present in the glycerol of different feedstock sources (such as canola, rapeseed, and soybean) were similar. This crude glycerol is not useful in Cosmetics, Pharmaceutical, food etc. so it need to purify for further use. Crude glycerol is can be purified by particular method (Mu *et al.*, 2006). Uses of crude glycerol are including various outlets for disposal and utilization of the crude glycerol generated in biodiesel plants. For large scale biodiesel producers, crude glycerol can be refined into a pure form and then be used in food, pharmaceutical, or cosmetics industries.

II. MATERIAL AND METHOD

- 1. Transesterification Mechanism:** Biodiesel (mono alkyl ester) and glycerol production by transesterification process is a reaction between triglycerides from vegetable oil and alcohol (Rajalingam *et al.*, 2016). In the transesterification process, some catalyst also used to increase the rate of reaction and quality of outcome product. The quantity and types of catalyst are deciding the amount of free fatty acid present in the (feedstock oil) products of biodiesel. If the amount of free fatty acid is higher, than it is unfavorable for biodiesel production which leads effect to formation of soap and biodiesel yield efficiency (Ramaraju A A; *et al.*, 2011). Biodiesel production can be done by two type of transesterification processes, which include acid catalyst transesterification process and base catalyst transesterification process. here much suitable method is base catalyst transesterification process for biodiesel production (B.K. Venkanna; *et al.*, 2009).
- 2. Base catalyst transesterification process:** In this process potassium hydroxide (KOH), Sodium Hydroxide (NaOH) and sodium methoxide are used as base catalyst. In this research work NaOH is used as base catalyst. the most efficient catalyst is Sodium methoxide but it is not economic. so, NaOH and KOH are more useful as base catalyst in biodiesel production. In this mechanism reaction between alcohol and oil in presence of base data list produce biodiesel (S. Prabhakar; *et al.*, 2011). reaction temperature 50°C - 60°C should be maintain in order to get biodiesel's highest yield. reaction temperature should be below of methanol boiling point, otherwise methanol is wasted due to vaporization. stirring process also carried throughout the process for dynamic mixing to increase the rate of reaction at 1300 rpm. At 1 hour it will take place to complete the reaction. by the transesterification reaction, biodiesel and glycerol produce. these both biodiesel and glycerol should be separated, by separating funnel for 12 to 24 hours. keep solution for a day, then two layer are appearing in separating funnel stock. upper is biodiesel and lower is glycerol (D. Subramaniam; *et al.*, 2013).
- 3. Glycerol Purification Method:** In the purification of glycerol obtained as a byproduct in the biodiesel process, the use of distillation under reduced pressure without fractionation. Results in the bottom material becoming discolored, indicating its degradation. This is associated with the passage of air and foaming during the distillation and induces

significant losses, which represent 86.3% of the raw material. thus, the purified glycerol is obtained in low yield with acceptable purity (95.0% on a dry basis). This distillation process is therefore not appropriate for certain industrial applications. for glycerol purification at 70 ml of 31.45% HCL into glycerol and set up 1 pH of glycerol. the separation of two-layer upper layer is fatty acid and lower layer is salt with glycerin. remove upper layer and take lower layer of salt and glycerin and set up pH 7 by adding base NaOH. the evaporate water at 110°C until solution reduced to about a 3rd of its volume and settle down solution, which have only salt and glycerol. Take upper layer of glycerin into another biker and decolorize glycerol by methanol, adding 4 time of its volume and add activated charcoal to filter glycerol. the first step in the purification of glycerol is the addition of an acid, usually Hydrochloric acid, to promote the separation of the waste catalyst from the insoluble salts and soaps in the glycerol, which precipitate during decantation, facilitating their removal. after acidulation and separation of the free fatty acids, the remaining alcohol must be removed by processes of evaporation, and there is a rapid increase in the concentration of glycerol during this step. Finally, this distilled glycerol is adsorbed onto activated carbon to remove the remaining impurities (Speight J.G. 2011).

4. **Stastical Analysis:** The obtained data were subjected to statistical data analysis procedures to check significance of collected data. collected data was subjected to specialized analysis like student t- test followed by t value > t critical determine particular hypothesis of t-test.

III. RESULT &DISCUSSION

1. Normal Transesterification of Groundnut Oil

Table 1: Data of normal transesterification of groundnut oil.

Oil	Methanol	NaOH	Biodiesel	Glycerol	Pure glycerol
100ml	20ml	1gm	83ml	27ml	1ml

From (Table 1) data, in this experiment the total volume of oil is taken 100 ml. The volume of methanol and NaOH is 20 ml and 1 gram respectively, for 100 ml oil. After end of reaction as a result, biodiesel production obtained 83 ml from 100 ml groundnut oil, and byproduct glycerol separate from reaction mixture is 27 ml. And when glycerol of first cycle, purified, it is obtained in amount 1 ml. From 100 ml groundnut oil. After experiment color change of oil to biodiesel is light orange to yellow and glycerol occurred in orangecolor.

2. Normal Transesterification of Sesame Oil

Table 2: Normal transesterification of sesame oil for biodiesel production.

Oil	Methanol	NaOH	Biodiesel	Glycerol	Pure glycerol
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100ml	20ml	1gm	61ml	32ml	1.3ml
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From (Table-2) the data, here total volume of oil is taken 100 ml. The volume of methanol and NaOH is 20 ml and 1 gram respectively, for 100 ml oil. After end of reaction as result biodiesel production obtained 61 ml. from 100 ml sesame oil, and byproduct glycerol separate from reaction mixture is 32 ml. And when glycerol of first cycle, purified it is obtained in amount 1.3 ml. From 100 ml sesame oil. After experiment color change of oil to diesel is orange to yellow and glycerol occurred in orange color.

3. Normal Transesterification of Cotton Oil

Table 3: Data of normal transesterification of cotton oil for biodiesel production.

Oil	Methanol	NaOH	Biodiesel	Glycerol	Pureglycerol
100ml	20ml	1gm	54ml	11.3ml	-

The experimental data (Table 3) obtain by the total volume of oil is taken 100 ml. The volume of methanol and NaOH is 20 ml and 1 gram respectively, for 100 ml oil. After end of reaction as result biodiesel production obtained 54 ml. from 100 ml cotton oil, and byproduct glycerol separate from reaction mixture is 11.3 ml. And when glycerol of first cycle, of cotton oil is not purified, because of turn in Solid state during heating. After experiment color change of oil to diesel is yellow to light yellow and glycerol occurred in off-white color.

4. Second Transesterification of Groundnutbiodiesel

Table 4: Data of second transesterification of groundnut oil for biodiesel production.

Biodiesel	Methanol	NaOH	Diesel	Glycerol	Pureglycerol
80ml	16ml	0.8gm	92ml	4ml	-

Here (Table 4) the total volume of bio-diesel is taken 80 ml. The volume of methanol and NaOH is 16 ml and 8.0 gram respectively, for 80 ml biodiesel. After end of reaction as result biodiesel production obtained 92 ml, because of addition of methanol and NaOH, production rate is increasing from primitive biodiesel amount. So this production is not pure as compare to first cycle. From 80 ml groundnut oil, and byproduct glycerol separate from reaction mixture is 4 ml and glycerol of second cycle, of groundnut oil is not purified, because of turn in Solid state during heating.

5. Second Transesterification of Sesame biodiesel

Table 5: Data of second transesterification of sesame biodiesel.

Biodiesel	Methanol	NaOH	Biodiesel	Glycerol	Pure glycerol
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60ml	12ml	0.6gm	69ml	2ml	-
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From the (Table 5) data, the total volume of biodiesel is taken 60 ml. The volume of methanol and NaOH is 12 ml and 0.6 gram respectively, for 60 ml biodiesel. After end of reaction as result biodiesel production obtained 69 ml, because of addition of methanol and NaOH production rate is increasing from primitive biodiesel amount. so this production is not pure as compare to first cycle. From 60 ml sesame biodiesel and byproduct glycerol separate from reaction mixture is 2 ml. and glycerol of second cycle, of sesame biodiesel is not purified, because of turn in Solid state during heating.

6. Second Transesterification of cotton Biodiesel

Table 6: shows second transesterification of sesame biodiesel.

Biodiesel	Methanol	NaOH	Biodiesel	Glycerol	Pure glycerol
27ml	5.4ml	0.27gm	27ml	5.72ml	-

Here (Table 6) total biodiesel volume is taken 27 ml. The volume of methanol and NaOH is 5.4ml and 0.27 gram respectively, from 27 ml biodiesel. After end of reaction as result biodiesel production obtained 27 ml, because of addition of methanol and NaOH production rate may remain constant from primitive biodiesel amount. So this production is not pure as compare to first cycle. From 27 ml cotton biodiesel and byproduct glycerol separate from reaction mixture is 5.72 ml. And when glycerol of second cycle, of cotton biodiesel is not purified, because of turn in Solid state during heating. here constant production is occurred 27 ml biodiesel gives 27 ml biodiesel. But change is biodiesel in semi solid state not in liquid state.

7. Third Transesterification of Groundnut biodiesel

Table 7: indicate data of third transesterification of groundnut biodiesel.

Biodiesel	Methanol	NaOH	Biodiesel	Glycerol	Pure glycerol
92ml	18.4ml	0.92gm	103ml	-	-

Here total biodiesel amount is taken 92 ml. The amount of methanol and NaOH is 18.4 ml and 0.92 gram respectively, for 92 ml biodiesel. After end of reaction as result biodiesel production obtained 103ml from 92 ml groundnut biodiesel because of addition of methanol and NaOH production rate is increasing from primitive biodiesel amount. So this production is not pure as compare to first cycle and byproduct glycerol is not separate from reaction mixture. So it can't be purified.

8. Third Transesterification of Sesame Biodiesel

Table 8: indicate data of third transesterification of sesame biodiesel.

Biodiesel	Methanol	NaOH	Biodiesel	Glycerol	Pure glycerol
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69ml	13ml	0.7gm	58.78ml	-	-
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Here (Table 8) total biodiesel volume is taken 69 ml. The amount of methanol and NaOH is 13 ml and 0.7 gram respectively, for 69 ml biodiesel. After end of reaction as result biodiesel production obtained 58.78 ml from 69 ml sesame biodiesel, this production rate is similar to first cycle because here production is decrease So this production is may be pure as compare to second cycle. And byproduct glycerol is not separate from reaction mixture, so it can't be purified also.

9. Third Transesterification of Cotton biodiesel

Table 9: indicate data of third transesterification of cotton biodiesel.

Biodiesel	Methanol	NaOH	Biodiesel	Glycerol	Pure glycerol
27ml	5.4ml	0.27gm	20.15ml	-	-

Here (Table 9) total biodiesel amount is taken 27 ml. The requirement of methanol and NaOH is 5.4 ml and 0.27 gram respectively, for 27 ml biodiesel. At end of reaction as result biodiesel production obtained 20.15 ml from 27ml sesame biodiesel, this production tare is similar to first cycle because here production is decrease so, this production is may be pure as compare to second cycle. And byproduct glycerol is not separate from reaction mixture, so it can't be purified also.

10. Transesterification of Groundnut Oil with Extramethanol

Table 10: indicates data of transesterification with extra methanol from groundnut oil

Oil	Need of Methanol	Extra Methanol	NaOH	Biodiesel	Glycerol
100ml	20ml	25ml	1 gm	81.33ml	7ml

In this (Table 10) modified method using extra methanol in reaction, and NaOH is not changed, it is used as per requirement. Here total groundnut oil amount is 100 ml. as a modification, instead of 20 ml methanol here utilized 25 ml methanol, it means 5 ml extra methanol is used and NaOH is 1 gram as per regular requirement. At end of reaction 100 ml oil gives 81.33 ml biodiesel production. And byproduct glycerol separate from reaction mixture is 7 ml. In modified method production rate is slightly decrease, compare to normal method. (here 83 ml to 81.33 ml)

11. Transesterification of Groundnut Oil with Extra NaOH

Table 11: indicates data of transesterification with extra NaOH from groundnut oil.

Oil	Need of NaOH	Extra NaOH	Methanol	Biodiesel	Glycerol
100ml	1 gram	1.4 gm	20 ml	80ml	16ml

In modified method (Table 11) using extra NaOH in reaction, and methanol is not changed, it is used as per requirement. Here total groundnut oil amount is 100 ml. as a modification, instead of 1 gram NaOH here utilized 1.4 gram NaOH, it means 0.4 gram extra NaOH is used and methanol is 20 ml as per regular requirement. At end of reaction 100 ml oil gives 80 ml biodiesel production. And byproduct glycerol separate from reaction mixture is 16ml. benefits of using modified method production rate is slightly decrease, compare to normal method (Here 83 ml to 80 ml).

12. Density difference between Oil and Biodiesel

Table 12: Density of oil and biodiesel

Density	Groundnut	Sesame	Cotton
Oil	0.860 g/cm ³	0.83 g/cm ³	0.878g/cm ³
Biodiesel	0.78 g/cm ³	0.831 g/cm ³	0.798g/cm ³

Groundnut oil density is 0.860 g/cm³ and when it converts into biodiesel it decreases at 0.78 g/cm³. Sesame oil density is 0.83 g/cm³ and when it converts into biodiesel, it remains constant from 0.831 g/cm³ to 0.831 g/cm³ and cotton oil density is 0.878 g/cm³, when it converts into biodiesel it decreases at 0.798 g/cm³ (Table 12). from three type of oil, groundnut and cotton oil change its density after converting into biodiesel. Sesame oil density is not changed after converting in to biodiesel. The density is an important biodiesel parameter with impact on fuel quality. The higher density and viscosity of biodiesel poses some acute problem when it is used in unmodified engine. Here density is decreases during converting oil to biodiesel so, it is beneficial for vehicle engines.

13. Melting point and Freezing Point of third Transesterification reaction

Table 13: shows data of third transesterification of all three type of biodiesel samples.

Types of biodiesel	Groundnut biodiesel	Sesame biodiesel	Cotton biodiesel
Melting point	37 – 40°C	40 – 54°C	50 – 54°C
Freezing point	15 °C	15 °C	15 °C

After 3rd cycle all samples are in solid state, hence that indicate its melting point and freezing point for (Table 13) their probable utilization. the melting point of groundnut biodiesel, sesame biodiesel and cotton biodiesel are 37 to 40 °C ,40 to 54 °C and 50 to 54°C respectively. their freezing points all are equal which is 15°C.the

conclusion is this biodiesel are useful during summer season only. during high temperature. Otherwise it can't be used during winter and monsoon because it is turning into solid and semi solid state so, it can damage vehicle engines. in present study different experiment of oil performed for biodiesel production. here all three type oil are taken in 100 ml amount and these gives different production ratio after experiment. here experiments are divided in two type first with converting oil to biodiesel in first cycle, then this product run in second cycle and at last second cycle product run in third cycle. second type experiment done by using extra methanol to improve and increase biodiesel production. it gives 1% less production compared to regular method. When using extra NaOH to get high production it is also give less production compared to normal method. for biodiesel production methanol and NaOH amount is essential and as per oil characteristics it gives different biodiesel production ratio in different quantity and quality. byproduct glycerol is separated after sedimentation of reaction mixture it's amount is also obtained in different ratio. when by product glycerol is purified, its volume is decreasing and in cycle 2 and 3 of all samples, it can't be purified due to solidifying by heating during purification.

When compare data of biodiesel production rate, in first cycle the groundnut will give high production from 100 ml to 83 ml, then second high biodiesel production of sesame oil, it gives 100 ml to 61 ml and lowest biodiesel production of cotton oil 100 ml to 54 ml. But glycerol is obtained high amount from sesame oil than from groundnut oil and lowest from cotton oil. in first cycle variation occur when converting oil to biodiesel, the amount of biodiesel is decreasing as compared to second and third cycle. in production of second cycle, the groundnut biodiesel and sesame biodiesel give high production from primitive by diesel, due to addition of methanol and NaOH. so, it is clear that this biodiesel is not pure as compared to first cycle because here production rate is continuous increasing. The cotton biodiesel production is remaining constant. So, it may be unaffected by methanol and NaOH but it is convert into semi solid state like groundnut biodiesel and sesame biodiesel. So it can't be use as fuel. in third cycle of groundnut biodiesel, the production is increase like second cycle, from 92 ml to 103 ml which is less pure as compared to first cycle. In third cycle of sesame and cotton biodiesel production rate is decreases like first cycle, 69 ml to 58.78 ml variation in sesame biodiesel. And 27ml to 20.15 ml variation occurred in cotton biodiesel. in modified experiment, data shows less production with extra methanol and NaOH as compared to normal experiment. when using extra methanol, it gives 2% less production compared to normal method and when using extra NaOH it gives 3% less production compared to normal method. At the end of modified method, it shows negative result, because of data showing less biodiesel production.

The difference between density of oil and biodiesel is about 6 to 7% in groundnut oil and groundnut biodiesel. For sesame biodiesel and oil no density difference occurred and density difference of cotton oil and cotton biodiesel is also about 6 -7% This parameter is very important for biodiesel. the higher density create problem when it is used in unmodified engine. Another parameter is melting point of groundnut biodiesel, sesame biodiesel and cotton biodiesel are 37 to 40 °C, 40 to 54 °C and 50 to 54°C respectively and for all the freezing points areequal which is 15°C. the production of groundnut biodiesel is 83% from row groundnut oil in present study and according to American Society for testing materials (ASTM) groundnut oil gives 86.8% biodiesel on a

volume basis and fatty acid profile of groundnut oil is 75.03% (Oniya O. O. & Bamgboye A. I.; 2014). Here difference between these two research is about 3% less production in present study and 3% more production of groundnut biodiesel is occurring according to ASTM. the production of sesame biodiesel is 61% achieved by transesterification in presence of sodium hydroxide and methanol. But according to Egyptian journal of Petroleum, the production rate of sesame biodiesel is 87.80% was achieved by transesterification in presence of sodium methoxide and methanol (Dawodu, F. A. *et al.*, 2014).

Here difference in biodiesel production ratio is may cause by utilization of different base catalyst, which are Sodium methoxide and sodium hydroxide. it means when use CH_3NaO it gives high production compared to NaOH catalyst. production of cotton biodiesel is achieved 54% at 60°C temperature for 60 minutes in present study but according to the open fuels and energy. science journal, the transesterification of cotton oil at 53°C temperature for 45 minutes it gives 97% biodiesel production of cotton oil (Fen X. *et al.*, 2011).



Figure 1:
Groundnut Biodiesel



Figure 2:
Sesame Biodiesel



Figure 3:
Cotton Biodiesel.

We can clearly observe that production ratio, colour and density difference of these three types of oils. The Groundnut oil (figure-1) gives highest amount of biodiesel yield then cotton and sesame oil. its colour changed from light orange to yellow, here oil density is 0.860 g/cm^3 which turn into 0.78 g/cm^3 . sesame oil (figure-2) gives least amount of biodiesel among three types of oil, its colour turned into yellow from light orange and its oil density is 0.83 g/cm^3 which remains same in after biodiesel conversion. cotton oil (figure-3) gives moderate amount of biodiesel yield amongst three types of oil, its colour turned into light yellow to yellow and oil density is 0.878 g/cm^3 which turn into 0.79 g/cm^3 .

14. Student T- Test

Table 14: Student T-Test Analysis

Sr. No.	Cycle Comparison	t value	t critical	Result
1.	Groundnut and sesame oil	4.10447	2.92	$t > t$ critical
2.	Groundnut and cotton oil	3.7179	2.92	$t > t$ critical
3.	Sesame and cotton oil	2.6172	2.92	$t < t$ critical

When data analysis by student t- test for all three cycles of oil samples (Table-14) to check comparative significant values from 3 cycles. The data of groundnut biodiesel are compared with sesame biodiesel, the t value is 4.1044 and the t critical value is 2.920 so, here t value $>$ t critical thus, null hypothesis is rejected and alternative hypothesis is accepted. here data of groundnut biodiesel are compared with cotton biodiesel, the t value is 3.717 and the t critical value is 2.920 so, here t value $>$ t critical thus, null hypothesis is rejected and alternative hypothesis is accepted. the data of sesame biodiesel are comparing with cotton biodiesel. The t value is 2.617 and t Critical value is 2.920, here $t <$ t critical here t -test prove that null hypothesis is accepted and alternative hypothesis is rejected.

IV. CONCLUSION

The conclusion of the present study after discuss result data of all oil cycles and modified method. It is concluding that after checking quality of biodiesel of first cycle of all oil samples if these all contain similar characteristics to fossil fuel so, it can be utilized as a fuel. here it's density and temperature are also normal like fossil fuel. thus burn like Petroleum so utilization of this biodiesel after it's HPLC. second and third cycle of biodiesel is in semi solid and solid state. it is not burn like fossil fuel and also damage engines. So, it is only utilized during summer season in high temperature and not burn in winter and monsoon at low temperature.

The modified transcrification method concluded that when changes amount of methanol or NaOH in the reaction, it affects directly to production rate it gives 2 to 3% less production compared to normal method. This is negative point for industrial biodiesel production, as a result it gives less production here modified method shows 2 to 3% negative result which cannot be neglect in diesel production. from three type of oil, groundnut and cotton oil change its density after converting into biodiesel. system oil density is not change after converting into biodiesel, so conclusion is that groundnut biodiesel and cotton biodiesel's quantity is 6 to 7% better than its oil form and now these oil have more characteristics of the biodiesel as compared to sesame biodiesel. Sesame oil and biodiesel both are remain same. so conclusion is, it has less characteristics of biodiesel.

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