A Review on Biodiesel Production from Jatropha Oil and Its Characterization Techniques

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Abstract:

Biodiesel, a promising substitute as an elective fuel has acquired huge consideration because of the anticipated brevity of regular powers and natural concern. The usage of fluid fills, for example, biodiesel created from Jatropha oil by transesterification process addresses one of the most encouraging choices for the utilization of traditional non-renewable energy sources. The Jatropha oil is changed over into jatropha oil methyl ester known as biodiesel arranged within the sight of homogeneous corrosive impetus. The actual properties, for example, thickness, streak point, Kinematic consistency, Cloud point and Spill point were found out for Jatropha oil and Jatropha methyl ester. Similar attributes study was additionally done for the diesel fuel for acquiring the pattern information for investigation. The qualities got from the Jatropha methyl ester is firmly coordinated with the upsides of regular diesel and can be utilized in the current diesel motor with practically no adjustment.

Key words: jatropha oil, transesterification, biodiesel

Introduction:

Biodiesel is an elective fuel produced using inexhaustible natural sources, for example, vegetable oils both (eatable and non-palatable oil) and creature fats. Vegetable oils are typically esters of glycol with various chain length and level of immersion. It could be seen that vegetable contains a significant measure of oxygen in their particles [1].

Essentially the high consistency of vegetable oils (30-200 Centistokes) when contrasted with that to Diesel (5.8-6.4 Centistokes) prompts negative siphoning, wasteful blending of fuel with air adds to fragmented burning, high blaze point brings about expanded carbon store development and substandard coking. Because of these issues, vegetable oil should be changed to bring the ignition related properties nearer to those of Diesel oil. The fuel alteration is essentially pointed toward diminishing the thickness and expanding the unpredictability [2].

One of the most encouraging cycles to change over vegetable oil into methyl ester is the transesterification, wherein liquor responds with fatty substances of unsaturated fats (vegetable oil) within the sight of impetus. Jatropha vegetable oil is one of the prime non eatable sources accessible in India. The vegetable oil utilized for biodiesel creation could contain free unsaturated fats which will improve saponification response as side response during the transesterification interaction [3].

All nations are at present intensely reliant upon petrol powers for transportation and rural hardware. The way that a couple of countries together produce the majority of petrol has prompted excessive cost change and vulnerabilities in supply for the consuming countries. This thus has driven them to search for elective energizes that they personally can deliver. Among the choices being considered are methanol, ethanol, biogas and vegetable oils [4].

Vegetable oils have specific highlights that make them alluring an alternative for Diesel fills Vegetable oil has the qualities viable with the CI motor frameworks. Vegetable oils are likewise miscible with diesel fuel in any extent and can be utilized as extenders. India exceptionally relies upon import of oil unrefined and almost two third of its necessity is met through imports. In addition, the gases discharged by petroleum, diesel driven vehicles unfavorably affect the climate and human wellbeing [5].

Source of jatropha Oil: The plant that is by and large developed to extricate jatropha oil is Jatropha curcas. The seeds are the essential source from which the oil is separated. Inferable from the poisonousness of jatropha seeds, they are not utilized by people. The significant objective of jatropha development, thusly, is performed for removing jatropha oil [6].

Analysis of jatropha curcus seed shows the following chemical compositions.
Moisture: 6.20%
Protein: 18.00%
Fat: 38.00%
Carbohydrates: 17.00%
Fiber: 15.50%
Ash: 5.30%

The oil content is 25-30% in the seed. The oil contains 21% soaked unsaturated fats and 79% unsaturated fats. These are a portion of the substance components in the seed, cursin, which is toxic and render the oil not proper for human utilization [7]. Oil has exceptionally high saponification esteem and being broadly utilized for making cleanser in certain nations. Likewise, oil is utilized as an illuminant in lights as it consumes without radiating smoke. It is additionally utilized as fuel instead of, or alongside lamp oil ovens. Jatropha curcus oil cake is wealthy in Nitrogen, Phosphorous and Potassium and can be utilized as natural excrement. By thermodynamic change process, pyrolysis, helpful items can be acquired from the jatropha oil cake. The fluid, strong (singe), and vaporous items can be gotten. The fluid can be utilized as fuel in heater and kettle. It very well may be moved up to higher grade fuel by transesterification process [8].

It is influential for bring up that, the non-consumable vegetable oil of jatropha curcus has the imperative potential giving a promising and industrially reasonable option in contrast to diesel oil since it has helpful actual substance and execution qualities equivalent to diesel. Vehicles could be run with jatropha curcus without requiring a lot of progress in plan. Jatropha oil removed from seeds and separated through channel press can supplant lamp oil or oil light. Jatropha oil can be utilized as fluid fuel for lighting and cooking. It will likewise be utilized in huge Diesel motor-based power producing sets, siphon sets, weighty homestead apparatus, where the consistency of oil isn't an issue [9,10].

The seeds of jatropha contain (half by weight) thick oil which can be utilized for production of candles and cleanser, in the restorative business, for cooking and lighting without help from anyone else or as a Diesel/paraffin substitute or extender. The last option use has significant ramifications for fulfilling the need for provincial energy administrations and furthermore investigating commonsense substitute for petroleum derivatives to counter ozone depleting substance amassing in the environment [11,12].

Jatropha curcus as an energy source: Oil from jatropha curcus: There are number of assortments of jatropha. Best among these are jatropha curcus. Jatropha oil is a significant item from the plant for meeting the cooking and lighting needs of the country populace, heater fuel for modern reason or as a suitable substitute for Diesel. Around 33% of the energy in the product of jatropha can be extricated as oil that has a comparative energy worth to Diesel fuel [13,14].

Jatropha oil can be utilized straightforwardly in Diesel motors added to Diesel fuel as an extender or trans esterified to a bio-diesel fuel. There are a few specialized issues to utilizing jatropha oil straightforwardly in Diesel motors that presently can't seem to be totally survived. Besides, the expense of delivering jatropha oil as a Diesel substitute is right now higher than the expense of Diesel itself [15].

Other products of Jatropha curcus: The jatropha oil can be utilized for cleanser creation and beauty care products creation in country regions. The oil is serious areas of strength for a, broadly utilized as a germicide for hack, skin sicknesses and as a pain killer from stiffness. Jatropha oil has been utilized economically as an unrefined substance for cleanser fabricate for a really long time, both by enormous and little modern makers. At the point when jatropha seeds are squashed, the subsequent jatropha oil can be handled to deliver an excellent biodiesel that can be utilized in a standard diesel vehicle, while the buildup (press cake) can likewise be handled and utilized as biomass feedstock to drive power plants or utilized as manure (it contains nitrogen, phosphorous and potassium) [16].

Use as jet fuel: Flying powers might be all the more generally subbed with biofuels, for example, jatropha oil than energizes for different types of transportation. On December 30, 2008, Air New Zealand fled effective practice run with a Boeing 747 running one of its four Rolls-Royce motors on a 50:50 mix of jatropha oil and fly A-1 fuel. In this manner, Air New Zealand and Houston based Mainland Carriers have run tests in Jan. 2009, further showing the practicality of jatropha oil as a stream fuel [17].

Variations in the Yield of Jatropha Oil: It is in many cases looked at that as a more successful extraction method would yield more noteworthy amounts of oil. This is incompletely mistaken, since a compelling extraction technique would just yield the ideal amount and not more than that. The ideal oil content in jatropha plants changes among species and hereditary variations. Climatic and soil conditions by and large influence the yield of the oil also. Nonetheless, ill-advised handling procedures, for example, delayed openness of the gathered seeds to coordinate daylight can hinder the oil yield impressively. The greatest oil content that has been accounted for in jatropha seeds has been near 47%. Nonetheless, the acknowledged normal is 40%, and the portion that can be extricated is taken to be around 91% [18].

Methods and Devices for Jatropha Oil Extraction

Some of the methods that are usually employed for the extraction of jatropha oil are as follows.

Oil Presses: Oil presses have been utilized with the end goal of oil extraction as basic mechanical gadgets - either controlled or physically determined. Among the different oil squeezes that are utilized for jatropha oil extraction, the most normally utilized presses incorporate the Bielenberg slam press. The Bielenberg slam press includes the conventional press technique to remove oil and gets ready oil cakes as well as cleansers. A basic gadget yields around 3 liters of oil for each 12 kg of seed input. Since the acknowledgment of jatropha as an elective energy source (specifically, biofuel), jatropha oil extraction techniques have additionally acquired due significance on the lookout. Since jatropha oil is the essential fixing expected in the creation of biofuels, the advancement of oil extraction strategies and the streamlining of existing techniques for removing the oil have become huge [19].

Oil Expellers: Various types of oil expellers are utilized with the end goal of jatropha oil extraction. The most regularly utilized ones are the Sayari oil expeller (likewise called the Sundhara oil expeller) and the Komet Expeller. The Sayari expeller is a diesel-worked oil extraction gadget that was initially evolved in Nepal. It is currently being created for use in Tanzania and Zimbabwe with the end goal of jatropha oil extraction and oil cake planning. The model included weighty parts made of solid metal. The lighter form has the solid metal supplanted with iron sheets. A model driven by power is likewise accessible. The Komet expeller is a solitary screw oil expeller that is frequently utilized for separating jatropha oil from the seeds and furthermore for the readiness of oil cakes. Conventional Strategies: Customary techniques by which the oil is removed from the seeds by hand utilizing basic carries out are as yet drilled in provincial and less created regions [20].

Modern Concepts: Strategies like ultrasonication have been found to be powerful in expanding the level of jatropha oil that can be removed utilizing substance techniques like fluid enzymatic treatment. The ideal yield for such strategies has been found to be around 74%. Jatropha oil extraction techniques are as yet being investigated. The objective of such explores is to find strategies to remove a more prominent level of jatropha oil from the seeds than the ongoing methodology permit.

Oil Extraction:
Oil Extraction may be done:
Mechanically (by pressing the kernels)
Chemically; and
Enzymatically

Production Process
Transesterification: Is the course of synthetically responding a fat or oil with a liquor in a presence of an impetus. Liquor utilized is normally methanol or ethanol Impetus is generally sodium hydroxide or potassium hydroxide. The primary result of transesterification is biodiesel and the co-item is glycerin.

Separation: After transesterification, the biodiesel phase is separated from the glycerin phase; both undergo purification. The chemical properties of jatropha oil are given below.

Item	Value
Acid Value	38.2
Saponification value	195.0
Iodine Value	101.7
Viscosity (at 31°C), Centistokes	40.4
Density (g/cm^3)	0.92

Fatty acid composition

Palmitic acid (%)	4.2
Stearic acid (%)	6.9
Oleic acid (%)	43.1
Linoleic acid (%)	34.3
Other acids (%)	1.4

Jatropha curcas seed

Jatropha curcas plant

Experimental Procedure

Balance: The vegetable oil contains around 14-19.5 % free unsaturated fats in nature, it should be liberated before taken into genuine transformation process. The presence of around 14% of free unsaturated fat makes Jatropha oil unseemly for modern biodiesel creation.

The got dried out oil is unsettled with 4 % HCl answer for 25 minutes and 0.82 gram of NaOH was added per 100 ml of oil to kill the free unsaturated fats and to coagulate by the accompanying response.

$$RCOOH + NaOH \rightarrow RCOONa + H_2O$$

The coagulated free unsaturated fat (cleanser) is taken out by filtration. This interaction carries the free unsaturated fat substance to under 2 % and is ideal hotspot for biodiesel creation. Biodiesel creation: In this review, the base catalyzed transesterification is chosen as the cycle to make biodiesel from Jatropha oil. Transesterification-particle response is completed in a group reactor. For transesterification process 500 ml of Jatropha oil is warmed up to 70°C in a round base cup to drive off dampness and mixed vivaciously. Methanol of 99.5 % immaculateness having density0.791 g/cm^3 is utilized. 2.5 gram of impetus NaOH is broken down in Methanol in bi molar proportion, in a different vessel and was filled round base cup while blending the combination ceaselessly. The blend was kept up with at climatic strain and 60°C for an hour.

After consummation of transesterification process, the blend is permitted to settle under gravity for 24 hours in an isolating channel. The items shaped during transesterification were Jatropha oil methyl ester and Glycerin. The base layer comprises of Glycerin, abundance liquor, impetus, pollutants and hints of unreacted oil. The upper layer comprises of biodiesel, liquor and some cleanser. The vanishing of water and liquor gives 80-88 %pure glycerin, which can be sold as rough glycerin is refined by basic refining. Jatropha methyl ester (biodiesel) is blended, washed with hot refined water to eliminate the unreacted liquor; oil and impetus and permitted to settle under gravity for 25 hours. The isolated biodiesel is taken for portrayal.

Biodiesel Characterization

The particular gravity lessens after transesterification, thickness from 57 to 4.73 centistokes, which is satisfactory according to ASTM standards for Biodiesel. Streak point and fire point are significant temperatures determined for wellbeing during transport, stockpiling and taking care of. The glimmer point and fire point of biodiesel was viewed as 128°C and 136°C individually. Streak point of Jatropha oil diminishes after transesterification, which shows that its unpredictable attributes had improved and it is likewise protected to deal with. Higher thickness implies more mass of fuel per unit volume for vegetable contrasted with diesel oil. The higher mass of fuel would give higher energy accessible for work yield per unit volume. Higher consistency is a significant issue in involving vegetable oil as fuel for diesel motors. Cloud and pour point are measure utilized for low temperature execution of fuel. The cloud point for Diesel is 4C which is extremely low and the fuel performs sufficiently even in chilly climatic circumstances.

The higher cloud point can influence the motor presentation and discharge unfavourably under chilly climatic circumstances. The pour point for Diesel is - 4C. As a general rule, higher pour point frequently restricts their utilization as fills for Diesel motors in chilly climatic circumstances. At the point when the encompassing temperature is beneath the pour point of the oil, wax accelerates in the vegetable oils and they lose their stream qualities, wax can impede the channels and fuel supply line. Under these circumstances fuel can't be siphoned through the injector. In India, encompassing temperatures can go down to 0C in winters. Fills with streak point above 66C are considered as protected fuel.

Table-1: The properties, Diesel, Jatropha oil and biodiesel

Property	Diesel	Jatropha oil	Biodiesel
Flash point °C	65	214	128
Fire point °C	78	256	136
Pour point °C	-6	6	-2
Cloud point °C	5	11	8
Viscosity at 40°C	2.86	36.92	4.82
Viscosity index	98	181	154
Specific gravity (29°C)	0.792	0.944	0.84
Refractive index at 40°C	1.32	1.61	1.46
Calorific value (MJ/kg)	44.34	39.76	42.80

Conclusion

In the ongoing examination, it has affirmed that Jatropha oil might be utilized as asset to get biodiesel. The exploratory outcome shows that basic catalyzed transesterification is a promising area of examination for the development of biodiesel in enormous scope.

Impacts of various boundaries, for example, temperature, time, reactant proportion and impetus focus on the biodiesel yield were investigated. The best mix of the boundaries was found as 6:1 molar proportion of Methanol to oil, 0.92% NaOH impetus, 60C response temperature and an hour of response time The thickness of Jatropha oil decreases considerably after transesterification and is practically identical to diesel. Biodiesel attributes like thickness, consistency, streak point, cloud point and pour point are similar to diesel.

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