Review on Biodiesel Production and Emission Characteristic of Non-Edible Vegetable Oil

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Abstract
Bio-diesel has become more popular in recent times as of its low after emissions and due to its extraction from renewable resources. Transesterification process is used to extract the bio-diesel from oil either by edible oil or by non-edible oil. The use of biodiesel has created a constructive effect in solving issues of decrement in petroleum stocks. Biodiesel can be extracted with the use of edible & non-edible vegetable oils. However, use of edible oils can threaten the food storage, so non-edible oil, which is also acknowledged as second-generation feedstock, can be used as another option in extraction of biodiesel from oil. This paper has explained in detailed some of the categories of non-edible vegetables oils have higher quality of biodiesel. In this review, an endeavor has done on bio-diesel production of various non-edible oil and its influence on internal combustion engines performance and emissions characteristics.

1. Introduction
Various researchers in the world were struggle to make an ecological welcoming conditions, effectiveness as well as reliability of energy consumption to an area of automotive sector. Efficient and effective lubrication for safe automobile vehicle functions are necessary which reduced frictional losses and wear, generally in internal combustion engines and drive trains.

The figure 1 shows the year wise world total energy consumption from 1987 to 2012 and it was estimated that total consumption in 2012 was increased nearly by 70% as compared to 1987 consumption [1]. The crude oil storage are diminishing rapidly, worldwide the total consumption of crude oil is 11 billion tons per year. Such a huge rate of consumption can drain out the crude oil storage by 2052 [2].

In automotive area, minerals oils are used as lubricants form a long period. However, this will be used in by the convenience of crude oil properties because it is a distillation outlet of crude oils. In addition, the traces of metal emission such as magnesium, zinc, calcium, iron etc. because of minerals oils combustion lubricants guide in situation for ecological humiliation [3].
To solve the environmental problems, bio-determine lubricant is consider today's appropriate alternate fossils-determine lubricant. Assets of the bio-driven lubricant as a different lubricant was also shows a higher value generally with regard to renewability and capability to decaying without damage[4]. Bio lubricants creation is feasible because it consists resources in various forms. A lot of researchers have gone through different works that is connected with uneatable plants oils function as an IC engines fuel nevertheless purely a few testing the employment of uneatable plants determine lubricant in self-propelled vehicle applications.

The important objective of recent study is to give the information to scholars, legislators, manufacturer specialized those associated with scope of bio-determine lubricant and biodiesel. It shows systematic evaluation outcome of employ uneatable plants determine bio-lubricant in consign of lubricant in self-propelled vehicles area. The study comprises the different production methods of the nonedible oils and their engine performance. In this review, it was comprise of the especially regarded publication and study works of literature, which are lately publicized.

2. Non Edible Oil

Bankovic et al. [3] have investigated the properties and various possible methods of production of biodiesel and found that jatropha, karanja and castor oil have huge potential of producing biodiesel suitable for diesel engines. The Use of Non edible oils is more beneficial over edible oils for using in IC engines because it can solve the issue of food versus fuel concern [4]. Standard ASTM values for feasible quantities in diesel and biodiesel has been
shown in table 2. Use of Mahua biodiesel produced lower thermal efficiency[5] and it also increases the BSFC with increment in blend ratio[6]. Different characteristics and data of produced biodiesel from non-edible oil are tabulated and shown in table 1.

2.1 Mahua (Madhuca Indica)

Indian Farming climate suits the cultivation of Mahua seeds. It is a non-consumable oil which has yearly production of almost 181 kg. The yield of oil from the seeds are up to 30-40% in India. [7, 8]. In India, many states like Madhya Pradesh, Orissa Chhattisgarh, and Bihar are growing Mahua plant. Wasteland and dry land can be well suited for Mahua production. Proper land and require climate can produce around 200 kg of seed production in a year from a single tree. As an estate tree, Mahua is a vital plant having fundamental financial esteem. This kind of plants can be planted at channel banks and so forth on business scale and in social ranger service programs, especially in innate regions. Mahua belongs to Sapotaceae Family, the forest based Mahua produced predominantly in Asia at large scale [9, 10].

2.2 Jatropha (Jatropha Curcas)

Jatropha is small height tree, which can grow up 7 m of maximum height and possess same family Euphorbiaceae like rubber seed. It mainly composed of unsaturated species[11, 12].

Jatropha curcas can be produced in a dry weather, developing incredibly in waste soil. This plant produces seeds with a combustible oil composition of 37%. It consumes with clear without smoke fire, tried effectively as fuel for basic diesel motor. It is used as a medicine for the treatments of cancer, snakebite & piles. It becomes on all around depleted soils with great air circulation and is very much adjusted to minor soils with low supplement content. Jatropha curcas can cultivate in most of soils like gravelly, saline soils and in sandy land. It can thrive with the least fortunate stony soil [27].

2.3 Karanja (Pongamia Pinnata)

Karanja is discovered almost all through India. The plant is furthermore said to be exceedingly forbearing to saltiness and could be grownup in various soil surfaces viz. dry, sandy and clayey. Karanja can grow damp and subtropical conditions with yearly precipitation going somewhere in the scope of 500 to 2500 mm. The current yield of the oil from the seeds is around 200 million tons/year. Four to seven years requires for the complete growth of this tree and after it produce 8 to 24 kg per tree per year. The oil content obtained by numerous oil producers deviates from 30 to 35% [13]. Karanja oil is mainly composed of oleic acid around 45-70%, linoleic around 11-19% and stearic acid about 5% [14].

2.4 Ricinus communis (Castor)

Family of this plant is Euphorbiaceae. It is mainly grown in African continent yet it can be find in various regions of different nations [22]. Castor is a tree, which can grow up to 6m of height. The relative favorable position of Castor is its complete growth time is much smaller than that of Jatropha and Pongamia [23]. Castor is a perfect contender for generation of high
esteem, mechanical oil feed stocks has around 45%–65% of oil percentage, and to a great degree elevated amounts of prospective oil creation (500–1000) of oil/section of land. Subsequently, Castor oil is more oxygenated than different oils and, in this way, Castor oil is dissolvable in alcohols amid the transesterification responses.

2.5 Hevea brasiliensis (Rubber)

Rubber seed non vegetable oil belongs to Euphorbiaceae family, which grows in all Asian countries like Malaysia, India, and Indonesia. It can grow up to 34 m of maximum height [15]. It is an elastictree that grow in short span of time and have its place to Euphorbiaceae family. It is the real wellspring of normal elastic and is currently broadly developed in tropics over the world [24]. It can grow maximum height of 34 m in stature, the plant needs substantial precipitation and harvests seeds weighted in the range of 2-4 gm which has very less applications in current scenario [25]. India is producing 150 kg of rubber per hectare which is little lower than the typical seed production average range from 70-500 kg / hectare every year [26].

Table 1: Dat of Biodiesel produced from non-edible oil seeds

| Non-edible Oil | Sulfur Content | Viscosity at40°C | Density at15°C | Pour point (°C) | Cloud point(°C) | Flash point(°C) | Cetane no. | Iodine no. | Acid value(m g/g) |
|----------------|----------------|------------------|----------------|-----------------|-----------------|-----------------|------------|------------|------------------|
| Mahua          | -              | 4.77             | 0.895          | 4.33            | 4.33            | 4.33            | 55         | 74.2       | 0.41             |
| Rubber         | -              | 5.6              | 0.875          | -7              | 3.1             | 173.4           | 53         | 144        | 0.12             |
| Jatropha       | 0.008          | 4.52             | 0.8655         | 6               | 5.66            | 175.5           | 55.43      | 95.75      | 0.24             |
| Karanja        | 0.003%         | 4.79             | 0.899          | 6.4             | 13.3            | 157.4           | 56.55      | 89         | -                |
| Castor         | 1.3%           | 17.14            | 0.922          | -20             | -11.16          | 178.5           | 37.55      | 85.53      | 0.148            |

Table 2: ASTM Standard table for maximum quantities in diesel and biodiesel(non-edible)

| PROPERTY           | DIESEL   | BIODIESEL | UNIT             |
|--------------------|----------|-----------|------------------|
| STANDARD TEST      | ASTM D975| ASTM D6751|                  |
| IODINE NUMBER      | 2.0-4.5  | 1.9-6.0   | (g12/100g)       |
| CARBON             | 87       | 77        | (Wt. %)          |
| SPECIFIC GRAVITY   | 0.85     | 0.88      | (g/ml)           |
| OXYGEN             | 0        | 11        | (Wt. %)          |
| POUR POINT         | -33 to -14 | -15 to -16 | (°C)            |
| WATER              | 0.05     | 0.05      | (Vol %)          |
| CETANE NUMBER      | 48       | 52-60     |                  |
| HYDROGEN           | 13       | 12        | (Wt. %)          |
| CLOUD POINT        | -14 to 5 | -3 to -11 | (°C)             |
| SULFUR             | 0.05     | 0.05      | (Wt. %)          |
| FLASH POINT        | 65 to 80 | 100 to 160| (°C)             |
3. Biodiesel Extraction

3.1 Transesterification from non-consumable oils

Transesterification process is the used in production of bio-diesel. In Transesterification process triglyceride reacts with an alcohol with catalyst having its role in the formation glycerol and esters. Table 3 shows the catalytic transesterification data of some selected non-consumable oils.

| Catalyst | Non-edible oil | Reaction time (h) | Temperature (K) | Catalyst (wt. %) | Yield (%) |
|----------|----------------|-------------------|-----------------|------------------|-----------|
| NaOH     | Jatropha       | 1                 | 338             | 1                | 97.6      |
| KOH      | Karanja        | 3                 | 333             | 1                | 97        |
| CH3ONa   | Mahua          | 1                 | 338             | 8                | 95        |
| KOH      | Rubber         | 2                 | 333             | 3.5              | 74.5      |
| KOH      | Castor         | 333               | 1.5             | 80               |           |

3.2 Catalytic transesterification methods

The following flow chart shows the various stage of bio-diesel production during the whole transesterification method. Flow chart shows growing of seed to the processing of oil. Figure 2 shows the conversion of non-edible plant seed growing to biodiesel production and Fig 3 shows the process flow diagram of processing of oil by catalytic transesterification method.

Fig 2: Process flow representation of conversion of non-consumable seeds to biodiesel production
4. Effect of non-edible oils on performance of engine and emission.

4.1 Mahua oil

Saravan et.al performed an experiment on a four stroke naturally aspirated DI, diesel engine utilizing methyl ester extracted from Mahua oil and diesel blend as fuel. The principle findings of the investigation demonstrated the better utilization of Mahua oil as compared to diesel at all the engine loads conditions. It inferred that Mahua could be advanced as another replacement for diesel or as a blend stocks with diesel [28-29].

4.2 Rubber oil

Researcher assessed the various engine characteristics of CI engine with application of rubber seed oil [30]. They reported that, low percentage of biodiesel and diesel blends enhance the brake engine efficiency. Pradeep and Sharma [31] executed an experiment on CI engine and found that brake thermal efficiencies were gone down for higher percentage of biodiesel with diesel and ignition delay was increased and due to which heat discharge rates were lower down for biodiesel bio-diesel blend. Ramadhas et al.[16] used rubber seed biodiesel in CI engine and observed that BSFC was increased at higher load with increment in brake thermal efficiency by 2.33 % at higher load conditions.

4.3 Karanja oil

Many researchers found that the use of Karanja oil increase the brake thermal efficiency of an engine at full load condition [17]. BSFC was increased with increase in biodiesel percentage in the blend of biodiesel and diesel. BSFC can be decreased by sending pre-heated biodiesel to engine [18]. Researchers also found that at high engine rpm and low biodiesel percentage in a blend can produce higher engine power [19]. Done execution and emanation tests utilizing diesel fuel and biodiesel mixes got from Karanja oil and smoke thickness were low [32].
4.4 Jatropha

Higher thermal efficiency was obtained with higher fuel consumption by the use of Jatropha biodiesel in CI engine[20]. Higher percentage of jatropha biodiesel produced higher engine power in some of the cases[18, 21]. Additionally researched the impact of preheating Jatropha oil on motor execution and outflows. The use of jatropha oil in the conventional diesel engine has proved to be better replacement as compare to diesel engine. At elevated temperature the viscosity of the oil decreases which affects the engine performance [33].

5. Conclusion

The physical and concoction characteristics of a biodiesel are resolved with its concoction organization. Due to its impressive O₂ content (regularly about 11%), biodiesel has bring down carbon and hydrogen substance contrasted with oil diesel. This outcomes in a decrease in mass vitality substance of about 10%, yet a decrease in volumetric vitality of just 5–7%. The two most normal arrangements of administrative principles for biodiesel blend with diesel are ASTM D6751 in the U.S. also, EN 14214 in Europe. A portion of the particulars containing these principles are specifically identified with the substance creation of the FAME – for example cetane number, cloud point, refining, esteem. Edible plant oil energizes by and by don't contend financially with oil based powers since they are more costly yet because of the ongoing increment in oil costs and vulnerabilities concerning oil accessibility, there is recharged the enthusiasm for non-consumable plant oil fills for CI engines. The Non-consumable plants can be a better replacement of diesel to the new generation compression ignition engine with enhancement in emission with a little compromise in break thermal efficiency of an engine.

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