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FUEL PROPERTIES OF BIODIESEL FROM TRANSESTERIFICATION OF *JATROPHA CURCAS* L OIL USING GC-MS

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ABSTRACT

Biodiesel has become more attractive recently, because of its environmental benefits and the fact that it is made from renewable resources. The development of *Jatropha curcas* as possible energy crop, the description of the plant, specification of oil, and expected yield of oil production is outlined. Methyl and ethyl esters of vegetable oils have several outstanding advantages among other new renewable and clean engine fuel alternatives. A technical process for the production of methyl esters from the seed oil is described. Methyl esters were analysed and the fuel properties of ester fuels were determined by GC-MS for biodiesel.

INTRODUCTION

Biodiesel, which is made from renewable sources, consists of the simple alkyl esters of fatty acids. As a future prospective fuel, biodiesel has to compete economically with petroleum diesel fuels. One way of reducing the biodiesel production costs is to use the less expensive feedstock containing fatty acids such as inedible oils, animal fats, waste food oil and byproducts of the refining vegetables oils Biodiesel as an alternative fuel for diesel engines is becoming increasingly important due to diminishing petroleum reserves and environmental consequences of exhaust gases from petroleum-fuelled engines (1).

Biodiesel is natural,renewable resource.Biodiesel is a cleaner-burning diesel replacement fuel made from natural, renewable sources such as new, used vegetable oils and animal fats. Just like petroleum diesel, biodiesel operates in compression-ignition engines or Diesel engines. Biodiesel has physical properties very similar to conventional diesel. (2)

Biodiesel is mono-alkyl esters of fatty acids derived from vegetable oils or animal fats, is known as a clean and renewable fuel. Biodiesel is usually produced by the transesterification of vegetable oils or animal fats with methanol or ethanol (3). Biodiesel has many advantages include the following: its renewable, safe for use in all conventional diesel engines, offers the same performance and engine durability as petroleum diesel fuel, non-flammable and nontoxic, reduces tailpipe emissions, visible smoke and noxious fumes and odors. The use of biodiesel has grown dramatically during the last few years. Feedstock costs account for a large percent of the direct biodiesel production costs, including capital cost and return (4).

Features of *Jatropha curcas* plant:

Jatropha curcas is a species of flowering plant in the spurge family, Euphorbiaceae, *J. curcas* is a poisonous, semi-evergreen shrub or small tree, reaching a height of 6 m (20 ft). It is resistant to a high degree of aridity, allowing it to be grown in deserts. The seeds contain 27-40% oil that can be processed to produce a high-quality biodiesel fuel, usable in a standard diesel engine. (5) The Centre for Jatropha Promotion & Biodiesel (CJP) is a bioenergy crop research and development company that is meeting global demand for sustainable plant oil by working towards scientific commercialization of dedicated biodiesel crop that will lend credibility; reliability and scalability.

MATERIALS AND METHODS

The *Jatropha curcas* seeds were collected from in and around Tiruchirappalli district Tamilnadu. The seeds were dried and collect the oil from the seed. The oil was transesterified and analysed by Gas Chromatography and mass spectrum (GC-MS) in Indian Institute of Crop Processing Technology Thanjavur, Tamilnadu.

Transesterification of the oil generally using the following steps:

The specified amount of 450ml methanol and 10 gram Sodium Hydroxide was mixed in a round bottom flask. The alcohol/catalyst mix is then charged into a closed reaction vessel and 1000ml Jatropha oil is added. Excess alcohol is normally used to ensure total conversion of the fat or oil to its esters. Once the reaction is complete, two major products exist: glycerin and biodiesel. The quantity of produced glycerin varies according the oil used, the process used, the amount of excess alcohol used. Both the glycerin and biodiesel products have a substantial amount of the excess alcohol that was used in the reaction. The reacted mixture is sometimes neutralized at this step if needed. The glycerin by-product contains unused catalyst and soaps that are neutralized with an acid and sent to storage as crude glycerin. In some cases the salt formed during this phase is recovered for use as fertilizer. In most cases the salt is left in the glycerin. The most important aspects of biodiesel production to ensure trouble free operation in diesel engines are complete reaction, removal of glycerin, removal of catalyst, removal of alcohol and absence of free fatty acids.

GC-MS (Gas Chromatography and Mass Spectrum):

The given biodiesel sample was analysed in GC-MS for different components present in the extract.Column:Elite-5MS(5%Diphenyl/95% Dimethyl poly siloxane),30x0.25mm x 0.25µm df Equipment: GC Clarus 500 Perkin Elmer Carrier gas: 1ml per min, Split: 10:1 Detector: Mass detector Turbo mass gold-Perkin Elmer Software: Turbomass 5.2 Sample injected: 2µl Oven temperature Programme-110°C-2 min hold Up to 200° C at the rate of 10 ° C/min-No hold Up to 280 ° C at the rate of 5° C / min-9 min hold Injector temperature 250° C Total GC running time 36 min Library used NIST Version-Year 2005 Inlet line temperature 200°C Source temperature 200°C Electron energy: 70 eV Mass scan (m/z): 45-450 Solvent Delay: 0-2 min Total MS running time: 36 mi.

RESULT

The properties of diesel, methyl ester of *Jatropha curcas* oil are given in table-1

Table-1

S.No	Properties	Diesel	Methyl ester of *Jatropha curcas* oil
1	Color	Golden Yellow	Golden Yellow
2	Density (Kgm^3)	842	878
3	Calorific value (MJ/Kg)	42.49	38.45
4	Viscosity (cst)	3.8	4.4
5	Carbon residue (%)	0.1	0.5
6	Sulphur (%)	0.25	0.00

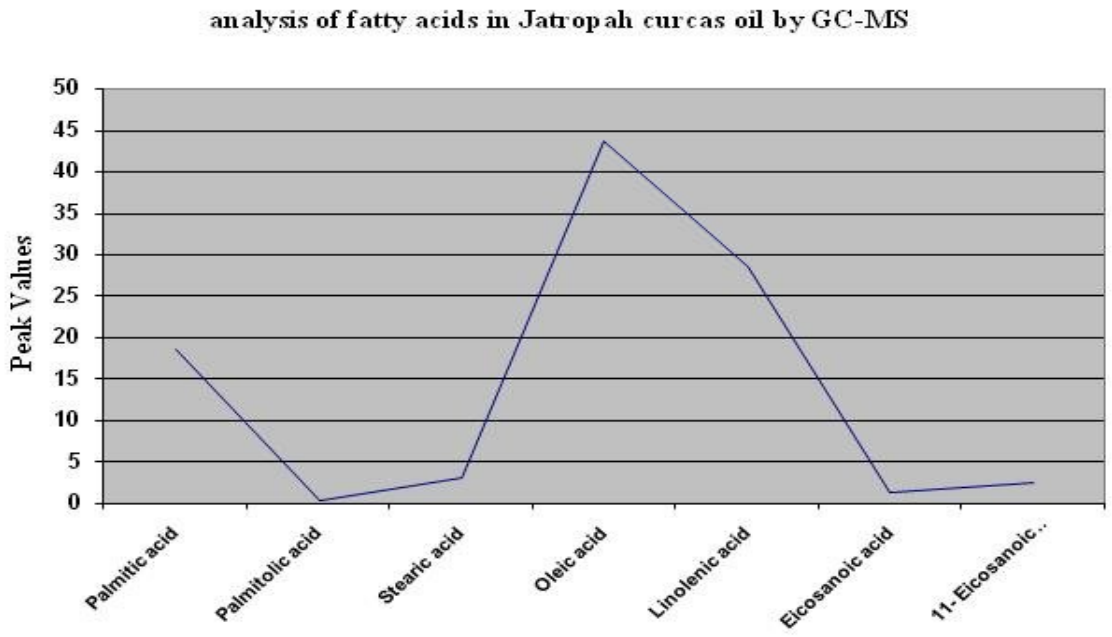
The investigation properties Colour, density, calorific value, carbon residue and sulphur content are presented on table -1. As stated earlier the high viscosity of plant oil represents one of the main constraints to their use as fuel for engine. The given *Jatropha curcas* oil analysed by GC-MS and the results were shown in the table -2. The different energy produces fatty acids with their molecular weight and its corresponding peak value.

Table-2

S. No	Name of the compound	Molecular Formula	Molecular Weight	Peak Area %
1.	Hexa deconic acid methyl ester (Palmitic acid)	$C_{17}H_{34}O_2$	270	18.64
2.	9-Hexa deconic acid methyl ester (Z) (Palmitolic acid)	$C_{17}H_{32}O_2$	268	0.31
3.	Octa deconic acid methyl ester (Stearic acid)	$C_{19}H_{38}O_2$	298	3.01
4.	9- Octa deconic acid methyl ester (E) – (Oleic acid)	$C_{19}H_{36}O_2$	296	43.72
5.	9, 12- Octa deconic acid (Z, Z) methyl ester (Linolenic acid)	$C_{19}H_{34}O_2$	294	28.55
6.	Eicosanoic acid, methyl ester	$C_{21}H_{42}O_2$	326	1.24
7.	11- Eicosanoic acid, methyl ester	$C_{21}H_{40}O_2$	324	2.54

The analysis of the fatty acids of the seed oil shows that the Oleic acid and Linolenic acid is the main. It is followed by the C19 molecules with more than 40% Stearic acid represents an important part of the fatty acids as present in the figure -1.

Figure-1



DISCUSSIONS

Biodiesel is an efficient, clean, 100% natural energy alternative to petroleum fuels. Among the many advantages of biodiesel fuel include the following: safe for use in all conventional diesel engines, offers the same performance and engine durability as petroleum diesel fuel, non-flammable and non-toxic, reduces tailpipe emissions, visible smoke and noxious fumes and odors (6). Biodiesel is better than diesel fuel in terms of sulfur content, flash point, aromatic content and biodegradability (7). The methyl esters of *Jatropha curcas* oil their fatty acid composition analysed by GC-MS. In our study various fatty acid were obtained, from the peaks conclude saturated and unsaturated fatty acids Linolenic acid, Palmitic acid and oleic acid peak values are high.

CONCLUSION

For developing countries *Jatropha curcas* L seems to be a very promising energy plant, because the presence of high ignites value of fatty acids present in the seeds. The plant can be grown on very poor soils and gives a high average yield of seeds. The production of methyl ester from the oil via transesterification has been demonstration. Biodiesel, derived from vegetable oil or animal fats, is recommended for use as a substitute for petroleum-based diesel mainly because biodiesel is a renewable, domestic resource with an environmentally friendly emission profile and is readily biodegradable.

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