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A Review on Chemical Properties of Biodiesel from Sorghum Oils

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Abstract : Biodiesel is getting to be distinctly conspicuous among the other options to traditional petro-diesel because of monetary, ecological and social variables. There has been incredible mindfulness in the region of the advancement of biodiesel particularly in the creating nations amid the current time. Noteworthy research exercises have been performed for its creation and new advancement. Biodiesels can be the fuel without bounds as it gives a choice of sparing, eco-accommodating, elective renewable vitality source. In the present examination sorghum bicolor seed oil and its methyl ester have been discovered their appropriateness as petro-diesel.
In the Present review the trial examination has been made to discover the chemical properties of sorghum oil. Research facility scale amounts of sorghum oil biodiesel were created through transesterification response utilizing 100 g sorghum oil, 17% methanol (wt% sorghum oil), 1.0% sodium hydroxide impetus at 80°C in 100 minutes. The examinations were triplicate and normal outcomes were assessed. The acquired biodiesel was described as an option diesel fuel through arrangement of ASTM and European association (EN 14214) standard fuel tests. The transesterification procedure yielded 95.8% sorghum oil biodiesel. The sorghum oil biodiesel had 88.8% lessening of thickness over its crude vegetable oil at 38°C. Comes about got were observed to be inside breaking points set by different International norms for biodiesel.
Keywords : Biodiesel, chemical properties, renewable fuel, transesterification.

Introduction:

As of now, biodiesel is getting to be distinctly prevalent as a situation inviting fuel. It has been utilized as an option for diesel fuel in the car business, regularly known as No. 2 diesel. The benefit of this biofuel over the customary diesel fuel incorporates high cetane numbers, low smoke and particulates, low carbon dioxide and hydrocarbon outflows; it is biodegradable and non toxic [1]. Specifically or mixed eatable or non-palatable oil can be utilized as a part of diesel motor however it can make issue in motor in view of its high viscosity [2,3]. Deficient ignition of eatable and non-palatable oil create high smoke along these lines bringing about ring staying and wasteful oil air blending impacts injector framework performance4. Biodiesel involves monoalkyl esters of long chain unsaturated fats. It is created utilizing consumable oil, non-eatable oil and creature fats by corrosive or by base catalyzed transesterification with ethanol or methanol [5]. The huge endeavors have been made for getting biodiesel by transesterification of oil got from Jatropha curcas [6], soybean [7], sunflower [8,9], cotton seed [10], rapeseed [11] and palm [12]. The ASTM-445 particular for consistency at 38°C of centistokes is by and large met by biodiesel and biodiesel mixes.

The announced thickness of soy methyl ester is going from 3.8 to 4.1 centistokes at 38°C. Glycerin defilement will increment biodiesel consistency which leads numerous different issues. Evaluations of the surface pressure of biodiesel propose that it might be a few circumstances as extraordinary as that for diesel.

The significant issue of utilizing biodiesel in diesel motor is higher thickness and cloud point. High thickness of palatable oil, nonedible oil and creature fats tends to bring about issue when specifically utilized as a part of diesel engines [13-16]. The fuel bead estimate amid infusion is influenced by the above properties. Higher NOx outflow might be because of bigger beads coming about because of both consistency and surface pressure of Biodiesel. Transesterification of oil and fats utilizing short chain alcohols, brings about monoesters having thickness that is nearer to petroleum based diesel fuel [17-19]. The physical and synthetic properties, for example, consistency, thickness, streak point, cloud point, cetane number, and corrosive esteem and so forth influence the biodiesel motor execution and emanation. Thusly, these properties are gotten from the unsaturated fat organization and the properties of the individual greasy esters in biodiesel. Increment in chain length and abatement in unsaturation [20] of greasy mixes result in increment in cetane number, warming quality and thickness.

Numerous types of the sort (Sorghum bicolor, family poaceae), are found in tropical and subtropical nations; Sorghum bicolor is product plant; eight types of sorghum are accounted for to happen in a few piece of India. The sorghum seed is contained 30-half oil and oil extraction won't influence the sustenance, encourage and grain needs of formers [21]. The unsaturated fat sytheses of sorghum oil comprise of palmitic corrosive, stearic corrosive, oleic corrosive, lenoliec corrosive, and lenolenic acid [21]. Along these lines, it draw in as the beginning oil for generation of biodiesel fuel. The compound properties, for example, free unsaturated fat, consistency, thickness, streak point, cloud point, cetane number, iodine esteem, saponification esteem and corrosive estimation of sorghum oil were examined and unsaturated fat structure of sorghum oil was resolved and contrasted and jatropha oil.

Material and Methods

Transesterification Reaction :

The response of triglyceride (oil/fats) with a liquor within the sight of acidic or soluble impetus is the procedure of transesterification and it requires the response temperature to be underneath the breaking point of liquor utilized, and response time ought not be under 30 minutes or over 2 hours to shape mono alkyl ester that is biodiesel and glycerol. It is a broadly utilized method to decrease the high consistency of triglycerides. The transesterification response is appeared in plan 1.

Chemical and Equipments :

The sorghum oil utilized as a part of the review announced thus is created locally in India. The sorghum oil was bought from nearby market Moga, Punjab, India. The methanol utilized (99% immaculate) is of investigative review with breaking point of 78°C; while the NaOH utilized were of logical review and bought from Aldrich Chemical Co. Ltd. Sodium sulfate, Potassium dichromate, Hydrochloric corrosive, Potassium iodide, starch, sodium thiosulphate, Phenolphthalein utilized were additionally a systematic review result of Merck Co Ltd. The attractive stirrer with hotplate, three necks round base flagon, measuring barrel, container, isolating pipe, burette, thickness bottle, channels, pet-bottle thermometers and measuring carafe were utilized.

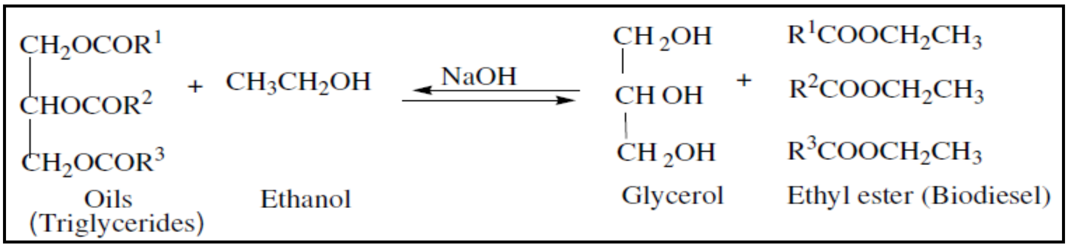
Experimental Procedure for Production of Biodiesel :

The soluble base catalyzed transesterification of sorghum oil was completed in a research facility scale setup. A 240 ml three necked round base jar was utilized as a reactor. Two necks were furnished with a condenser and thermometer, while the other neck utilized as a channel for the reactants. The blend was warmed in the reactor and mixed well by attractive stirrer with hotplate at a similar speed for all investigation. In an average trial a known measure of sorghum oil is charged to a round base cup. A known measure of impetus sodium hydroxide in light of weight percent of oil is blended in overabundance mole percent of methanol. The blend of sodium hydroxide in methanol is added to the sorghum oil in the round base jar, while mixing the material of the carafe. Required temperature is kept up by controlling the electrical warming till the response is finished. After total expansion of methanol sodium hydroxide arrangement, tests are drawn at general interim (10-20 minutes) to affirm the development of methyl ester. The development of methyl ester is checked by utilizing slim layer chromatography (TLC) procedure. After the finishing of methyl ester arrangement, a known measure of sulfuric corrosive in methanol is added to the methyl ester to kill the sodium hydroxide display in the ester. The abundance methanol show in the methyl ester is recuperated by refining with electrical warming and steady blending.

The transesterification response temperature was kept up at 60°C for 120 minutes keeping the molar proportion of oil to methanol at 5:1 and sodium hydroxide focus 0.5(g) weight rate of oil and rate of overabundance methanol utilized is 200%. The refined example was further cooled and centrifuged to evacuate remaining cleanser. The pH level of the natural layer is measured and killed independently. The washed example was further fricasseed. Under ideal condition the yield of sorghum methyl ester from sorghum oil is around 92%. The response parameter, for example, methanol/oil molar proportion, rate of abundance liquor, response time and temperature, centralization of impetus were upgraded for the creation of sorghum methyl ester.

Results and Discussion

Composition of Fatty Acid: Sorghum grains oil contained high extent of Linoleic corrosive with impressive measure of oleic corrosive palmitic corrosive, stearic corrosive, lenolenic corrosive and myristic corrosive when contrasted with Jatropha oil from writing in table 1. The capacity of biodiesel to meet ASTM D 6751 standard criteria is subject to the unsaturated fat composition [22, 23]. The petro-diesel contained carbon bind length of 8 to 10 carbon iota are produced using hydrocarbon while sorghum oil contained free unsaturated fat involving 16 to 18 carbon atom20. Cetane number is expanded with expanding carbon particle that shows the fuel quality for diesel engine [24]. Fanned chains and twofold bonds enhance low temperature stream properties [23].



Scheme-1 Transesterification of ethyl ester (biodiesel) production

Table-1 Fatty acid composition of sorghum oil as compared with Jatropha oil

Fatty acid	Structure	Formula	Sorghum oil	Jatropha oil
Myristic acid	C 14:0	C14 H20 O2	0-0.35	Nd
Palmitic acid	C 16:0	C16 H32 O2	12-17	5.5
Stearic acid	C 18:0	C18 H36 O2	03- 06	8.2
Oleic acid	C 18:1	C18 H34 O2	04-49	44.3
Linoleic acid	C 18:2	C18 H32 O2	41-59	35.4
Lenolenic acid	C 18:3	C18 H30 O2	0-0.3	Nd

Chemical Properties of Sorghum oil :

The chemical properties of crude sorghum oil were researched for the generation of biodiesel for use in diesel motor. The concoction properties that were examined are taking after: glimmer point, thickness, saponification esteem, iodine esteem and corrosive esteem. Unsaturated fat piece and physical and synthetic properties of the sorghum oils were likewise decided and contrasted and jatropha oil given in table 2.

Table-2 Chemical properties of sorghum oil andcompared with jatropha oil

Properties	Sorghum oil	Jatropha oil
Flash point	232	172
Saponification value	183-194	199
Iodine value	109-126	104.9
Acid value	0.804	6.52

Characterization of Sorghum Methyl ester (Biodiesel):

Standard test techniques were utilized for deciding physical and substance properties of sorghum oil biodiesel. These standard qualities were computed and contrasted and USA (ASTM D6751), Germany (DIN 51606), Indian (BIS) and European association (EN 14214). The synthetic properties, for example, streak point, pours point, cloud point, saponification esteem, iodine esteem, and corrosive esteem are given in table 3. The vital compound exploratory estimation of sorghum oil biodiesel, for example, saponification esteem, iodine esteem, corrosive esteem and blaze purpose of sorghum oil biodiesel were figured by taking after conditions.

Acid value: The quantity of NaOH required to killing the free unsaturated fat present in 1.0 gm of the sample [25].

$$\text{Acid value} = \frac{6.52\, X\, T}{W}$$

Where; T = Volume in ml of 0.5N NaOH required for titrationin ml. W = Weight in gm of sample taken.

Saponification value :

A known amount of oil is refluxed with an overabundance measure of alcoholic KOH. After saponification, theremaining NaOH is evaluated by titrating it against a standard acid [25].

$$\text{Saponification value} = \frac{28.05\ X\ (T2 - T1)}{W}$$

Where: T_2 = Volume in ml of 0.5N acid required for the blank.T_1 = Volume in ml of 0.5N acid required for the sample. W =Weight in g of the sample taken.

Iodine value :

The most critical logical assurance of oil is the estimation of its unsaturation. The by and large acknowledged parameter for communicating the level of carbon to carbon unsaturation of oil or their subordinates is iodine esteem. Iodine esteem is characterized as g of iodine consumed by 100g of oil. It is helpful parameter in concentrate oxidative rancidity of triacylglycerols since, higher the unsaturation, more prominent is the likelihood of rancidity [25].

$$\text{Iodine value} = \frac{12.7\ (B - S)\ N}{\text{Weight of the sample (g)}}$$

Where;

B = Volume in ml of standard sodium thiosulphatesolution required for the blank. S = Volume in ml of standardsodium thiosulphate solution required for the sample. N =Normality of the standard sodium thiosulphate solution, W =Weight in g of the material taken for the test.

Flash Point:

Streak purpose of a fuel is characterized as the temperature at which it will touch off when presented to fire or start. The blaze purpose of test was dictated by Pensky Martens Flash Point mechanical assembly.

Conclusion

This review uncovered that biodiesel could be delivered effectively term the sorghum oil by soluble base catalyzed transesterification. The impacts of various parameters, for example, response time, temperature, impetus fixation and reactant proportion on the biodiesel yield were dissected. The great mix of the parameters were found as 5:1 molar proportion of oil to ethanol, 0.5% NaOH impetus, 60°C response temperature and a hour and a half of response time. The consistency of sorghum oil lessens considerably after transesterification and is tantamount to petro-diesel and the physical and concoction properties of biodiesel created comply with accessible benchmarks.

Table-3 Comparison of fuel properties of Sorghum biodiesel and Petro-diesel

Properties	**Sorghum Biodiesel**	**Petro-diesel ASTM D0975**	**Biodiesel ASTM D6751**	***Biodiesel* EN 14214**
Flash point °C	158	65-85	105-175	>125
Pour point	07	-38 to -17	-17 to 18	….
Cloud point	09	-17 to 7	-4 to 15	….
Acid value (mg NaOH/g)	0.42	0.41	<0.9	<0.6
Iodine value	106	…	…	…
Saponification value (mg NaOH/g)	168	…	…	…
Ash content (%)	Nil	0.02	<0.03	<0.03
Water content (%)	Nil	0.03	0.04	<0.06

ASTM= American Society for Testing and Materials, EN= European Organization

References

1. Encinar J. M., Gonzalez J. F. and Rodriguez R. A.,Ethanolysis of used Frying oil. Biodiesel preparation andcharacterization, *Fuel Processing Technology*, 88, 513-522,(2007).
2. Pramanik K., Properties and use of jatropha curcas oil anddiesel fuel blend in compression ignition engine,*Renewable Energy*, 28, 239-248 (2003).
3. 3.Ferial Zaher, M.S.Gad,Assessment of Biodiesel Derived from Waste Cooking Oil as an Alternative Fuel for Diesel Engines, International Journal of ChemTech Research Vol.9, No.03pp140-146,2016
4. Muragesan A., Umarani C., Chinnusamy T. R., KrishananR., Subramanean R., and Neluzchezhain N., Production and analysis of biodiesel from non-edible oils: A Review. *Renewable and Sustainable Energy Reviews*, 13, 825-834(2009).
5. Ma F., Hanna A. M., Biodiesel production: a review,*Bioresour. Technol*., 70, 1-15 (1999).
6. Francis G., Edinger R. and Becker K., A concept fo rsimultaneous wasteland reclamation, fuel production, andsocio-economic development in degraded areas in India:need, potential and perspectives of Jatropha plantations,*Natural Resources Forum*, 29, 1, 12–24 (2005).
7. Kaidea M., Samukawa T., Kondo A., Fukuda H., Lipasecatalyzedproduction of biodiesel fuel from vegetable oils,*J. Biosci. Bioeng.*, 91, 12-15 (2001).
8. Mittelbach M., (1990): Lipase catalyzed alcoholysis ofsunflower oil, *J. Am. Oil Chem .Soc*., 67, 168 (1990).
9. Antolin G, Tinaut F. V., Briceno Y., Castano V., Perez C.,Ramirez A. I., Biodiesel preparation by lipase- catalyzedtransesterification of jatropha oil. *Bioresour. Technol.*, 83,111 (2002).
10. Oznur K., Tuten M., Aksoy H. A., (2002): Enzymatic transesterification for biodiesel production, *Bioresour.Technol*., 83, 125 (2002).
11. Linko Y. Y., Lamsa M. W. X., Vosu Kairun W., Sapala J.,Linko P. J., Bioderadable product by lipase biocatlysis, *J.Biotehnol.*, 66, 41-50 (1999).
12. Crabbc E., Nolasco-Hipolito C., Kobayashi G., SonomotoK., Is Hizaki A., Recent advances in microbial polyhydroxyalkanoate, *Process. Biochem.*, 37, 65-71(2001).
13. Rayan T. W., Callahan T. J., and Dodge L. G.,Characterization of vegetable oils for use as fuels in dieselengines, Vegetable oils as Fuels-proceeding of the International Conference on Plant and Vegetable oils asFuels, August, 70-81 (1982).

14. Frot E. F., and Blumberg P. N., Performance and durability of a turbocharged diesel Fueled with Cottonseed oil Blend,Vegetable oils as Fuels-proceeding of the International Conference on Plant and Vegetable oils as Fuels, August,374-382 (1982).
15. Walter J.P. and Derry J., The 1981 Flower Power Field Testing Program, Vegetable oils as Fuels-proceeding of the International Conference on Plant and Vegetable oils as Fuels, August, 384-393 (1982).
16. Baranescu R.A. and Lusco J.J., Performance, durability and Low Temperature Evaluation of Sunflower oil as a DieselFuel Extender, Vegetable oils as Fuels-proceeding of the International Conference on Plant and Vegetable oils asFuels, August, 312-328 (1982).
17. Graboski M. S. and Mccormick R. L., Combustion of fat and vegetable oil derived fuels in diesel engines, *Prog.Energ Combust. Sci*., 24, 125-164 (1998).
18. Noureddini H., Teoh B. C., and Clements D. L., Viscosities of vegetable oils and fatty acids, *J. Am. Oil Chem. Soc.*, 69,1189-1191 (1992).
19. Gouw T. H., Vlugter J. C. and Roelands C. J. A., Physical properties of fatty acid methyl esters, *J. Am. Oil Chem.Soc*., 43, 433-436 (1966)
20. Khothe G., Dependence of biodiesel fuel properties on the structure of fatty acid alkyl esters, *Fuel Processing Technology*, 86, 1059-1070 (2005).
21. www.chempro.in/ fatty acid.htm (2013).
22. Andrew K., Cuevas J. A., Mark F., Daniele R. and GrahamI. A., Potential of jatropha curcas as a source of renewableoil and animal feed, *Journal of Experimental Botany* , 60,2897-2905 (2009).
23. Keith O. A review of jatropha curcas: an oil plant of unfulfilled promise, *Biomass and Bioenergy,* 19, 1-15(2000).
24. Raja S. A., Robinson Smart D. S. and Robert Lee C. L.,Biodiesel production from jatropha oil and characterization, *Research Journal of Chemical Science*, 1 (1) 81-87 (2011).
25. Indian Standard Methods of Sampling and Test for Butterfat's, Fifth edition, December, (1995).

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