A Comprehensive Review on- Plant, Animal and Micoalgea as a alternative aspect for the Production of the Biodiesel

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Abstract **- Biofual is an rising need of a today's era as we are fastly proceeding to the highly growing environmental and also the economical issues. So for the sustainability in such difficult situation we must step forward towards the production of the natural energy sources which might prove to be effective and beneficial at a greater extent to the human beings, For replacement to the conventional diesel we can produce the biodiesel from the oils and fats of natural origin like Microalgae, Sunflower, Castor or Jatropha etc by trans esterification of triglycerides with an alcohol. Biodiesel contains carbon as a combustion source that directly absorbed from the atmosphere by plants and trees as they grew. There are many plants which are having the perspective for synthesizing Biodiesel and harnessing them as a fuel for future. Economics behind manufacturing of biodiesel is a determiner in making this programme happens to be a milestone. Manufacturing economics though relay upon many factors in which the availability of the feed material is considered mainly. In the global framework, biodiesel would not only minimize import of petro-diesel but also smooth the progress of large- scale employment and enhance rural development. Moreover, huge wastelands could be utilized for the cultivation of non-edible oil producing natural resource suitable for production of biodiesel. But from the viewpoint of stability the biodiesel is susceptible to oxidation because of the presence of unsaturated fatty acid in the ester. Oxidative degradation takes place in biodiesel on aerobic contact during storage as well as with metal contaminants. An effort has been made to review the various alternative Natural sources for biodiesel production over here.**

Index Terms **- Biodiesel, Natural resources, transesterification, Microalgae, Sunflower etc.**

INTRODUCTION

With the emerging necessities to lessen carbon emissions, and the declining reserves of crude oil, fuels obtained from natural resources such as plant animal marine are an most striking source thing for nowadays. A biodiesel or renewable diesel is a Biofual which is intended as a substitute to the diesel. Slow manufacturing and mounting demands, along with economic, political issues and environmental issues, are collectively motivating the explorer for ways of alternating fuel sources and chemicals [(1)].Biomasses are used to generate fuel, but the reaction procedures used to process the feedstock differ and thus yield compositionally diverse fuels. The limited availability of renewable diesel has restricted characterization of this fuel type. In distinguish the effortlessness and lower price of biodiesel manufacture fuels has facilitated better distribution and marketable use. Biodiesel may prove to be the great alternative with lesser emissions and health hazards. Still in India and worldwide there is a vast scope to the biologically synthesized fuel and energy sources.[(2)] Because of growing utilization of fuels causes environmental hazards and also influencing the economy both locally and globally.[(3)] As per the BP statistical review of world energy 2008, the world currently uses 86 million barrels of oil per day with forecast that demand for liquid fuel will increase to 1118 million barrels by 2030.[(4)] in addition, with other forms of renewable energy such as wind, tidal, and solar, liquid biofuels can be used directly for existing needs. Currently, bio-ethanol from, for example, corn starch, sugar cane or sugar beet, and biodiesel from oil crops such as palm and oilseed rape, are the most widely available forms of biofuel.[(5)]

A wide array of biomass feedstock can be used to produce biodiesel fuels. Oil, comprising of oxygen-containing triglycerides, is extracted from the feedstock and processed to produce biodiesel. Transesterification is the most commonly used manufacturing method due to its little expenditure and effortlessness. [6,7] As per the BP statistical review of world energy 2008, the world currently uses 86 million barrels of oil per day with forecast that demand for liquid fuel will increase to 1118 million barrels by 2030(8).Investigation of bio-fuel resources such as, animal, plants, oil, algae etc. therefore represents an hopeful counter in the today's age.[9]

Biodiesel as a fuel resource-

Biodiesel that is derived from the oils and fats of Natural resources consisting of methyl esters of long-chain fatty acids. Which is a budget friendly alternative for fossil fuel.[10] Owing to the constantly raising of world trade yield, Each mass of energy is vital. This energy can be supplied through biological, chemical, electrochemical or physical means, obtaining from the from natural resources. Due to the augmented fuels stress on the market, natural resources of biodiseal production can prove to be important aspect because of the global ecological imbalance due to the conventional sources. Taking is into the consideration, another fuel source is essential.[11] Biodiesel is a way for fuel that can be synthesized from practically by plant or animal oil by means of transesterification of triglycerides with an alcohol.[12] among the advances towards experiments were known to expand second generation biodiesel fuel stock with low cost participation technology.[13] Biodiesel obtained from oil is a potential renewable and can be a natural alternative to petroleum fuels.[14] Biodiesel seems very interesting for several reasons: it's greatly recyclable and has least toxic effects, it can substitute fuel in numerous things like in boilers and combustion engines without key changes and fewer efficiencies are reported, nearly zero emissions of sulfates, aromatic compounds and other chemical substances that are harsh to the character, a moment net contribution of carbonic acid gas (CO2) when the full life-cycle is taken into account (including cultivation, production of oil and conversion to biodiesel), it seems to originate considerable progress of rural economy.(15) The innovation of the edible fat fuelled engine by Sir Rudolf Diesel dated back within the 1900s. Though, investigation of biodiesel only came into light within the 1980s as a result of recent advancements in renewable energy sources for reducing gas (GHG) emissions, and enhancing the depletion of fuel resources. Biodiesel could be a mono-alkyl esters of long chain fatty acids obtained from vegetable oils or animal fats and alcohol with or without a catalyst.(16,17) just in case of biodiesel it produces no sulfur, no net CO2, less CO, particulate matters, smoke and hydrocarbons emission and more oxygen. More free oxygen results in the whole combustion and decreased emission. Biodiesel has been in use in many countries like us of America, Malaysia, Indonesia, Brazil, Germany, France, Italy and other European countries. However, the latent for its manufacturing and relevance is way more.(18)

Table 1 list of the top 10 countries Manufacturing the biodiesels.[19,20,21]

Sr.no	Country	Biodiseal Manufacturing (ML)	Production ($/L)
1.	Malaysia	14,540	0.53
2.	Indonesia	7595	0.49
3.	Argentina	5255	0.62
4.	USA	3212	0.70
5.	Brazil	2567	0.62
6.	Netherlands	2496	0.75
7.	Germany	2024	0.79
8.	Philippines	1234	0.53
9.	Belgium	1213	0.78
10.	Spain	1073	1.71

Edible oils	Non Edible Oils	Animal fat	Other Sources
Soybeans (*Glycine max*) Rapeseed (*Brassica napus L.*) Safflower Rice bran oil (*Oryza sativum*) Barley Sesame (*Sesamum indicum L.*) Groundnut Sunflower (*Helianthus annuus*) Palm and palm kernel (*Elaeis guineensis*) Peanut Canola coconut Corn Wheat Sorghum	*Jatropha curcas* Karanja or honge (*Pongamia pinnata*) Cotton seed (*Gossypium hirsutum*) Camelina (*Camelina Sativa*) Pongamia (*Pongamia pinnata*) Mahua (*Madhuca indica*) *Terminalia belerica* *Aleurites moluccana* *Pachira glabra* *Croton megalocarpus* Nagchampa (*Calophyllum inophyllum*) Coffee ground (*Coffea arabica*) Salmon oil Tall (*Carnegiea gigantean*) Rubber seed tree (*Hevca brasiliensis*) Tobacco seed Moringa (*Moringa oleifera*) Passion seed (*Passiflora edulis*) Jojoba (*Simmondsia chinensis*) Neem (*Azadirachta indica*) *Abutilon muticu* Cumaru *Cynara cardunculus*	Pork lard yellow grease Beef tallow Poultry fat Fish oil Chicken fat	Bacteria halophytes sea mango, . algae and halophytes Algae (Cyanobacteria) Microalgae (Chlorellavulgaris) Tarpenes Poplar Switchgrass Miscanthus Latexes Fungi

Table.3 Anticipated oil content and yields of different biodiesel resorces.

Sr. No.	Name of Natural resource	% oil content	Oil yield(per hecter)
1.	Castor	53	1413
2.	Jatropha	Seed: 35–40,kernel: 50–60	1892
3.	Linseed	40-44	-
4.	Neem	20-30	-
5.	*Pongamia pinnata (karanja)*	27–39	225–2250
6.	Soybean	15–20	446
7.	Sunflower	25–35	952
8.	*Calophyllum inophyllum L.*	65	4680
9.	*Moringa oleifera*	40	–
10.	*Euphorbia lathyris L.*	48	1500–2500
11.	*Sapium sebiferum L.*	Kernel 12–29	–
12.	Rapeseed	38–46	1190
13.	Tung	16–18	940
14.	*Pachira glabra*	40–50	–
15.	Palm oil	30–60	5950
16.	Peanut oil	45–55	1059
17.	Olive oil	45–70	1212
18.	Corn (Germ)	48	172
19.	Coconut	63–65	2689
20.	Cottonseed	18–25	325

21.	Rice bran	15–23	828
22.	Sesame	–	696
23.	Jojoba	45–50	1818
24.	Rubber seed	40–50	80–120
25.	Sea mango	54	–
26.	Microalgae (low oil content)	30	58,700
27.	Microalgae (medium oil content)	50	97,800
28.	Microalgae (high oil content)	70	136,900

Algae possessing the Biodiesel activity –

A wide variety of biomass feedstock can be used to produce biodiesel fuels.(33) Algae have gained overall awareness as a renewable source of biodiesel also may have an vital role in financial development of the country. A array of blue and green algae are playing the vital role in manufacturing of biodiesel. Microalgae are sunlight driven cell factories that exchange CO2 to potential biofuels, foods, feeds and high value bioactive.(34) Furthermore they assist in bioremediation and as nitrogen fixer in bio fertilizes.(35) They supply methane produced by anaerobic absorption of the algal biomass.(36) The algae used in biodiesel manufacturing are aquatic unicellular green algae. These algae are photosynthetic eukaryotes characterized by high growth rates and high population densities. Under good condition green algae can double its biomass in less than 24 hours. Oil output of microalgae significantly increasing the oil yield as compared to the best oil crops.(37) Microalgae with other uses and were grown on marine land, thus they are somewhat costly.(38) yet, biodiesel obtained from green Microalgae has the prospective for huge quantity economical manufacturing. It can be carbon neutral and obtained intensively on relatively small marginal land.(39)

Table.4 Oil content of some Microalgae

Sr.no	Micro Algae	Oil content (% dry wt)
1	*Botryococus braunii*	25-75
2	*Chlorella species*	28-32
3	*Crypthacodinium chnii*	20
4	*Cyllindrotheca species*	16-37
5	*Dunliella primolecta*	23
6	*Isochrysis species*	25-33
7	*Monallathus saline*	>20
8	*Nannochlorie species*	20-35
9	*Neochlorospis species*	31-68
10	*Neochloris oleabundans*	35-54
11	*Nitzschia species.*	45-47
12	*Phaeodactulum tricornutum*	25-30
13	*Schizochtrium species*	50-77
14	*Tertaelmis species*	15-23
15	*Nitzschia*	45-47

Advancely, microalgae have appeared to be the third generation of biodiesel raw material. Microalgae are photosynthetic microorganisms that convert sunlight, water and CO2 to algal biomass but they do it more beneficial than conventional crop plants. It shows a great efficiency feedstock because of its high photosynthetic efficiency to produce biomass, higher growth.rates and potential and high oil value compared to edible and non-edible feedstocks are greater.(40,41)Here some of the Microalgae enlisted which is having theire role in manufacturing of biodiesel like Camelina (Calophyllum inophyllum) Chlamydomonas reinhardtii, Dunaliella salina, and various Chlorella species like Chlorella vulgaris, Chlorella protothecoides, C. protothecoides, C. minutissima, as well as Botryococcus braunii, Phaeodactylum tricornutum, Parietochloris incisa and Thalassiosira pseudonana, and other heterokonts including Nanno chloropsis and Isochrysis , Saccharomyces cerevisiae,S. obliquus, Tetraselmis subcordiformis , Parachlorella kessleri, Chlorococcum oleofacien. (42,43)

Plants Possessing the Biodiesel perspective-

Jatropa

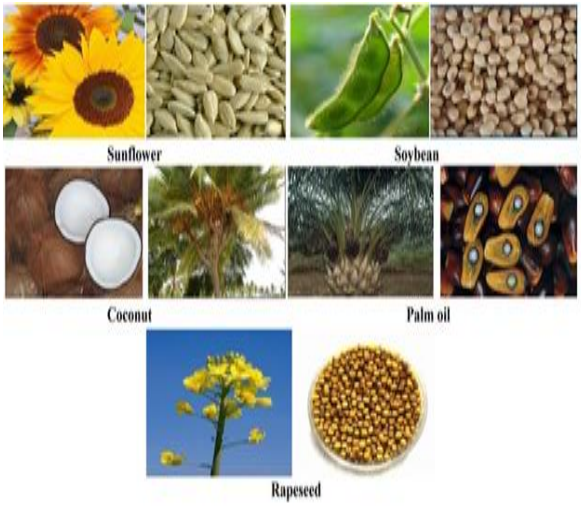

Figure 1A: Edible Oil Feedstock

Figure 1B:Non-edible Oil Feedstock

Ricinus communis(44,45,46,47)–

Is Ricinus communis; Family: Euphorbiaceae popularly said as 'castor plant' and commonly mentioned as ‘palm of Christ’, Jada (Oriya), Verenda (Bengali), Endi (Hindi), Errandi (Marathi), Diveli (Guajarati). The plant is generally known for its ornamental aspects. The aperient plant could also be a fast-growing, suckering perennial shrub or occasionally a soft wooded small tree up to 6 meter or more, but it isn't hardy in nature. This plants was cultivated for leaf and flower colors and for boring. Its ability to with stand high and vasoconstrictor compared with food crops gives it a singular importance. It are often grown on productive lands and provide viable income with low input cost. it is the potency to become biodiesel plant because its seeds contain 45% oil.

Argeomone Mexiana(47)-

Also referred to as argemone,Mexican prickly poppy, flowering thistle. An hardy pioneer plant,tolerant of drought and poor soil, often being the sole cover on new road cuttings or verges. Argemone species have economic potential because of their oil content in seeds (30 to 40%) and therapeutic potential.Argemonemexicana seeds contain 22–36% of straw non-edible oil, called argemone oil or katkar oil. Mexican poppy is an annual herb with egg-shaped seed.

Citrullus colocynthis(48)-

Also known asTumba is nativeto tropical Africa and India It is highly drought tolerant, herbaceous annual or perennial plants. Each plant produces 15-30 fruits which are green and become yellow when dry. Seeds are small and brownish whenripe. Its seed are rich in oil and proteins. It can be used a soil plant as its oil composition resembles sunflower oil.It can be regarded as second generation biodiesel plantfor future.

Sunflower(49)-

Herbaceous plants of the Compositae (Asteraceae). Sunflowers are helianthus native primarily to North and South America, and a few species are cultivated as ornamentals for his or her spectacular size and flower heads and for his or her edible seeds. Sunflower may be a high oil content seed and average yields can produce 600 pounds of oil per acre, considerably quite soybeans. there's an excellent deal of interest from local areas for construction of small processing facilities for sunflower biodiesel production. it's most vital that processing equipment be analyzed very carefully for little 'press' only facilities. In most cases a small amount of the oil is left within the by-product meal thereby reducing economic efficiency.

Pongamia pinnata(50)

Also known as Derris indicais alegume tree with seed containing oils and fatty acids suitable for biodiesel production. It reaches 40 feet height and is fast growing ever green tree. It has broad spreading canopy. Its flowers are purple and pink which blossom

throughout the year. Pods have brown seeds. It can tolerate high heat and sunlight and is drought tolerant. It can withstand temperature below 0oC to 50oCand annual rainfall 5-25 dm. The tree can be grown on sandy and rocky soils. It is a nitrogen fixing tree(NFT'S) and produce seeds containing 30-42% oils. Its seed oil is an important asset it is used as lamp oil in soapmaking and as lubricant for last many years. It can be grown on degraded and marginal land and has quality ofoil comparable to other crops. It is non edible source o ffuel and so no competition with food crops. As a legumeit is able is fix its own nitrogen from the soil with minimum need of fertilizers Pongamia pinnata can beexplored as a source of second generation of Bio-diesel.

Moringa oleifera(51)

is a very fast growing tree reaches 4meter height in 10 months of planting with fruit development in first year. Its black and winged seeds arerich in oil which can be crushed to produce biodiesel. Moringa oleifera could yield 3 ton oil/ ha which couldbe used for food in shortage time. The seeds for contain30-40% oil that is high in oleic acid. Biodiesel madefrom Moringa has better oxidative stability thenbiodiesel made from other crops. Being multi- purposeplant it attract farmers. It produces a lot of seed andother than biodiesel its pods can also produce ediblehighly nutritious seeds. In addition to these it's someparts have medicinal purposes and sap can be used as adye. Moringa is hardy and handled stress. It can beharvested for biodiesel potential with advantages ofhaving food crop, as edible source of fuel and no directcompetition with existing farmland.

Madhuca indica(52)

Or Mahua is potential tree for tree borme non- edible oil. It is found in tribal belts of centralIndia. Its flower are sweat, delicious and are consumed for tasty fruits. Its seed yield fat known as Mahua butte rused in cooking/ adulteration of ghee etc. beside used asa treatment for rheumatism and constipation. Mahua cake is insecticidal and also used for fishing as prey. It isrich in sugar (73%) and used as raw material for alcohol fermentation. The kernel of the Mahua fruit containsabout 50% oil. It can be used as biodiesel resources as alternative sources Jatropha.

Simarouba glauca(53)

is very rapid growing tree found in a varying range of climatic conditions. It is an important tree species growing in the forest of central and South America National Bureau of plant genetic resources introduce it in 1960 at Amravati, Maharashtra. It was brought to the University of Agriculture Sciences, Bangalore in 1986 and started systematic research and developmental programmers from 1992. Simarouba glauca; (Paradise tree, Lakshmi taru) is a multipurpose tree that can grow well under a wide range of hostile ecological conditions. Cultivation of simarouba with high productivity of oil seed to meet the edible industrial and biofuels oil needs of the world as renewable source for long term gains. It can be grown in marginal wasteland and generate employment to farmers, artesian, carpenters, pharmacists etc. used as biodiesel,

Simmnondsia chinesis(54)

is a new oil producing industrialcrop. It is known as Jojoba. The plant is known to produce jojoba oil that is used in cosmetic, medicinal, pharmaceutical, food products, manufacturing and automotive industries as well as are renewable energy resource. Jojoba seed contains 50%pure oil by volume. It is native to semi acid regions of Southern California and Maxico. Now it is cultivated in Israel and Rajasthan. It is dough resistant and can be grown on marginal land without replacing any existing crops. Mature shrub/ tree can reaches a height of 15 feet with alife span of 100-200 years. Jojoba oil has a lot of promise to be used as alternative source of fuel. It releases lot of energy when burn. It has potential to be uses as alternative source for bio- diesel industry of future.

Palm oil(55)

The oil formed from palm trees is spoken as CPO(Crude Palm Oil)of cold expression pf kernels of Elaisguineensis Belonging to the Palmaceae family. The CPO is send to vegetable oil refinery to be refined. The refined oil can be converted into methyl ester and directly used as biodiesel. Another method is by blending refined oil with petroleum diesel to create diesel oil. Blending certain percentage of petroleum diesel with palm diesel is named Envo Diesel. Methyl ester from oil has low engine emissions, high oxidation stability except for the high pollutant emission which is higher.

Cerberaodollam (56)

Belonging to family Apocynaceae and commonly called the suicide tree, pong-pong, mintolla, Sea mango The similarities between vegetable oil and C. odollam oil make the latter a possible alternative feedstock for biodiesel production. However, because of the high free carboxylic acid content in C. odollam oil, very specific catalyst is required for the transesterification process and to form the full process commercially feasible.

Coconut(57)

Coconut oil is that the oil expressed from the dried solid a part of endosperm of coconut, cocoa palm belonging to Palmaceae. Coconut is cosmopolitan throughout the planet. it's largely cultivated in African and southeast Asian countries. Coconut also referred to as copra may be a dietary further as industrial product throughout the planet. lots of abundance of oil is produced in India, land Malaysia, African country, China, Indonesia, and other countries. oil may be blended with fuel and under certain circumstances and is increasingly utilized in both transport and electricity generation through its lower local cost.

Jatropa(58)-

It is also referred to as nettlespurge.TheJatrophacurcas L. (JCL) belonging to the Euphorbiaceae Most of those are native to America. Most of those are native to America. it's originally native to the tropical areas of ground from Mexico to Argentina and has been spread throughout the planet in tropical and subtropical regions round the world. as a feedstock for the assembly of bio-diesel is rapidly growing. The properties of the crop and its oil have persuaded investors, policy makers and clean development mechanism (CDM) project developers to contemplate JCL as a substitute for fossil fuels to cut back greenhouse emission emissions. However, JCL remains a wild plant of which basic agronomic properties aren't thoroughly understood and therefore the environmental effects haven't been investigated yet.

Advantages of Biodiseal:

- Biodiesel has 10–11% of oxygen; so biodiesel is having high ignition rate.
- Biodiesel decreases carbon-dioxide emissions by 78% on a lifecycle basis when put next to traditional fuel and reduces smoke.
- Biodiesel is renewable, non-toxic, non-flammable, portable, readily available, biodegradable, sustainable, eco-friendly and free from sulfur and aromatic content, this makes it a perfect fuel for heavily polluted cities. Biodiesel also reduces particular matter content within the ambient air and hence reduces air toxicity. It provides a 90% reduction in cancer risks and neonatal defects because of its less polluting combustion.
- Biodiesel helps rural development to revive degraded lands over a period. Moreover, it's good potential for rural employment generation.
- Biodiesel is climatic neutral visible of the climatic change that's presently a very important element of energy use and development.
- Biodiesel has higher cetane number (about 60–65 betting on the vegetable oil) than petroleum diesel which reduces the ignition delay
- Production will be raised easily and is a smaller amount time consuming.
- No need for drilling, transportation, or refining like petroleum diesel. Therefore, each country has the flexibility to supply biodiesel as a locally produced fuel. Moreover, there's no must pay tariffs or similar taxes to the countries from which oil and petroleum diesel is imported.
- Biodiesel has superior better lubricity properties. This improves lubrication in fuel pumps and injector units, which decreases engine wear, tear and increases engine efficiency.
- Biodiesel is safe for transportation, handling, distribution, utilization and storage thanks to its higher flash point (above 100–170 ◦C) than petroleum diesel (60–80 ◦C).
- Biodiesel reduces the environmental effect of a waste and might be made out of used cooking oils and lards.
- Biodiesel might not require engine modification up to B20. However, higher blends may have some minor modification(60-64)

Disdvantages of Biodiseal:

- Biodiesel has 12% lower energy content than diesel, this ends up in a rise in fuel consumption of about 2–10%. Moreover, biodiesel has higher cloud point and pour point, higher oxide emissions than diesel. it's lower volatilities that

cause the formation of deposits in engines thanks to incomplete combustion characteristics.

- Biodiesel causes excessive carbon deposition and gum formation in engines and also the oil gets contaminated and suffers from flow problem. it's relatively higher viscosity (11–18 times diesel) and lower volatility than diesel and thus needs higher injector pressure. xidation stability of biodiesel is less than that of diesel. It may be oxidized into fatty acids within the presence of air and causes corrosion of fuel tank, pipe and injector.
- Due to the high oxygen content in biodiesel, advance in mechanical system and timing and earlier start of combustion, biodiesel produces relatively higher NOx levels than diesel within the range of 10–14% during combustion
- Biodiesel can cause corrosion in vehicle material (cooper and brass) like equipment blockage, seal failures, filter clogging and deposits at injection pumps
- Use of biodiesel in burning engine may cause engine durability problems including injector cocking, filter plugging and seal sticking, etc.
- As quite 95% of biodiesel is formed from edible oil, there are many claims that this might produce to further economic problems. By converting edible oils into biodiesel, food resources are being employed as automotive fuels. it's believed that large-scale production of biodiesel from edible oils may bring forth a worldwide imbalance within the food supply-and-demand marketLower engine speed and power, high price, high engine wear, engine compatibility.
- Transesterification process is pricey (cost of fuel increases), these oils require expensive carboxylic acid separation or use of less effective (or expensive acid catalysts)
- The transesterification has some environmental effects like waste disposal and water requirement for laundry, soap formation, etc.(65-68)

CONCLUSION

Worldwide, the transportation sector is the largest energy consuming sector after the industrial sector and accounts for 30% of the world's total produced energy. The factors such as economy environmental hazards and human safety are playing the very significant role in human life. In the present scenario higher demands and lower production and with raising hikes in price of conventional diesel becomes a crucial difficulty. Now a day with higher advancements in research we can move towards the biodiesel by using the plant animal and microalgae so that it can prove to be the great and higher advantageous fuel of next generation. Taking the advantages and disadvantages into consideration we all researches can take a step forward on the path of manufacturing the biodiesel. It becomes the crucial need of today's era to work on the alternative sources of conventional organic oils.

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