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Oil Extraction, Cultivation, & Seed Cake for Various Types of Edible Oil & Non-Edible Seeds

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Abstract: Rundown as of late, the commercial potential of oil extraction and biodiesel production derived from vegetable seed is being realized. The process energy input requirements are important factors in oil extraction and biodiesel production. This research work investigated oil extraction from non- edible & edible seeds and compared extraction yield with the energy load. The effect of moisture content on the oil yield was compared between a mechanical oil expeller, organic solvent extraction, organic solvent and microwave assisted, organic solvent and ultrasonic assisted, and combined microwave and ultrasonic with organic solvent. The maximum oil yields % wt./wt. from these techniques was 22.6%, 36.3%, 10.0%, 42.0% and 27.8%, respectively. The moisture content had a significant effect on oil yield with the mechanical oil expeller, organic solvent method and ultrasonic assisted extraction, whereas no or little effect was found on microwave-assisted extraction. The microwave-assisted extraction showed better results compared with the ultrasonic-assisted and combined treatment methods. The relative energy consumption of these processes was experimentally investigated; energy ratios were calculated based on the amount of energy recovered to the amount of energy supplied to the flax seed for oil extraction.

Keywords: Bio-Diesel, Transesterification, Edible Non-Edible, Seedcake

I. INTRODUCTION

Biodiesel is an option fuel like ordinary or "fossil" diesel. Biodiesel can be delivered from straight vegetable oil, creature oil/fats, tallow and waste cooking oil. The procedure used to change over these oils to Biodiesel is called Trans esterification. This procedure is depicted in more detail beneath. The biggest conceivable wellspring of reasonable oil originates from oil yields, for example, rapeseed, palm or soybean. In the UK rapeseed speaks to the best potential for biodiesel generation. Most biodiesel created at present is delivered from waste vegetable oil sourced from eateries, chip shops, mechanical nourishment makers, for example, Birdseye and so forth. In spite of the fact that oil straight from the horticultural business speaks to the best potential source it is not being created financially essentially in light of the fact that the crude oil is excessively costly. In production all biodiesel is created utilizing base catalysed Transesterification as it is the most prudent procedure requiring just low temperatures and weights and delivering a 98% change yield. Hence just this procedure will be portrayed in this report. After the expense of changing over it to biodiesel has been included it is just excessively costly, making it impossible to contend with fossil diesel. Waste vegetable oil can frequently be sourced for nothing or sourced officially treated at a little cost. [1] Biodiesel has numerous naturally advantageous properties. The fundamental advantage of biodiesel is that it can be depicted as 'carbon impartial'. This implies the fuel creates no net yield of carbon as carbon dioxide (CO2). This impact happens in light of the fact that when the oil crop develops it assimilates the same measure of CO2 as is discharged when the fuel is combusted. Indeed, this is not totally exact as CO2 is discharged amid the generation of the compost required to treat the fields in which the oil harvests are developed. [1] Transesterification is the conversion of a carboxylic acid ester into a different carboxylic acid ester. The most common method of transesterification is the reaction of the ester with an alcohol in the presence of an acid catalyst. [3] In the extraction section various strategies for oil extraction were connected to the seed samples, which were set up with dampness substance of4%, 8% and 12% (on % dry premise). The medications were applied in triplicate and the midpoints of the outcomes were determined. Every one of the tests were directed at a room temperature (21^{o}C) [4]. We have discussed about type of methods i.e. mechanical screw method, organic

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solvent extraction method, ultrasound assisted oil extraction method, microwave assisted extraction method, combined microwave and ultrasonic-assisted oil extraction method. [4] There are different type of cultivation required for each one of them, according to their categories and climates. [5,6,7,8,10]

1.1. Objectives

- The main objective of this research paper is to be reduced pollution which has become a critical issue in this era, and also an alternative for fossil fuel like diesel and petrol.
- We can able to calculate and get the benefits by seedcakes and make it usable.
- We'll able to use that seedcake as a fertilizer as well as feed for cattle.
- This will be beneficial for farmers & industry purpose as well
- Soybean seedcake can also use for human feed as an energy feed
- Only one precaution we need to aware about is what kind of seedcake used for what kind of purpose
- By this research paper, we can able to calculate how much seedcake and how much yield oil get by seeds
- By this research, we can also aware how to cultivate different kind of seeds with climate & and what kind of resources (irrigation, fertilizer, seeds, and soil) used to grow the crops
- There are several techniques for cultivation of different kind of seeds

II. RESEARCH METHODOLOGY

As the requirement/uses of fossil fuels in this era, we have to choose an option to continue it for future, and if we are talking about a country like India, India is one of the countries which is also known as fertile land and it is producing more crops in terms of several kinds of crops. Therefore, if we are going to set up a plant of Bio-diesel in India this will be very beneficial.

As I have gone through the bottom to top for research of biodiesel I have learned so many ways to the cultivation of several kinds of seed, and each one has the unique techniques to cultivation, irrigation, extraction, etc. Bellow, I am going to describe each and every technique which I have learned from this research. Instead of that, each one has a different kind of extraction processes and the quantity of seedcake and oil is so different. In the trans esterification process, there must have use of 22% of alcohol(ethanol/methanol) needed over edible or non-edible oil.

I have taken several kinds of edible & non-edible seeds to experiment and produces their biodiesel with the trans esterification process, seeds are followed.

I- Non-Edible seed

· Neem
· Castor
· Jojoba
· Jatropha
· Mahua
· Karanja
· Almond
· Tung

II-Edible seed

· Copra
· Coconut
· Sunflower
· Soybean
· Rice
· Cottonseed
· Rapeseed
· Camelina

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For these seeds, I have gone for a research Centre to done a transesterification process for each and every seed, and before this process, I have gone through several areas to find out the climate

and their crops what is suitable for? And I have learned so many different kinds of techniques to grow crops. In the transesterification process, we can produce biodiesel, seedcake as well as glycerine which is very beneficial for cosmetic industries.

2.1-Experimental Setup Of Transesterification Process:

Biodiesel fuel blend can be conventionally prepared by using alkali or acid as catalyst.100gm of refined neem oil is mixed with 12gm of alcohol and 1gm of sodium hydroxide (NaOH) which acts as catalyst. The experiments were conducted in a manner similar to Soxhlet extraction apparatus. This mixture is taken in a 500ml round bottomed flask. The amount of catalyst that should be added to the reactor varies from 0.5% to 1% w/w. Using magnetic stirrer and heater equipment the above mixture is thoroughly mixed and maintained at a temperature of 50-55 0 C for two hours. The mixture is now allowed to settle for 24 hours at which two separate layers are obtained. The top layer will be methyl ester of neem oil (fatty acid methyl ester (FAME) i.e, .biodiesel) and the bottom one glycerin. Using a conical separating funnel, the glycerin is separated at the bottom. To separate the FAME (fatty acid methyl ester) from glycerol, catalyst (NaOH) and methanol, washing was carried out with warm water. Further water and methanol will be removed by distillation. Then the NaOH, Glycerol, methanol and water was treated with phosphoric acid for neutralizing the catalyst. Finally, glycerine is obtained as a by-product in case of alkali transesterification process.Acid catalyst production is the second conventional way of making the biodiesel. The most commonly used acid is sulphuric acid. This type of catalyst gives very high yield in esters but the reaction is very slow, requiring almost always more than one day obtaining the final product. [37]

2.2. Distillation Of Crude Biodiesel:

The crude biodiesel was composed of FAME and methanol. FAME was purified by a distillation system. It was provided with an evaporator and an internal condenser. Feed (0.2 L/h) was let in using a jacketed glass vessel equipped with a flow regulation valve, where the temperature was maintained at 400 C.The discharge of distillate and residue was done in glass flasks. The vacuum system was composed of a mechanical pump and a diffusion pump. The heating of the evaporator was provided by a j acket. The yield of the purified biodiesel (FAME) was calculated by from the ratio of the mass of the purified biodiesel to that of the crude biodiesel. Biodiesel was distilled from the crude biodiesel at evaporator temperatures of 40, 50, 60, and 70 °C. Other conditions for distillation were maintained at evaporator vacuum to be 1.0 Pa, the condenser temperature at 40 °C. [37]

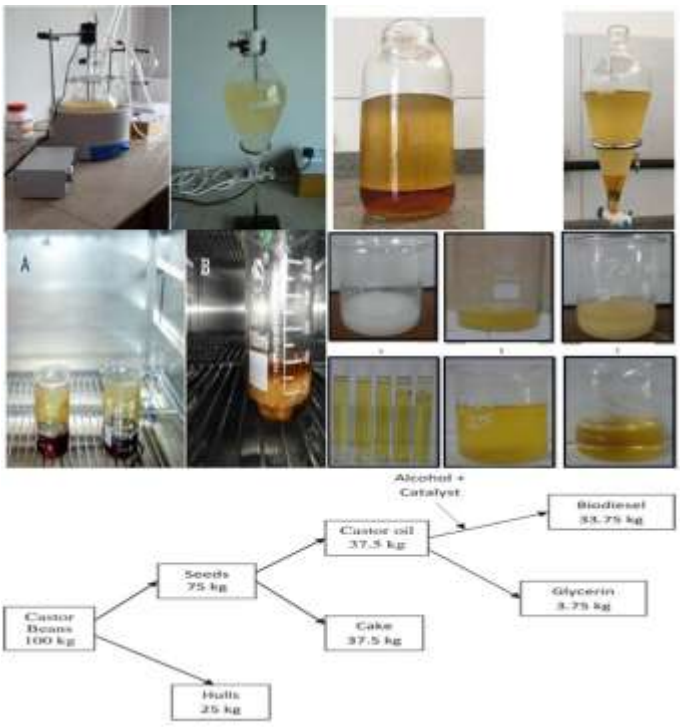

Fig. 1 – All the set-up for extracting Bio-Diesel from seeds

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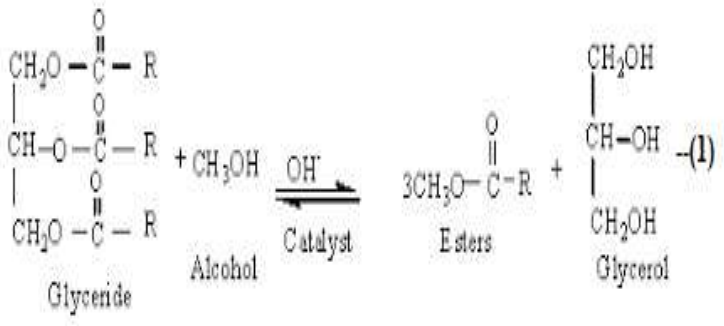
III. OUTCOMES OF OIL EXTRACTION

Seed (kg/ha) or Fruit (kg/ha)	Decortication		Expeller		Output
	Shell	Seed	Seed cake	Oil	Bio-diesel
Jatropha Fruit production (8805.8kg/ha) Yield (4764kg/ha) [8]	35-40%	60-65%	50%	50%	91%
Castor 1760kg/ha [6]	30-35%	65-70%	45-50%	35-55%	88%
Soybean Production (2500 kg/ha) [8]	20-25%	40%& (30-40)% Undecorticated meals	49-55%	60-65%	92%
Neem 10-25kg/tree/year Amature tree (30-100kg/year) [5]	30-35%	50-60%	7-12%	50% (yield 40%)	93%
Sunflower 701 kg/ha in all India level [15]	24-27%	38-50%	40-44%	48-53%	89%
MAHUA Yield(100-150%) & kernel (60-80 kg/tree/year) [9]	60% (approx.)	40-45%	35-45%	50-55%	95%
Karanja 1560 kg/ha [10]	25-30%	27-30%	30-40%	40-50%	86%
COPRA 5295 nuts/ ha. [13]	20-25%	60-70%	30-40%	65-75%	90%
Tung 450-500kg/ha [12]	60-80%	14-20%	53-60%	30-40%	84%
Coconut 70nuts/pa 2260kg/ha [14]	20-25%	60-70%	30-40%	65-70%	91%
Jojoba 400kg/ha [7]	60%	64-70%	16-20%	50%	85%
Almond 400-600kg/ha [11]	55-60%	68%	80-90%	50% fixed oil	94%
Camelina 445-1112kg/ha [20]	63-75%	53%	45-60%	35%	88%
Rapeseed 1530 kg/ha [19]	20%	33.2-47.6%	50-60%	40-50%	91%
Cotton seed 1850kg seed cotton/ha [18]	16%	16-17%	11-12%	5-7.5%	81%
Rice 30-40kg [17]	18%	90%	5% bran	14-18%	79%

IV. EQUATION



V. RESULTS OF SEEDCAKE AND OIL CONTAINS

The overall result of this research paper is to decrease unwanted pollution and to utilize waste oils and non-edible oils. According to the demand/uses of fossil fuel, the amount of fuel decreases gradually. Therefore the Bio-diesel would be the best and reliable option to move the world accordingly.

Here are the results of this research paper according to seeds.

1.1. Jatropha

- Bio-Diesel output -91%
- It is use as fertilizer fuel, animal fodder.
- Energy content in seed cake is 25 mj/kg.
- Some 60% biogas has produce from jatropha seed cake in anaerobicdigester from cattle dung and that it had a higher CV.
- Biogas also produce from fruit shells.
- Seed cake mainly remains in form of protein and carbohydrates [21].

1.2. Neem

- Bio-Diesel output -93%
- Neem cake organic manure protects plant root from nematodes.
- It is also used as natural fertilizer with pesticidal properties.
- Neemcake improves the organic matter contents of the swipe.
- It has contents of Nitrogen 2-5%.
- 100% NPK occurs in seed cake.
- It has also phosphorus 0.5-1%
- Potassium 1-2%
- Calcium 0.5-3%
- Magnesium 0.3-1% [22].

1.3. Mahua

- Bio-Diesel output -95%
- Seedcake of mahua contains 29.4% protein.
- The seed cakes obtained after extraction of oil constitute very good fertilizer.
- It is used to make soaps & candle.
- The calorific value of mahua seedcake is 19.97.
- It is also used as cattle feed or sold to solvent extraction plant.
- Aleic acid in seedcake is 46·3% [23].

1.4. Karanja

- Bio-Diesel output -86%
- Its cake is used as pesticide and fertilizer.
- Energy contains in seedcake is 118–124 kJ/mol.
- Energy value of seed cake biomass from 18.1 to 24.5 MJ/kg.
- It is also used to cattle feed [24].

1.5. Tung

- Bio-Diesel output -84%
- Energy contains in seedcake is 14.2 kcal/ g mole.
- It is used mainly in industry and medicines.
- It is also used as fertilizer and cattle feed.
- Contains of oleic acid 4.0%.
- Seedcake contains linoleic acid 8.5% [25].

1.6. Castor

- Bio-Diesel output -88%
- The calorific value of deoiled castor cake is about 4200 Kcal per kg.
- Nitrogen 5%
- Phosphorus (as P205)2%
- Potassium 1.25% - 1.5%

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- Moisture 10% max. approx.
- Oil Content 0.7% max. approx.
- Protects plants from nematodes and termites.
- It is used as fertilizer as well as fuel [26].

1.7. Castor

- Bio-Diesel output -85%
- Energy of seedcake is 10%.
- It is used as fertilizer & pesticide in medicines.
- Jojoba esters are mainly used as emollients in cosmetics such as lipsticks.
- It is also used to making biogas [27].

1.8. Castor

- Bio-Diesel output -94%
- The energy content in seedcake is 2408 kj (576 kcal).
- It is mainly used to making poppy seedcake.
- It is also used as small soft cake.
- It has 25.47% carbohydrate.
- It has 3.11% crude protein.
- It has 33.66% crude fiber.
- It has 32.73% lipid [28].

1.9. Castor

- Bio-Diesel output -91%
- Seedcake content:60%
- Seedcake mainly use for the preparing poppy cake.
- It has 354 kcal energy.
- It has 24.3 unit carbohydrates.
- Fruit shells is used as fuel for burning.
- And it has also content of protein, vitamins, minerals and other content. [29]

1.10. Copra

- Bio-Diesel output -90%
- Copra is similar to the coconut and its property as well.
- Energy content in seed cake is 354 kcal.
- Seedcake mainly used for the making poppy cake.
- Carbohydrate content in seed cake is 24.3 unit.
- It is occurring some other protein, minerals, vitamins etc. [30]

1.11. Soybean

- Bio-Diesel output -92%
- It is used to forage plant, plant produces/by products, feed of animal origin.
- Energy content in soybean is 1866 kj (446 kcal)/100 gram.
- Seed also contains fat, protein, vitamins, minerals.[31]

1.12. Sunflower

- Bio-Diesel output -89%
- In sunflower seedcake is 40-44%.
- Protein is 14-19%
- And used as cattle and poultry feed.
- It has also contained vitamin E, B1, B3, B6, copper, selenium, manganese, magnesium. [32]

1.13. Rice

- Bio-Diesel output -79%
- Rice seedcake is known as bran which is used for cattle feed.
- It has oil content of 14-16%.
- Energy content in seed cake is 1,527 kJ (365 kcal).
- Biogas production with fruit shells.
- Protein content is 7.13 gram.
- Carbohydrate is 80 grams.

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- And it has also content of minerals, vitamins etc[33].

1.14. Cotton Seed

- Bio-Diesel output -81%
- Cotton seed oil cake is very useful for as a feed for cattle. It is widely use in every nation for animal feed because in it much more oil content so it's so favorable. Some time it is useful as an organic fertilizer for soil health to get more crops. Seedcake of rapeseed:
- Uses of cottonseed feed products for livestock, Cottonseed meal, Cottonseed hulls, Cottonseed oil, Fertilizer, Cosmetics [34].

1.15. Rapeseed

- Bio-Diesel output -91%
- The rapeseed seedcake is used for cattle feed, poultry feed and also use as fertilizer.
- Protein content in seedcake is 38% min.
- Sand & silica content is 2.5% max.
- Fiber content in seedcake is 12%.
- 30% of total energy in seedcake. [35]

1.16. Camelina

- Bio-Diesel output -88%
- Gross energy value was determined to be 4931 kcal/kg.
- The seedcake is used for animal feed, poultry feed etc.
- The vitamin E content of camelina oil is approximately 110 mg/100 g.
- It has 1–3 % erucic acid.
- 27-32% protein in seedcake. [36]

VI. CONCLUSION

Different oil extraction method from different type of seed was applied to investigate and compare all the property of oil, seedcake, and also included different type of method for cultivation of various type of seeds. We have some of the seed which are from non-edible like jatropha, almond, jojoba, mahua, castor, tung, and neem & other edible seeds. What is the uses of seedcake, seed, kernel, shells, and their seeds? It has also defined its energy in seedcake. The energy efficiency calculations showed that microwave-assisted oil extraction has the highest oil extraction energy efficiency (25.21%) as compared with the other processes. This analysis showed that the MAE method was optimal in terms of speed and minimizing solvent use, with 10.4% oil yield with 3-min treatment and 20 mL of solvent.The energy analysis of the in site ultrasonic transesterification showed a positive energy balance of (3.58%) with 4% moisture content (on % dry basis).

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[37]. Novel Production of Biofuels from Neem Oil K.V.Radha1,*, G.Manikandan1 1 Department of chemical Engineering, Anna University, Chennai, India * Corresponding author. Tel: +91 044 22359124, E-mail: radha@annauniv.edu

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Krishna Murari Gupta is a very self-esteemed person with a lot of integrity towards each aspect of life either it would be personal or professional, he is a great technical enthusiast and reliable person indeed. Krishna always set his own goals and dedicate himself as well with 100 percent efforts. He always believes in positivity, hard work and helping others. Krishna has completed his schooling from UP Boards in the Hindi medium. After completing his 12th board he appeared for IIT JEE for becoming an engineer in the mechanical department, As the result was not good he took admission to Pratap University with his dream course mechanical engineer. He got selected in a reputed company HD Fire protect Pvt. Ltd. In last year of engineering as a junior engineer for 1 year and 7 months, just because he wanted to pursue his post-graduation he left the job, As Krishna is an optimistic personality he always pursues his study appearing for GATE but not succeeded, and finally, he decided to get admission in Jagannath University and pursuing M-Tech (thermal engineering)

Achievements:

1. Winner of the project competition 2017 final year project of B-Tech, Project-Solar cum electric & dynamo powered bicycle
2. Played a key role in UL approval by taking initiatives such as acting as a participating member for proportioning the balance valve
3. Winner in SAKSHAM (POWERED BY EICHER ABILITY OF SOFT SKILL) at national level
4. Supervised inspection of hydro testing machines which improved production quality by putting innovative plugs & fixtures
5. Steered efforts in setting up and making it operatable of Engraving Machine & Designed Diagrams

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Mr. Rakesh Kumar is an assistant professor of Jagannath University Jaipur Chaksu branch, in the department of mechanical engineering and coordinating overall M-Tech student. Mr. Rakesh is a very talented and knowledgeable professor indeed, a great visionary for future endeavor. He believes in hard work as well as karma. He has 9 year of experience in teaching.

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