

Extraction Characterization and Study of hydrocarbons from seeds of *Ricinus communis*

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Abstract—History of fossil fuels starts from ancient times where wood was used as fuel for heating and cooking. It was observed that human focus shifted from conventional fuels like wood to fossil fuels. With increase in demands for fossil fuels and increase in population fossil fuels were used up faster than generated. Good thing about fossil fuels are they have a lot of energy per unit mass. At the sametime major drawback is earth has limited amount of them. So with increase in demand we have to go back to only reliable source that is forest. Forest has a lot of plants/trees which give hydrocarbons or chemicals which are similar to petrol they are called as Petro crops. There are more than 400 species of plants that are petro crops. Exudate from petro crops which have fuels like properties are called as Bio fuels. Fuels made from plants that are renewable and more environmental friendly are called as Bio fuels. Bio fuels are fuels similar to fossil fuels liquid or gases which can be derived from biomass. Bio fuel is becoming topic of interest due to two things 1.Sustainability 2. Renewability. The current work focuses on exploring different Petrocrops for use as Biofuels.

Index Terms—Fossil fuels, Bio fuels, Petro crops, Sustainability.

I. INTRODUCTION

Due to increase in global energy demand utilization of fossil fuels has increased, exhausting fossil fuel reserves, which in turn causes a shift to renewable source of energy. In past focus shifted to fossil fuels as soon as they were discovered, fossil fuels like coal, petroleum and natural gas. The advantage of fossil fuel is its high energy output per unit mass. The disappointing problem or disadvantage is lesser resources and time for formation. Drastic increase in population has led to depletion of fossil fuel resources. So we have to search other resources to meet

our needs. Plants that produce petroleum like product are called as Petrocrops. Petrocrops produce petroleum like products. There are around 400 species of plant that are classified as Petrocrops.

Exudates from these plants produce fuel like substances known as Biofuels. They can be described as renewable and environmental friendly fuels which may be liquid or gaseous depending on type of plants. Other than increase in demand of fossil fuel the environmental effect it creates is also a matter of concern. Amount of green house gas which is released by burning of fossil fuels is tremendous which is leading to depletion of ozone layer. The depletion in ozone layer increases Global Warming which in turn is responsible for adverse climate change.

Biofuels have gained significant place in research due to its dual benefit of Renewability and Sustainability⁽¹⁾. History of biofuels starts from 1900 where peanut oil was used to run test engines. Later due to increase in fuel prices and decrease in import researchers started exploring plant species for its oil content⁽⁷⁾. Later biofuel were extracted from easily available plants like sugarcane and corn. This further led to study of more oil bearing seeds for oil properties and its use as Biofuels.

II. MATERIALS AND METHOD

Materials-

Ricinus communis is an angiosperm which belongs to family of Euphorbiaceae. It belongs to monotypic genus *Ricinus* and subtype *Ricininae*. It is a perennial plant which is native to Africa and India. It can grow under any habitat. It is called as Castor oil plant or castor bean plant. Also known as erandi in Hindi. Plants can grow upto height of 5 to 10 m in length. Leaves of Castor plant are star shaped which can be a feature to

identify them. Seeds are oval in shape and brown in colour with brittle seed coat and white endosperm.⁽¹⁾

Extraction of oil-

Seeds of *Ricinus communis* were crushed on mortar and pestle into powder form. This powder of seeds of *Ricinus communis* were used to extract oil. The extraction can be done using different methods. Extraction of oil was done using Soxhlet apparatus⁽¹⁾

Soxhlet extraction method involves recurring cycle of extraction by solvent in a specialized apparatus called Soxhlet extractor. Process involves various steps like Heating, Vaporization, Condensation and immersion through solid sample. Powdered seeds were weighed approximately 20g seeds were wrapped in Whatman filter paper no 41 and placed in soxhlet extractor. In round bottom flask approximately 200 ml of solvent was added. Solvent used was n-hexane which was of AR grade 99% pure manufactured by Loba Chemie Pvt Ltd with molecular weight 86.18 g/mol and boiling range of 68° C-70°C. A condenser was attached to Soxhlet extractor for Condensation of solvent. Temperature of heating mantle was set to 65°C. Constant and recurring cycles of n-hexane were passed through seeds for a time frame of 8 hours. After 8 hours the solvent oil mixture was collected. Further as two separate layers were obtained which were allowed to separate. Oil obtained was analyzed for its properties which are given in Table-1

Analysis of oil-

Density of oil-

At room temperature around 31°C density of oil was measured a clean beaker was taken and weighed on a weighing scale. Then 10ml of carefully measured oil was poured in it and weighed. Density was calculated using formula

$$\text{Density} = \frac{\text{mass of oil}}{\text{volume of oil}}$$

Iodine value-

0.25g of oil sample was mixed with 20ml of Ethanol and 25ml of Wij's reagent was added flask was stoppered and swirled to mix the content and kept for exact 30 mins hours and 10ml of 10% KI and water

were added to the mixture. The mixture was titrated against 0.1N sodium thiosulphate solution using starch as an indicator ASTM test method (D-2078).⁽²⁴⁾

Viscosity-Measured using Oswald's Viscometer.

Saponification Value-For measurement of Saponification value 0.305g of sample was added in conical flask to which 25ml of ethanolic KOH was added and was refluxed for 1.5 hours. Mixture was cooled to reach room temperature to which 2 drops of phenolphthalein indicator was added and titrate against 0.1 N HCl solution.(D-94)⁽²⁴⁾

Acid number value-

1.045g of oil sample was weighed in a clean and dry beaker and appropriate amount of Ethanol was added. Ethanol was neutralized using 0.1N NaOH. Few drops of phenolphthalein indicator was added and it was titrated against 0.1N NaOH.

pH-

Oil was transferred in a clean and dry beaker and pH was measured using combined glass electrode. pH meter was already calibrated using buffer of pH 4,7,9.2

Ash value-

2g of oil was weighed in a silica gel crucible. The crucible was then heated on flame to ignite all organic matter. The crucible was then further heated in a muffle furnace at 550°C

Following analysis were done-

Oil was analyzed using FTIR which was taken on Perkin Elmer 10.6.2. Sample obtained was added on FTIR plate using beamsplitter OptKBr. Background run was taken to avoid any disturbance in signals.

III. RESULTS AND DISCUSSION

Amount of oil obtained from Soxhlet extraction is 6ml from 20g of seeds

$$\begin{aligned} \text{\% of oil obtained (v/w)} &= \frac{\text{amount of oil obtained}}{\text{weight of seeds}} \\ &= \frac{6 \times 100}{20} \\ &= 30\% \end{aligned}$$

IR spectrum of isolated oil is depicted in Fig.1

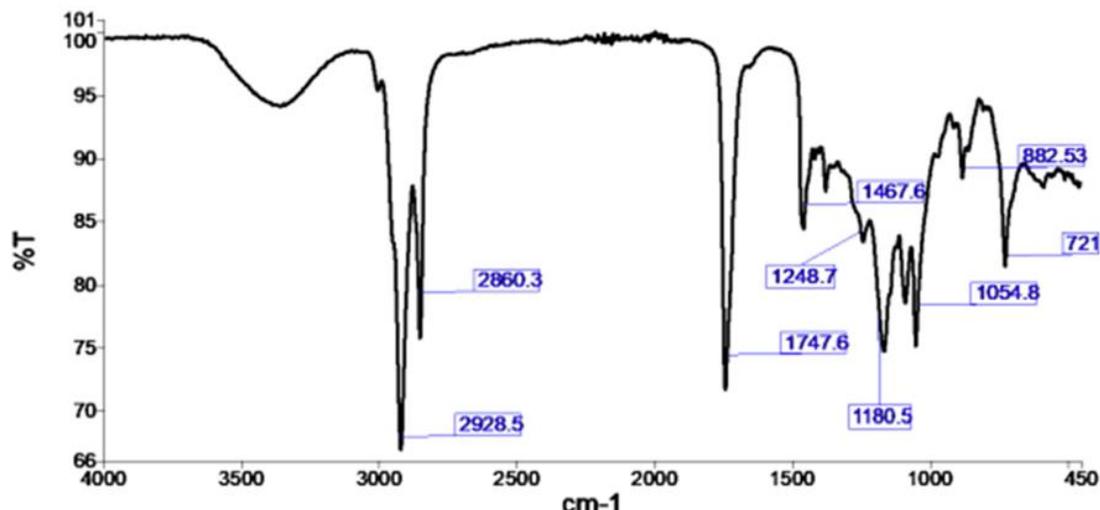


Fig.1 FTIR spectra of oil obtained from soxhlet extraction using n-hexane as solvent.

Peaks obtained from FTIR are as follows-

Peaks	Functional group interpretation
3325 cm ⁻¹	O-H stretch
2860 cm ⁻¹ and 2928 cm ⁻¹	C-H stretch for alkanes
1087cm ⁻¹ and 1045 cm ⁻¹	C-O bond stretch
1747.6 cm ⁻¹	Presence of C=O stretch

Solubility of oil was checked and oil was found to be soluble in Ethanol and insoluble in n-hexane and water.

Table-1 Summarises the characteristics of extracted oil

Table-1 Summary of characterisation of extracted oil

Properties of oil	Observed Values.	Reported values
Density of oil	0.685 g/mL	0.80 g/ml to 0.88g/ml
Iodine Value	247.65g of oil per 100 g of iodine	120 g of oil per 100g of iodine
Kinematic Viscosity	2.644 mm ² /s at Room temperature	3.5 to 5.0 mm ² /s
Saponification Value	233.75 mg/KOH	174 to 327.4 mg/KOH
Acid number value	17.22 mg/g of KOH	14.42mg/g of KOH
pH	2.1	6 to 7.5
Total ash value	3.916%	0.02%
Water soluble ash value	0.960%	-
Water insoluble ash value	2.956%	-

Density-Study of density of biofuels is very important parameter as it affects engine performance and efficiency⁽¹¹⁾.It is also method to assess quality of fuels.The expected value of density of biofuels ranges from 0.80g/ml to 0.88 g/ml⁽¹²⁾. The experimental value obtained is 0.685g/ml.Lower density of obtained indicate low energy efficiency.⁽¹³⁾

Iodine value-Iodine value is indication of unsaturation in oil.Iodine value determines number of double bonds present in oil.Reported value for Iodine value for biofuel is 120g of I₂ per 100g of oil⁽¹⁴⁾ Experimental

value of iodine value was found to be 247.65g of I₂ per 100g oil. The experimental value is higher than expected standards.This indicate presence of higher degree of unsaturation⁽¹⁵⁾.It is unsuitable for biofuels as it can react with oxygen and undesirable reaction can occur it.The oxidation of oils can render it unsuitable to be used as biofuels⁽²⁰⁾.

Viscosity-Viscosity is fluids internal resistance of fluid to flow. Viscosity is opposite of fluid velocity.Viscosity affects atomization in engines⁽¹⁸⁾.High viscosity can cause wear and tear of

engines. Standard viscosity range is 3.5 to 5.0 mm²/s⁽²⁵⁾. Experimentally observed value is 2.644 mm²/s

Saponification Value-It is value of KOH required to saponify specific amount of oil or fat. Experimental Saponification Value obtained is 233.75 mg/KOH. Values obtain from literature ranges from 174 to 327.4 mg/g^(16,17). Saponification Value of oil is inversely proportional to its molecular mass. Higher saponification value may indicate smaller chain length and vice-versa⁽¹⁹⁾.

pH-pH is the measure concentration of hydrogen ion in the solution. No Standard value is declared but most of it should be in range of 6 to 7.5⁽²³⁾. pH of experimental biofuel obtained is 2.1. The high acid content may be attributed to residual acids present in the oil naturally.

Acid number value-Acid value number is indication of number of free fatty acid group in oil or fat⁽¹⁶⁾. Acid number value is an important parameter as it can effect engines wear and tear. Observed acid number value is 14.42 mg/g of KOH⁽¹⁷⁾. Experimental value is 17.22 mg/g of KOH.

Ash value-Incombustible residue which is left behind after burning of oil is called as ash. Determination of amount of this residue is called as Ash value. Standard ash value should be less than 0.02% according to biodiesel ASTM D 6751⁽²¹⁾. Experimental ash value obtained is 3.916% which is quite high. Higher ash content affects soot filler of engines and can also increase back pressure and flow restriction⁽²²⁾

IV. CONCLUSION

From above results we can conclude that oil from *Ricinus communis* that is castor oil cannot directly be used as biofuels. The oil needs to be heated and processed so that it becomes stable to be used as Biofuels.

V. FUTURE PROSPECTUS

We are looking at processing the oil to remove excess acid and render it more suitable for use as Biofuels.

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