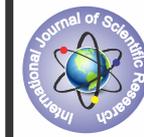


Isolation and Comparative study of Biodiesels from *Madhuca indica* and *Ricinus communis* a preliminary study in Bihar.



Biological Science

KEYWORDS: Mahua seed oil, Castor seed oil, Biodiesel, Transesterification, FAME, Fuel characteristics, Cetane number, Flash point, Density, Pour point.

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ABSTRACT

With the increase in population, industrialization and development of countries, the demands of fossil fuels for power generation and transportation increases continuously in all over the world. The fossil fuels limited source, their shortages, and environmental concern have led to look for alternative fuels, among which biodiesel from vegetable oil feedstocks are widely practiced. Being biodegradable and renewable, biodiesel is chemically fatty acid alkyl ester (FAME/FAEE), which can be derived from vegetable oil/fat by transesterification. In this study, a comparative analysis were investigated on biodiesel production from locally purchased (from Bihar state of India) seeds of Mahua (*Madhuca indica*) and Castor (*Ricinus communis*).

1. Introduction

The term fuel refers to any substance that produces heat and power through chemical or nuclear reactions [1]. The fuel source can be divided into Fossils (Non-renewable), Renewable, and Nuclear (Fissile) [2,3]. Petroleum, coal, oil shales, natural gases are fossil fuel sources which were created through certain chemical and physical phenomenon beneath the earth many years back [4,5]. They are still being formed, but their natural production is very slow, will take thousands of years, so they are not easily replaced as soon as their consumption, i.e. there reservoirs are limited that's why they are regarded as non renewable fuel [6]. Biofuels can be defined as, "All types of gaseous, liquid and solid fuels or energy carrier obtained from biomass". Biodiesel is fatty acid methyl esters having properties close to petrodiesel [11]. Its biomass feedstock is triglycerides of vegetable oil, which on reaction with alcohol result FAME. It is renewable, clean biofuel and produces negligible amounts of pollutants on combustion in diesel engines. Bio-oil is also a clean fuel like biodiesel which is produced when biomass feedstock subjected to a thermo chemical process like flash pyrolysis (FP) and hydrothermal liquefaction (HTL). In FP, the solid organic biomass feedstock is subjected to high temp (450-500°C) for a short period of time and in the absence of oxygen [12]. Mahua (*Madhuca indica*), a deciduous tree belongs to *Sapotaceae* family. It is found throughout the tropical and subtropical (mainly in central and north forest) region of the Indian subcontinent. It has socioeconomic values as about 30-40 percent of the tribal economy of India, primarily in northern India such as in Bihar, Madhya Pradesh and Orissa, are dependent on the Mahua flowers and seeds. Moreover, *Madhuca Indica* and *Madhuca longifolia* is two important species of Mahua in India, whose seeds are used for extracting yellowish oil (Mahua butter) generally meant for soap production. Mahua Seed yield ranges from 20-200 kg per tree every year, where oil content is 30-45%. Castor / Palma Christi or arand (*Ricinus communis*) is a species that belongs to the *Euphorbiaceae* family. It is a non-edible, poor soil resistant, a perennial oilseed crop that can be grown in tropical, subtropical (wild or cultivated), arid, semiarid region and even on marginal lands, which are not competitive with food production lands of the globe. At Present, India ranked one in the production as well as in export of castor oil (60 to 70% of world trade) in the world followed by China and Brazil. In India, it is grown on 713,000 hectares of rain fed land and it yields 850,000 tons of castor seeds per year. Although, castor is growing in nearly all provinces of India, but equally a matter of their production, Gujarat (83%) passes over other states followed by south Indian states. India exports 200,000 to 225,000 tons of castor oil and about 15000 tonnes castor seeds per year. In this study, we were analysed biodiesel properties of Mahua and castor oil of different part of Bihar.

The objectives of our study were to produce biodiesel from the locally purchased (from Bihar, India), soxhlet extracted *Madhuca Indica* and *Ricinus communis* seed oils by transesterification and to compare their

fuel characteristics.

2. Material & Methods :-

Castor and Mahua seeds were locally purchased from the Samastipur District of Bihar. Seeds were cleaned properly and kernels were removed. To reduce moisture kernels were dried using an electric oven. Dried kernels were grinded by using a mortar pestle to rupture the cell wall so that solute release for direct contact with solvent. On an electric balance kernels were weighed before and after the drying process.

2.1 Extraction of Oil :-

Extraction of oil from the kernels of Mahua and Castor was done by soxhlet apparatus using n-hexane as solvent at constant heat of 60°C for 6 hours. After that oil was recovered by solvent evaporation. Then recovered oil was again heated at a low temp to complete evaporation of solvent, leaving behind the oil.

2.2 Formation Of Biodiesel:-

Transesterification is the process used for the formation of Biodiesel from Mahua oil. In this process, pure Mahua oil was carried in 500 ml round bottom flask supported with water condenser, containing 16.5 ml of methanol and 100 ml of oil, and 0.82g NaOH (as A catalyst) at 60°C for half an hour. The mixture was allowed to settle for 24 hours before removing the glycerol layer from the bottom in a separating funnel to get the fatty acid methyl ester (biodiesel) layer on the top. The fuel characteristics like density at 15°C, Flash point, Pour point, Cetane number and sulfur content were determined by ASTM D 287, ASTM D 93, ASTM D 97, ASTM 613 and ASTM D 5453 methods respectively. The value of fuel characteristics, thus obtained were compared with standard value prescribed in ASTM D6751 & EN I4214 for biodiesel and as well as ASTM D975 for HSD.

Castor biodiesel has prepared by trans esterification process using methanol (300-330 ml) and conc. H₂SO₄ (10 ml). Whole process carried out for 1 L Castor oil at 65-70°C for 6 hr. on a thermo regulatory hot plate and after 8 hour settling time in a separating funnel. This settled reactant mixture would consist of bio diesel and traces of glycerine etc. bio diesel recovered from top layer [13].

3. Result and discussion :-

3.1. Isolation of Mahua oil and Castor oil

The 41.58 % and 33.25% by mass of Mahua seed oil and Castor seed oil respectively was obtained through solvent extraction method. Such yield might be depends on geographical conditions from where the seeds were collected.

3.2. Fuel characteristics

The fuel characteristics of Mahua and Castor biodiesel are given in Table 1. It was observed that that Mahua biodiesel fuel property was in agreement with those of the prescribed for petrodiesel, and within

the limits prescribed in the ASTM and EN standards for biodiesel. While Castor is beyond the limits in some properties like Cetane no, Flashpoint.

Table 1 shows a comparative fuel properties Mahua and Castor bio diesel.

Table 1: Comparative Fuel Characteristics of Castor and Mahua Biodiesel

Property	Flash Point	Sulfur content	Pour point	Density at 15 ^o	Cetane no
Unit	^o C	mg/kg	^o C	kg/m ³	^o C
HSD Limits (ASTM D975)	35	350	3-15	820-845	51
ASTM D6751	>130	15	-	870-900	47
EN 14214	>120	10	0 max	860-900	51
Castor biodiesel	59	18	0	840	44.5
Mahua biodiesel	>110	150	21.0	840	61.5

4. Conclusions

Flash point of Mahua and Castor biodiesel slightly higher than HSD. However, but Mahua has greater flash point than Castor which makes it advantageous over Castor bio diesel for its storage, handling and transportation. Again Mahua bio diesel has Cetane no slightly higher than HSD while Castor has low Cetane value comparing ASTM and EN standards. It shows Mahua bio diesel is better than Castor bio diesel for combustion. The higher Sulfur content in Mahua biodiesel is alarming, but the very high Pour point positively reflects its suitability in cold climate where as Castor shows low pour point. Therefore, the Mahua biodiesel has improved Cold flow property.

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