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STUDIES ON*ARGEMONE MEXICANA OIL*FOR ITS USAGE AS BIODIESEL

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ABSTRACT

Argemone mexicana is a herbaceous medicinal plant belonging to the family Papaveraceae. It is indigenous to Mexico. Nowadays it is distributed throughout the hotter parts of India, up to 1500 meters elevation as a weed. *A.mexicana* seeds were collected from the Agasthiyamalai Biosphere Reserve Forest of South Western Ghats regions. The seeds were crushed by using a Mortar and Pestle. The oil was extracted with hexane by using a Soxhlet apparatus. The oil was blended with the conventional diesel at 10% (B10) & 20% (B20) proportions for the physico chemical analysis. The physical properties assessed includes, pH, viscosity, density, specific gravity, flash point, fire point, cloud point, pour point, smoke point, carbon residue. The chemical properties analyzed were acid value, iodine value and saponification value. The evaluation was carried out for its potential use as a biodiesel and the results were discussed in the present communication.

KEYWORDS: ***Argemone mexicana,*** **Iodine value, Viscosity, Biodiesel, Flash point, Carbon residue.**

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INTRODUCTION

Biodiesel has become more attractive recently because of its environmental benefits and the fact that the biodiesel is made from renewable energy source [1]. The world energy crisis is a result of population growth and increasing energy consumption in both developed countries and emerging economies [2]. The greater demand for petroleum products are as a result of an enormous increase in the number of automobiles serves the growing problem of the developing countries. With crude oil reserves estimated to last only for a few decades, therefore efforts are on way to find out new alternatives to diesel [3]. Depletion of crude oil could cause a major impact on the transport sector. Of the various alternative fuels under consideration, biodiesel derived from vegetable oils appears to be the most promising alternative fuel to diesel [4] [5]. The non-edible vegetable oils are preferred as potential low priced biodiesel sources. The contribution of non-edible plant oil as a new source of biodiesel production has the advantage of not competing with edible oils produced from crop plants [6] [7]. A lot of research work has already been carried out to use vegetable oil both in a pure form and also in blended form. Studies have shown that the usage of vegetable oils in its pure form is possible but not preferable. Biodiesel can be used in pure form (100%) or blended with conventional diesel up to 20% to create a biodiesel blend fuel for its use in the compression ignition engines [9]. It can be used a stand-alone fuel and blend with petroleum diesel in diesel engine. [10]. Biodiesel can be used neat (B100%) or various blend ratios with diesel fuel. A blend of 5% (B5) can already be included within existing diesel fuel supplies without modification of the engine [website]. At present the Government of India is having a proposal to blend 5% biodiesel with the conventional diesel for domestic use from 2017 onwards. Biodiesel has attracted considerable interest as a substitute or a blend component of conventional petroleum diesel fuel (Petro Diesel). Biodiesel is defined as simple mono alkyl esters of long chain fatty acids prepared from vegetable oils or animal fats, possesses a number of technical advantages over petro diesel such as derived from renewable and domestic feed stocks, displacement of imported petroleum, inherent lubricity, essentially no sulphur content, superior flash point, reduced toxicity, eco-friendly and biodegradable. *Argemone mexicana L* belongs to the family Papaveraceae. It is indigenous to Mexico, but the plant is naturalized throughout the subtropical and tropical regions of the world. It is commonly known as Bhrahmadanthi (Sanskrit), Mexican Poppy, Prickly poppy (English), Satyanasi (Hindi), Ummatta (Kannada), Ponnummattu (Malayalam), Kutiyotti, Bramhadantu (Tamil), Bhahmadandicettu (Telugu). The plant is profusely branched, prickly annual herb attains a height of 60-90 cm with yellow latex on the plant body [11] [12]. The leaves are simple, sessile, and spiny. The flowers are large, bright yellow coloured produced on terminal short leafy branches. The fruits are prickly capsules, oblong-ovoid, opening by 4-6 walls with numerous black seeds. The leaves are used in treating wounds and skin diseases. The seeds are useful in skin diseases, leprosy, dental caries, and rheumatism. The latex is used in skin diseases, jaundice, and inflammations [13] [14]. Two aliphatic compounds; mexicanol & mexicanic acid have been isolated from the leaves. Three isoquinoline alkaloids have been isolated known as dihydropalmitine hydroxide, berberine & protopine from the seeds.The oil contained up to 40% free glycerides of fatty acids.

MATERIALS AND METHODS

Collection, extraction, purification and preparation of Argemone Mexicana oil

The *Argemone Mexicana* fruits were collected from the Agastyamalai Biosphere Reserve Forest area of South Tamilnadu. The fruits were dried, and dehulled to obtain the seeds. The seeds were separated, dried and the impurities were removed by hand-picking. The seeds were crushed by using a laboratory mortar and pestle. The bulk of the oil was extracted using by Soxhlet apparatus

with hexane for 24 hours. The diesel used was purchase at Indian oil Filling Station, Thuckalay, Tamilnadu, India. The *Argemone Mexicana* oil was mixed with the conventional diesel in two different proportions namely at BI0 (90% diesel and 10% *A.mexicana* oil) and at B20 (80% diesel and 20% *A.mexicana* oil). The physico-chemical properties were evaluated for the blended proportions of biodiesel and petro diesel.

Physico-chemical analysis

The specific gravity and density were determined using the specific gravity bottle and were estimated using the equations below

$$SG = \frac{Massof Oil}{Massof\ an\ equalvolumeofwater}$$

$$Density = \frac{MassofBiodiesel}{VolumeofBiodiesel}$$

The fire point, flash point, smoke point, carbon residue, cloud point, pour point were carried out. The fire point was carried out by using the Clevenant open cup apparatus. The flash point was determined by using Pensky-Martens closed cup tester apparatus. The cloud point and pour point were obtained by using Deep vision Cloud point apparatus. Carbon residue was determined by using the Conradson carbon residue apparatus. The smoke point was determined using Seta Smoke point apparatus. The viscosity was measured by using calibrated Ostwald Viscometer. The pH was determined by using Elico pH meter. The econometric and acidimetric chemical properties were analyzed for the *Argemone Mexicana* oil. The econometric constant namely the Iodine value was determined by Wijs method. The acidimetric constant namely the Acid value and saponification value were measured by AOAC method. The average molecular weight of the oil was determined by using their acidimetric chemical constant. The free glycerol was determined by ASTM D6584 method.

RESULTS AND DISCUSSION

The oil content of the dried seed is about 35% on dry weight basis. The physical parameters such as flash point, fire point, smoke point, cloud point, pour point, carbon residue, pH, Specific gravity, density and viscosity were measured for diesel and the *A.mexicana* oil biodiesel blended at 10% (B10) and 20% (B20) proportions. The results were given in the Table 1. The chemical parameters such as iodine value, acid value, and saponification value were estimated and presented in the Table 2. The flash point of these B10 and B20 are almost equal to the petro diesel and the values are within the range specified for petro diesel (Manufacture of Fuel standard comparison table, http://www.rix.co.uk). The flash point of biodiesel is higher than that of fossil diesel so it clearly indicates that biodiesel is safer to handle than fossil diesel. The fire point of the blends B10 and B20 are almost equal and the B20 is slightly higher than that the petro diesel, and which falls within the range of the ASTM Standard (American Society for Testing and Materials). This indicates the biodiesel is safer to handle in the feedstock and use in the engine. This clearly indicates that the biodiesel is nonpolluting. The smoke point of the biodiesel blends are less than the petro diesel but within the range of the ASTM standards. The carbon residue is slightly higher than the petro diesel. The high value of carbon residue may be due to the impurities in the biodiesel blends that can be removed by further filtration. But the values are within the ASTM standard. The Cloud point and Pour point is slightly higher than the petro diesel, because of the fatty acids and the nature of fatty acids present in the biodiesel blends. The pH of the biodiesel blends are slightly less than the petro diesel which also indicates the biodiesels are more acidic than the conventional diesel due to the presence of fatty acid and that can be easily altered. The density and viscosity and specific gravity are important when considering the spray characteristic of the fuel within the engine. Higher density and viscosity of the liquid fuels affects the flow properties of the fuel, such as spray atomization, subsequent vaporization and air-

fuel mixing in the compression chamber. The change in spray can greatly alter the compulsion properties of the fuel mixture. Specific gravity, Viscosity and density of vegetable oil is several times higher than that of diesel. By mixing the vegetable oil with the conventional diesel with B10 and B20 the specific gravity, density and viscosity were found to be slightly higher than that of diesel and it is within the range of the ASTM standard value for the biodiesel. The chemical parameter, the acid value of the blends indicates that the amount of fatty acid present in the sample. The acid value of blends is slightly higher than that of the ASTM standard. The number of double bonds present in a vegetable oil is calculated by treating with iodine. The higher the iodine number is the amount of iodine needed to be saturate or break the double bonds. From the result the iodine values of biodiesel blends are lesser than the petro diesel and it is within the range of ASTM standard for the biodiesel. The saponification value can indicate the non-fatty impurity and the amount of alkali that could be required by the fat for its conversion to soap. In the biodiesel blends the saponification values are less than that of the petro diesel. However the saponification value is found to be within the acceptable range of biodiesel. The present study on *A.mexicana* oil blended with the conventional diesel shown that most of the physical and chemical properties evaluated for the biodiesel blends (B10 and B20) falls within the range of ASTM and EN standard values. The values are nearer to the conventional diesel properties. It could be concluded from the study that the biodiesel produced from *A.mexicana* oil blend B20 is the most potent source of biodiesel. It can be a replacement for fossil diesel. The production and effective use of biodiesel blend B20 will help to reduce the cost effect the production of energy. It is eco-friendly and protect the environment from the various hazards. The plant *A.mexicana* is found as a weed in most of the fallow lands. It grows naturally during the monsoon seasons. As it is a weed, the cost of production of oil is very less when compared to other agricultural commercial crops. It could be tamed under cultivation through biotechnological methods the yield potential may increase. The production and usage of *A.mexicana* biodiesel will boost the economy of the country.

Table 1
Physical properties of Argemone Mexicana L. oil blend B10, B20 and diesel.

Parameters	*Argemone mexicana* L.		Diesel
	B10	B20	
Flash point	34.2°C	41.3°C	47.2ºC
Fire point	40.5°C	49.1°C	54.0ºC
Smoke point	6mm	5mm	9mm
Carbon residue	0.2gm	0.18gm	0.2g
Cloud point	4°C	5°C	3 ºC
Pour Point	2°C	1°C	0°C
pH	5.6	4.8	6.8
Specific gravity	0.951	0.958	0.880
Density	0.809g/cm^3	0.816g/cm^3	0.804g/cm^3
Viscosity	3.7	3.9	3.5

Table 2
Chemical properties of Argemone Mexicana L. oil blends B10, B20 and diesel

Parameters	*Argemone mexicana* L.		Diesel
	B10	**B20**	
Acid value	101.4	233.7	16.31
Iodine Value	9.582	16.526	6.838
Saponification value	134.6	168.2	109.41

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