

PHYSICO-CHEMICAL ANALYSIS OF *CLEOME VISCOSE* L. OIL: A POTENTIAL SOURCE FOR BIODIESEL

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ABSTRACT

Cleome viscosa L. is an annual herb belonging to the family Capparidaceae, which is commonly found in Asia. The *Cleome viscosa* seeds were collected and the oil was extracted by using a hydro-carbon solvent. The Physico-chemical properties of the oil obtained from the seeds of *Cleome viscosa* has been analyzed for its potential use as a Biodiesel. The physico-chemical properties were analyzed by blending the oil with the conventional diesel at 10% (B10) & 20% (B20) proportions and compared with that of diesel. The physico-chemical properties assessed includes, specific gravity, density, viscosity, flash point, fire point, cloud point, pour point, smoke point, pH, viscosity, carbon residue, saponification value, acid value, and iodine value. The results were presented and discussed in the present communication.

Keywords: *Cleome viscosa*, Biodiesel, Ethnobotanical, Naikkaduku

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INTRODUCTION

Biofuel is a nonpolluting, locally available, accessible, sustainable, and reliable fuel obtained from renewable sources. The liquid biofuels are obtained from plant resources like lipids, simple sugars and polysaccharides¹. Biodiesel refers to vegetable- oil or animal fat based fuel consisting of alkyl (methyl, propyl, or ethyl) esters obtained by chemical reaction of the lipids (vegetable- oil, animal fat) with an alcohol^{2,3}. Biodiesel is a clean burning alternative fuel to diesel. It is produced from domestically grown renewable resources⁴. Chemically most biodiesel consist of alkyl esters instead of the alkanes and aromatic hydrocarbons of petroleum derived diesel.

Cleome viscosa L belonging to the family Capparidaceae⁵. It is an annual sticky herb with strong penetrating odor. The plant is clothed with glandular and simple hairs⁶. It's widely distributed herbaceous plant with yellow flowers and long slender pods containing seeds, which is similar that of mustard. In Tamil it is known as Naikkaduku. It is found as a weed throughout the larger part of Indian Subcontinent, often in waste places^{7,8}. The native of the plant is Africa and S. Arabia to Australia^{[9], [10]}. The leaves are diaphoretic, rubefacient and vesicant. They are used as an external application to wounds and ulcers. The juice of the leaves has been used to relieve earache. The seeds are anthelmintic, carminative, rubefacient and vesicant. The seeds of *C.viscosa* are used to treat fever, diarrhea, and infantile convulsion⁹. *C.viscosa* is a popular remedy for a variety of ailments as documented in Ethno-botanical surveys and traditional systems of medicine, such as Ayurveda, Siddha and Unani.

EXPERIMENTAL

Collection, extraction and preparation of *Cleome viscosa* oil

The *Cleome viscosa* fruits were collected from the Agastyamalai Biosphere Reserve Forest area of South Tamilnadu, India. The fruits were dried, and dehulled to obtain the seeds. The seed were separated, dried

and the impurities were removed by hand-picking. The seed were crushed by using a laboratory mortar and pestle. The bulk oil was extracted by using Soxhlet apparatus with hexane for 24 hours. The diesel used for the experiment was purchased at Indian oil Filling Station, Thuckalay, Tamilnadu, India.

The *Cleome viscosa* oil was mixed with the conventional diesel in two different proportions namely at B10 (90% diesel and 10% *C.viscosa* oil) and at B20 (80% diesel and 20% *C.viscosa* oil). The physico-chemical studies were carried out for the blended proportions of biodiesel.

Physico-chemical analysis

The specific gravity and density were determined by using the specific gravity bottle and the values were calculated by using the equations below-

$$\text{Specific gravity} = \frac{\text{Mass of Oil}}{\text{Mass of an equal volume of water}}$$

$$\text{Density} = \frac{\text{Mass of Oil}}{\text{Volume of Biodiesel}}$$

The fire point, flash point, smoke point, carbon residue, cloud point, pour point were carried out for the blended biodiesel at different proportion. The fire point was analyzed by using Cleveland open cup apparatus. The flash point was determined by using Pensky-Martens closed cup tester apparatus. The cloud point was obtained by using Deep vision cloud point apparatus. The pour point was analyzed by using Deep Vision pour point apparatus. Carbon residue was determined by using Conradson carbon residue apparatus. The smoke point was observed by using Seta Smoke point apparatus. Viscosity was measured by using calibrated Ostwald Viscometer. The specific gravity was measured by using Borosil glass bottle. The pH was determined by using Elico pH meter.

The econometric and acidimetric chemical properties were analyzed for the *Cleome viscosa* oil blended with conventional diesel at B10 and B20 proportions. 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 the standard AOAC method.

RESULTS AND DISCUSSION

The oil content of the dried seed of *Cleome viscosa* is about 24-26% on dry weight basis. The oil is non edible but it is used as medicine for some human ailments. The physical properties of flash point, fire point, smoke point, cloud point, pour point, carbon residue, pH, specific gravity, density and viscosity were measured for diesel and the Cleome oil biodiesel blended at 10% and 20% proportions. The results were given in Table- 1. The 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 Fuels standards comparison Table, <http://www.rix.co.uk>). The flash point of biodiesel is higher than that of fossil diesel so it clearly indicated that biodiesel is safer to handle than fossil diesel. Fire point of the blends B10 and B20 are almost equal and the B20 are slightly higher than that the petro diesel, and which falls within the range of the ASTM Standard (American Society for Testing and Materials). This also indicates that the biodiesel is safer to use. 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 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 biodiesel is more acidic than the conventional diesel due to the presence of fatty acid. The density, 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 compression properties of the fuel mixture. Specific gravity, viscosity and density of vegetable- oil are 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 properties like 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 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 in the fatty acid. From the result the iodine values of biodiesel blends are lesser than the petro diesel and it is within the range of ASTM standard of the biodiesel. The saponification value can indicate the non-fatty acid 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 with in the acceptable- range of biodiesel.

The present study on *C.viscosa*oil has 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 present study that the biodiesel produced from *C.viscosa* oil blend B20 is the most potential source of biodiesel. It can be a replacement for fossil diesel. The production and effective usage of biodiesel blend at B20 will help to reduce the cost effect the production of energy. It is eco-friendly and protect the environment form the various environment hazards. The plant *C.viscosa* is found as a weed in most of the fallow lands¹¹. It grows naturally during the monsoon seasons. As it is a weed, the cost of production of oilisvery less when compare to other agricultural cash crops. It could be tamed under cultivation and improve the crop production through biotechnological methods. The production of the biodiesel *C.viscosa*biodiesel will boost the economy of the country.

Table - 1: Physical properties of *Cleome viscosa* oil B10, B20 and diesel.

Parameters	<i>Cleome viscosa</i>		Diesel
	B10	B20	
Flash point	49.3°C	46.8°C	47.2°C
Fire point	53.9°C	53.7°C	54.0°C
Smoke point	8mm	5mm	9mm
Carbon residue	0.14g	0.15g	0.2g
Cloud point	5 °C	2°C	3 °C
Pour Point	1 °C	2 °C	0 °C
pH	5.7	5.1	6.8
Specific gravity	0.933	0.940	0.880
Density	0.813g/cm ³	0.829g/cm ³	0.804g/cm ³
Viscosity	3.7	3.9	3.5

Table- 2: Chemical properties of *Cleome viscosa* oil B10, B20 and diesel

Parameters	<i>Cleome viscosa</i>		Diesel
	B10	B20	
Acid value	81.1	141.9	16.31
Iodine Value	3.2	12.04	6.838
Saponification value	86.9	151.4	109.41

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