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PHYSICO-CHEMICAL ANALYSIS ON CROTON TIGLIUM OIL FOR POTENTIAL USE AS BIODIESEL

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ABSTRACT

The increasing consumption of energy with the depletion of crude oil reserves urges the usage of alternative fuel. Since there is an existing demand for edible vegetable oils, waste vegetable oils and non-edible crude vegetable oils are preferred as potential low priced biodiesel sources. In this present work the utilization of a commonlyavailable bioenergy crop in the Western Ghats region,Croton tigliumis evaluated for its use as biodiesel by physico -chemical analytical method. The Croton tiglium is a member of Euphorbiaceae family. It is a multi-functional bioenergy crop of significant economic importance because of its several industrial and medicinal purposes.The Physico- Chemical Properties of the oil was analyzed by blending with conventional diesel at 10%(B10) and 20%(B20)proportions.The properties assessed in the physical parameters includes,pH,Density Salinity, Viscosity, Specific gravity, Conductivity, Total dissolved solid and Total dissolved oxygen. The significant biodiesel characters like flash point, fire point, smoke point, pour point, cloud point andcarbon residue were also assessed. The chemical parameters estimated such as Acid value, Iodine value and Saponification value. The values were compared with the ASTMT standards of biodiesel. The blend B20 is found to be within the ASTM standard and it can serve as a potential source for biodiesel.

KEYWORDS: **Croton tiglium, Biodiesel, Physico-chemical parameters.**

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INTRODUCTION

Croton tiglium is a small tree belongs to the family Euphorbiaceae. It is commonly called Neervalam (or) Nirvalamin Tamil, Purging Croton in English,Cadalavanacu in Malayalam,NaepalvaemainTelungu,Kanakaphala in Sanskrit,JamaalGota in Hindi and Urdu.The plant is commonly found in native to Asia from India to New Guiena and Java, North Indonesia and China[1]. It is also found wild throughout the Philippine Islands, where it is also cultivated to a limited extent. It is often becoming naturalized after cultivation. It is grown in SouthernCalifornia and elsewhere as an ornamental and curious plant occurs in for its medicinal uses.It grows up to an elevation of 1500m. It grows in mixed forest and commonly planted in towns.The plant has a few spreading branches bearing alternate petiolate leaves, which are ovate to acuminate with serrated or smooth margin. The leaves are dark green on upper surface paler beneath and furnished with two glands at base. Flowers are in erect terminal racemes. The lower ones are female flowers and the upper malewith straw coloured petals. Fruitsare smooth capsule of the size of a filbert, three cells, each containing a single seed. These seeds resembles like Castor beans in size and structure, oblong, rounded at the extremities with two faces. The kernel is yellowish brown and it contains 45-50% oil. The oil is obtained by expression from the seeds. The Croton oil consists chiefly of the glycerides of stearic, palmitic, myristic, lauric and oleic acids.The Croton oil is used to treat various aliments of human beings.The seeds are mainly used as purgative. The active principle is believed to be Crotonic acid, which is freely soluble in alcohol.The plant is used as a cathartic in Ayurvedic system of indigenous medicine[5]. The various parts like roots, fresh leaves, seeds and oil from the seeds are commonly used as medicine for disease likerheumatic pains of the legs and waist. It is used as antidote to snake bites. It is also used as insecticide for venomous insect bites.The processed seed are used in treating Flatuence,Dyspesia, Constipation, Colic, Edema, Dysponea,and Persistent cough. Croton seed oil has been used as purgative, for treatment of schistosomiasis roots, bark, seeds, leaves are considered a drastic purgative[6,7]. Bruised root has been applied to carbuncles and cancerous sores.The testa of the seed is used for fluxes. In Annam, bark is used as a tonic. Root decoction is used asabortifacient by the tribal people. The roots are also used for cutaneous affections, like eczema, ichthyosis and erythema. A seed, while half-roasting over a lamp or candle flame, is inhaled through the nostril to relieve asthma. The seed oil and bark isused in folk remedies for cancerous and tumours[2]. The plant is used fordiaphoretic, ecbolic, emitic, emmenaogue, rubefacient and vesicant.Purging croton is a folk remedy for apoplexy, cancer, carbuncles; scabies skin disease, throat and toothache[3,4]. Plant is universally used as fish poison in tribal areas.The Arbour arrow poison of the northeast frontier Assam is a paste believed to be made from pounding soft plant parts of Croton tiglium. When seeds are used as fish poison they are pulverized, put in sacks, and placed in ponds or rivers. Nowadays the plant is reported to have antifungal and antibacterial activity[8]. Many authors have reported the vegetable oil of non-edible plant can be used as potential source of biodiesel[9,10].Many authors compared the blends with different content biodiesel. The authors believed that, with increasing the content of biodiesel, engine fuel consumption will increase[11,12]. Carraretto et al[13] found that the increase of biodiesel percentage in the blends resulted in a slight decrease of both power and torque over the entire speed range for different blends (B20, B30, B50, B70, B80, B100) of biodiesel and diesel on a 6-cylinder DI diesel engine. Currently, there is resistance from engine manufacturers to warrant engines above 5% biodiesel blends[14,15].

MATERIALS AND METHODS

Collection

The Croton tiglium seeds were collected fromKani the tribal settlement of Mothiramali, AgasthiamalaiBiosphre Reserve Forestof KanyakumariDistrict in Tamilnadu, India.

Extraction

The seeds were dried and dehulled and the impurities were removed by hand picking.The seed were crushed by using a laboratory mortar and pestle. The oil was extracted by using Soxhlet apparatus withthe solvent,Petroleumether for 48 hours.

Blend preparation

The diesel used for the experiment was purchased at Bharat Petroleum, Marthandam Tamilnadu India.The blends were made on a volume basis and stored in glass bottles at room temperature. A blend of 20% biodiesel with 80% conventional petroleum diesel, by volume, is termed ‘‘B20” and a blend of 10% biodiesel with 90% conventional petroleum diesel, by volume, is termed ‘‘B10”. The PhysicoChemical studies were carried out for the blends of biodiesel.

Physico- Chemical Analysis

Croton tiglium oil blends (B10 and B20) were analyzed for various physical chemical properties. The physical parameters studied werepH,specific gravity,viscosity, density, and significant biodiesel properties like fire point, flash point, smoke point, cloud point, carbon residue. The general physical parameters include conductivity, salinity, total dissolved solid, and total dissolved oxygen. The acidimetric constant chemical properties such as the Acid value, Iodine value and Saponification value were analyzed. The pH was determined by using Elico pH meter. The specific gravityand density was measured by using Borosil glass bottle method. Viscosity was measured by using calibrated Ostwald Viscometer. 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. The Smoke point was observed by using Seta Smoke point apparatus. Carbon residue was determined by using Conradson carbon residue apparatus. The econometric constant namely the Iodine value was determined by Wijs method. The acidimetric namely acid value and saponification value were measured by the standard AOAC method.

RESULTS AND DISCUSSION

The oil content of the dried seed of Croton tiglium is about 45% on dry weight basis. The General Physical properties of Croton tiglium oil such as pH ,Specific gravity, Viscosity,density, total dissolved solid and total dissolved oxygen were measured for blends at 10%, 20% proportions. The results were given in Table1. The Significant physical properties of the oil such fire point, flash point, Cloud point, Pour point, Smoke point, Carbon residue were measured for blends of 10% and 20% proportions. The results were given in the table-2. The chemical properties of the oil such as Acid value. Iodine value and Saponification value results were recorded in the Table -3.The pH of 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 specific gravity is 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 automation, subsequent vaporization and air-fuel mixing in the compression chamber. The change in spray can greatly alter the compression properties of the fuel mixture. The Specific gravity, Density and viscosity of vegetable oil are several times higher than that of diesel. By mixing the vegetable oil with the conventional diesel with 10% and 20% the Specific gravity, Density and Viscosity were found to slightly higher than that of diesel and it is within the range of the ASTM standard value of the biodiesel. The fire point of the blends B10 and B20 are almost equal and the B20 are slightly higher than that of petro diesel, and which falls within the range of ASTM standard.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. The flash point of the biodiesel is higher than that of fossil fuel, so it clearly indicated that biodiesel is safer to handle than fossil fuel. The cloud point and pour point is slightly higher than the petro diesel, because of the fatty acids and the natureof fatty acids present in the biodiesel blends. The Smoke points of the biodiesel blend are less than the petro diesel but within the ASTM standard

value. Thecarbon residue is slightly higher than the petro diesel. The high value of carbon residue may be due to the impurities present in the biodiesel blends.The acid value of blends indicates that the amount of fatty acid present in the sample. The Acid value is slightly higher than that of ASTM standard because of the presence of the long chain unsaturated fatty acid in the blends. The number of double bonds present in the 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.Here 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 within the acceptable-range of biodiesel.The present study on Croton tiglium 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 Croton tiglium oil blend B20 is the most potential source of biodiesel. It can be a replacement for fossil fuel. The production and effective usage of biodiesel blend at B20 will help to reduce the cost effect in the production of energy. It iseco-friendlybiodegradable and protects the environment from the various environmental hazards. The plant Croton tiglium is found naturalized in many parts of India and Sri Lanka Now a days it is often cultivated because of its export potential. The plant yields in the third year and it is about 200-750kg seed/ha, Full bearing of the plant starts after 6 years and it will be about 750-2,000kg/ha. In addition to this oil source the plantparts can be used as a viable source of Traditional System of Medicine. United States imports Croton tiglium about 1.5 MT/Anum from Germany and United Kingdom. Export of seeds from Sri Lanka and India were reported before Independence.

Table 1

General Physical properties of Croton tiglium oil blends B10, B20 and diesel

Parameters	Croton tiglium Oil Blends		Diesel
	B10	B20	
pH	4.39	4.52	6.8
Specific Gravity	0.85	0.86	0.880
Density(g/ml)	1.010	1.056	0.804g/cm^3
Viscosity(Nm-2s)	7.36	9.28	3.5
Conductivity(µs)	0.58	0.60	0.00
Salinity(ppt)	0.00	0.00	0.00
Total dissolvedsolid(ppm)	0.24	0.25	0.00
Total dissolved oxygen(ppm)	6.8	10.5	0.00

Table 2

Significant Physical properties of Croton tiglium oil blends B10, B20 and diesel

Parameters	Croton tiglium Oil Blends		Diesel
	B10	B20	
Fire point	54.4^{o}C	44^{o}C	54.0^{o}C
Flash point	54^{o}C	36.9^{o}C	47.2^{o}C
Cloud point	6^{o}C	8^{o}C	3^{o}C
Pour point	3^{o}C	3^{o}C	0^{o}C
Smoke point	13mm	8mm	9mm
Carbon residue	0.1g	0.15g	0.2g

Table 3
Chemical Properties of Croton tiglium oil blendsB10, B20 and diesel

Parameters	Croton tiglium Oil Blends		Diesel
	B10	B20	
Acid value (mg KOH/g)	34.64	37.18	16.31
Iodine value	13.493	14.534	6.84
Saponification value	305.79	322.63	180.41

CONCLUSION

Biodiesel has become more attractive recently because of its environmental benefits and the fact that it is made from renewable resources.The world energy crisis is a result of population growth and increasing consumption of energy in both developed countries and emerging economies. The use of such bio energy crops for biodiesel adds environmental benefit such as emission of low smoke and particulate matters, thereby developing an eco-green environment. Also cultivation of bio energy crops results in the utilization of waste lands, preventing soil erosion As Croton tiglium is a quick growing small tree naturalized in India with high oil content (about 45%), the cost of production of oil isvery less when compared to other agricultural cash crops. Further it could be tamed under cultivation and improve the crop production through biotechnological methods. The production of the Croton tiglium will enhance the economy of our county through export of the seeds. By using the oil as biofuel it will reduce the import of fossil fuel.

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