



Planning and Evaluating Veg Oil Catalytic Separating Products Utilizing Acidified Catalysts

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ABSTRACT

There is no doubt that petroleum is essential to our way of life. It is known that petroleum is a nonrenewable source of vitality since petroleum generation all over the globe will not exceed 30 years, and as a result, oil will run out some day in the future., thus it may be necessary to find out other sources of vitality to advance with ease. Investigators are now seeking contemporary alternatives to fossil fuel. Biofuels are considered the most environmentally safe fillers that may be employed. In this study, Egyptian Oil - induced and Safflower oils were obtained and converted into their contrasting biofuels using catalytic breaking with catalysts that are diversified (Alumina and Montmorillonite - HCl) in varying proportions (0.2 percent, 0.4 percent, 0.6 percent, 0.8 percent & 1 percent). The following biofuel generation circumstances were investigated: catalyst type, catalyst proportion (percent), change time, and temperature. The obtained items' findings were equivalent to The United States Society for Quality (ASTM) standards.

Keywords: Catalytic going to crack; biofuels; seed oil; almond oil; fuel properties.

1. INTRODUCTION

Crude oil is a substance recognized to be the source of fuels, lubricants, heat and power generation sources, and raw materials in the petrochemical industry. It is also recognized that petroleum-derived fuels have a negative impact on the environment; biofuels are thought to be the most environmentally friendly fuels available. A sustainable alternative fuel that has no harmful ecological, financial, or cultural consequences.

Sustainable biofuels should not compete with food or freshwater resources, nor should they contribute to deforestation, while also providing socioeconomic value to local communities where plant stocks are grown. Jatropha and castor oil are two oil-based energy crops that can meet these sustainability criteria. The use derived from oil extracted from seeds is favorable because it is a non-edible oil that will not compete with food crops. Biodiesel, as opposed to conventional petroleum diesel, is a clean energy source. The commercialization of

biodiesel in several countries is in addition to the advancement of criteria to ensure good biofuel performance.

According to ASTM standards, biodiesel is characterized by determining its physical and fuel properties such as density, viscosity, iodine value, acid value, cloud point, pour point, and volatility. Biofuels are preferable to petroleum diesel for a variety of reasons, including their ease of transport, renewable nature, effectiveness. in the combustion process, low aromatic, sulphur content, and high cetane number [1] , and biodegradability.[2] When compared to petroleum diesel, biodiesel has higher parameters such as viscosity, cloud point, pour level, oxides of nitrogen emission, and engine minimize; and carry parameters such as fuel content, engine pace, and engine compatibility.[3]

In terms of safety, biodiesel outperforms petroleum diesel because it is less combustible and has a higher flashpoint.[4] These biodiesels can be blended. in any proportion in conjunction with petroleum diesel or used directly utilizing diesel engines without alteration.[5] Biodiesel's high cost has a significant impediment to commercializing it.[6] The cost of raw materials accounts for 80% of the total cost of biodiesel production.[7] Biofuels are produced through the crack formation of various plant oils, including Alcea pale oil [8]. Oils of wood [9, 10], Soy proteins [10], palm kernel oil [11], textile canola oil [12], Seed oil [13], and disposal oils [14] are all examples of plant oils. Fatty acids are cracked either thermally without the use of a catalyst [15] or chemically with alkaline catalysts [16], metal oxides [17], and zeolite.[18-20] For commercial purpose, reduced raw materials such as Egyptian plant oils (ECO), grown in Upper Egypt's Al-Alaki valley and covered with water, industrial and pretreated wastewater, are indeed being considered for producing biodiesel. Upper Egypt widely produces almond oil in the southwestern regions in an area of approximately 2,000,000 ha and generating and over 250,700 metric tons of seed per year.[21] Almond oil yield oilseed is approximately 40-60%. Furthermore, Castor plants are becoming more prevalent popularity due to their low maintenance requirements and fewer crop husbandry management practices.[21] The goal of this study was to compare the fuel properties of bioethanol production through carbonization of Egyptian canola oil and seed oil crude oil to those of Petro-diesel.

2. MATERIALS AND METHODS

2.1. Materials

Hydraulic pressing was used to extract oil methyl esters and Canola oil from oil extracted and Canola oil seeds; ceramic and Magnetite catalysts were purchased from the producer (Sigma-Aldrich, Germany).

2.2. Methodologies

2.2.1. Seed oil and Canola oil extraction

500 g of dry oil extracted, and Canola oil seeds crushed individually in a hydraulic push to extract the oil. After centrifuging the oil to remove any solid contaminants and water, it was used without further purification or treatment.

2.2.2. Catalytic cracking of *Jatropha* and *Castor oil* into biodiesel

The following catalytic cracking procedures were carried out: In a 500 mL two-necked flask, Seed oil and Canola oil in the amount of 150 mL were billed individually, and Catalysts (Alloy and Magnetite) were added individually at different ratios of (0.2 percent, 0.4 percent, 0.6 percent, 0.8 percent, and 1 percent) by weight relative to oil. The mixture was mixed and

subjected to 4 hours of thermal agitation at 250 °C. A condenser was used to collect the reaction products and determine their volumes. Biofuels extracted from the two oils were settled in a separating funnel to separate the produced water, and then centrifuged to remove any contaminated or dispersed water. The reaction was completed, and the products were as follows: 75% bioethanol, 15% moisture, 3% solid particles, and the rest is waste remainder vapors. The motivator to a metal ratio (percent), conversion temp, and duration are all factors that influence the transformation of oil methyl esters and Canola oil biodiesels. These parameters were investigated to achieve the optimal conversion reaction conditions.

2.2.3. Characterization of oil

The fatty acid composition of the obtained oil methyl esters and Canola oil was determined using GC-Chromatographic analysis on a GC-7890A equipped with a DB-23 column, 60 mm x 0.25 mm, with an i.d. of 0.25 m. The following jatropha and castoroil properties were determined calculated value, the acid real value, motion kinematic viscosity at 40°C, intensity, fog point, pour level, peroxide value, and ash contents are all factors to consider.

2.2.4. Specification for biofuel

ASTM standards have been used to find the density, higher flash, boiling points, cloud point, dynamic viscosity at 40 °C, moisture content, total sulfur dioxide, metal corrosion strip, carbon content, and mineral content of the acquired biofuel production [22-30]. The suitable blends of bioenergy and energy were characterized.

3. RESULTS AND DISCUSSION

3.1. The unique properties of oil methyl esters and Canola oil

Table 1 shows properties and fatty acid profiles of Jatropha and Castor oils.

Table 1 The fatty acid profiles Jatropha and Castor oil characteristics

Estate	Castor essential oil	Jatropha essential oil
Composition of fatty acids (wt %):		
Palmitic acid (C16:0)	1.00	15.20
Palmit-oleic acid (C16:1)	-----	0.70
The acid stearic (C18:0)	-----	6.80
The acid oleic (C18:1)	3.00	44.60
The acid Linoleic (C18:2)	5.00	32.20
The acid Linolenic (C18:3)	1.00	-----
The acid Arachidic (C20:0)	-----	0.20
The acid Ricinoleic (C18:1, OH)	89.00	-----
Acid calculation, (mg KOH/g)	3	3.81
K.Viscosity @40 °C,(mm ² /s)	43.1	37.1
Density, (g/cm ³) at 15 °C	0.95	0.91
fog point, (°C)	8.1	8
Pour level, (°C)	3	3
Stability of oxidation, (h)	5.51	2.56
Iodine content, gI ₂ /100 g oil	80.6	104.4
Sulphur level %	0.00	0.00

3.2. Properties of the obtained biofuel

The obtained biofuels' characteristic specifications were determined using (ASTM) specifications. Tables 2-5 list concentration, higher flash, water content, fog point, dynamical friction coefficient at 40°C, water holding capacity, total sulfur dioxide, copper rust strip, carbon content, and mineral composition were all measured.

Table 2. Physical & chemical properties of biofuels results from catalytic cracking of Jatropha oil with Alumina catalyst with different concentrations (0.2, 0.4, 0.6, 0.8, 1.0 % conc.)

Properties							Standard Test Methods
		0.2%	0.4%	0.6%	0.8%	1.0%	
Density at 15 °C	gm/cm ³	0.8989	0.8991	0.8991	0.8992	0.8992	ASTM D-4052
Flash P. (P.M.C.C)	(°C)	45	44	45	45	44	ASTM D-93
Pour level	(°C)	-3	-6	-3	-6	-3	ASTM D-97
Fog Point	(°C)	3	6	3	3	6	ASTM D-2500
Kinematic Viscosity at 40 °C (CSt)		6.04	6.07	6.1	6.11	6.11	ASTM D-445
Water Content	(vol. %)	15	14	17	15	16	ASTM D-95
Sulfur Total	(wt. %)	0.01	0.01	0.02	0.02	0.02	ASTM D-4294
Copper Corrosion Strip at 50 °C/2h		1A	1A	1A	1A	1A	ASTM D-130
Carbon Byproduct (wt. %)		0.050	0.060	0.060	0.060	0.070	ASTM D-4530
Carbon Byproduct (wt. %)		0	0	0	0	0	ASTM D-482

3.3. The optimal blend of obtained biofuels and gas oil fuel

There are numerous combinations of prepared biodiesel as well as gasoline fuel were created in this study. The appropriate blend of obtained biodiesel as well as gasoline fuel was (10% Biodiesel + 90% petroleum fuel diesel). According to Standard test method specifications' reference standards, when compared to diesel fuel, the outcomes of this biodiesel and its blends were within the range that is acceptable. When the composite measure of prepared biodiesel to diesel fuel exceeds 10%, the obtained biofuel's spark point falls below ASTM standards (less than 52 °C).

3.3.1. Motion analysis Viscosity at 40 °C.

Motion analysis viscosity at 40 °C describes fluid flow properties as well as their proclivity to deform under stress. Motion analysis viscosity is measured in centistokes (cSt). In ASTM standards D-445 [24], the kinematic viscosity of gas oil at 40 °C should be between (1.6 cSt –7.0 cSt). The prepared plant-diesel fuel blends' kinematic viscosity values were included in ASTM range (3.07 cSt – 3.13 cSt).

3.3.2. Cetane Number

The ability of the fuel to ignite quickly after injection is defined by the cetane number (CN). A higher value of (CN) indicates that the fuel's ignition quality is better. Following ASTM D-4737 [29], the cetane number for gas oil should be 40 as minimum. The prepared

Table 3. Physical & chemical properties of biofuels results from catalytic cracking of Castor oil with Alumina catalyst with different concentrations (0.2, 0.4, 0.6, 0.8, 1.0 % conc.)

Properties							Standard Test Methods
		0.2%	0.4%	0.6%	0.8%	1.0%	
Density at 15 °C	gm/cm ³	0.9211	0.9213	0.9213	0.9214	0.9216	ASTM D-4052
Flash P. (P.M.C.C)	(°C)	45	46	44	45	45	ASTM D-93
Pour Level	(°C)	-3	-3	-6	-3	-6	ASTM D-97
Cloud Point	(°C)	6	3	6	3	3	ASTM D-2500
Kinematic Viscosity at 40 °C (CSt)		3.19	3.2	3.21	3.21	3.22	ASTM D-445
Water Content	(vol. %)	17	16	16	15	15	ASTM D-95
Sulfur Total	(wt. %)	0.02	0.01	0.01	0.02	0.01	ASTM D-4294
Copper Corrosion Strip at 50 °C/3h		1A	1A	1A	1A	1A	ASTM D-130
Carbon Byproduct	(wt. %)	0.06	0.05	0.05	0.07	0.06	ASTM D-4530
The Amount of Ash	(wt. %)	0	0	0	0	0	ASTM D-482

Table 4. Physical and chemical characteristics of biofuels results from catalytic cracking of Jatropha oil with Montmorillonite-HCL catalyst with different concentrations (0.2, 0.4, 0.6, 0.8, 1.0 % conc.)

Properties							Standard Test Methods
		0.2%	0.4%	0.6%	0.8%	1.0%	
Density at 15 °C	gm/cm ³	0.8988	0.8990	0.8990	0.8991	0.8991	ASTM D-4052
Flash P. (P.M.C.C)	(°C)	42	44	43	45	43	ASTM D-93
Pour P.	(°C)	-6	-3	-3	-3	-6	ASTM D-97
fog Point	(°C)	3	3	6	6	3	ASTM D-2500
Kinematic Viscosity at 40 °C (CSt)		6.06	6.09	6.11	6.12	6.12	ASTM D-445
Water Content	(vol. %)	15	15	15	17	16	ASTM D-95
Sulfur Total	(wt. %)	0.01	0.01	0.02	0.02	0.01	ASTM D-4294
Copper Corrosion Strip at 50 °C/3h		1A	1A	1A	1A	1A	ASTM D-130
Carbon Byproduct	(wt. %)	0.06	0.06	0.06	0.06	0.06	ASTM D-4530
The Amount of Ash	(wt. %)	0	0	0	0	0	ASTM D-482

Table 5. Physical & chemical properties of biofuels results from catalytic cracking of Castor oil with Montmorillonite-HCL catalyst with different concentrations (0.2, 0.4, 0.6, 0.8, 1 % conc.)

Properties							Standard Test Methods
		0.2%	0.4%	0.6%	0.8%	1.0%	
Density at 15 °C	gm/cm ³	0.9210	0.9211	0.9212	0.9213	0.9213	ASTM D-4052
Flash P. (P.M.C.C)	(°C)	45	45	46	45	44	ASTM D-93
Pour Point	(°C)	-3	-6	-6	-3	-3	ASTM D-97
Cloud Point	(°C)	3	6	3	6	3	ASTM D-2500
Kinematic Viscosity at 40 °C (CSt)		3.2	3.2	3.21	3.22	3.23	ASTM D-445
Water Content	(vol. %)	16	15	17	16	15	ASTM D-95
Sulfur Total	(wt. %)	0.01	0.01	0.01	0.02	0.01	ASTM D-4294
Copper Corrosion Strip at 50 °C		1A	1A	1A	1A	1A	ASTM D-130
Carbon Byproduct	(wt. %)	0.050	0.060	0.050	0.070	0.060	ASTM D-4530
The Amount of Ash	(wt. %)	0	0	0	0	0	ASTM D-482

biodiesel blend's cetane number values were within the ASTM range (49 – 51). The higher the cetane of biodiesel made from oil methyl esters and canola oil indicates that it has a high ability to ignite in motors after infusion.

3.3.3. Density

The fuel's mass represents 1 g of its weight. Because the fuel adds weight to the vesicle, density is an important consideration. consideration during the fueling and rapid combustion processes. As a result, higher densities will consume a lot of fuel more fuel during automotive work. According to test method D-4052 [27], the frequency of gas oil was (0.8394 g/cm³). The density values obtained for the prepared biodiesel blends were in the range (0.8462–0.8472 g/cm³), which is marginally greater than the density of gas oil.

3.3.4. Pouring Point

Pouring point in terms of fuel denotes the temp where the fuel is burned solidifies prior to it and becomes liquids following that pouring level is a crucial signifier to consider when transporting fuel at elevated low temperatures. High pour point fuels freeze in cold climate countries with low temperatures. The pour statistical approach is a basic test for determining the flowability of biodiesel in extreme cold weather [33]. The pour point testing and materials tD-97 [23] recommends (max. 15 °C) for gas oil. The prepared biodiesel blends pour point morals are within ASTM range (-6 °C to -9 °C).

3.3.5. Cloud Point

When a liquid is cooled, the fog point is classified according to the temperature at which the first fog of the crystalline phase appears. Crystals of wax form in two stages: development and results in the formation needs. The fog point of biodiesel occurs when higher molecular weight components begin to form wax clusters, resulting in visible crystals [32-34]. Agglomeration occurs because of the sample being continuously cooled. At this

point, it is necessary to interact to produce larger crystals, a trade-off must be made between the high and low melting components. Cloud points are an important property of biofuels because the establishment of frequent hydrocarbon groupings reduces the biofuel's fluidity, limiting its transport through pipelines. According to ASTM D-2500 [26], the cloud point for gas oil should be (-3 °C to 12 °C). The prepared biodiesel blends cloud point morals were within the ASTM range (3 °C).

3.3.6. The Flashpoint

The flammability of blended fuels is the temp where it becomes highly combustible when exposed to a spark or flame. As a result of its high critical temperature, biodiesel is a less hazardous fuel to transfer and solve [31]. Following ASTM D-93, the flashpoint for gas oil should be (min. 52 °C). The ready-to-use biodiesel blends' flash point values were included in ASTM distance (55 °C – 62 °C).

3.3.7. Carbon Residue

The carbon percentage in gas oil should be (max. 0.1 percent) in accordance with ASTM test D-4530 [28]. The carbon average percent values obtained for the able to prepare biodiesel were within the ASTM range (0.06 – 0.08 %), which are extremely low values that have no environmental impact when ignited.

3.3.8. Ash Content

The ash percentage in gas oil should be (max. 0.01 percent) according to ASTM D-482 [25]. The ash % calculated value from the ready biodiesel and its ASTM standards were met by the blends. distance (zero) , indicating that when ignited, there was no risk to the environment.

4. CONCLUSIONS.

The following conclusions can be drawn from the findings of this study:

- Using heterogeneous catalysts (Aluminium oxide and Magnetite in various ratios), canola oil and seed oil were converted into biofuel (0.2 percent, 0.4 percent, 0.6 percent, 0.8 percent and 1 percent).
- The obtained products' specifications were significant compared to American STM standards.
- A best suited mixture of the procured biofuels and petroleum diesel or gasoline was (10% Biodiesel + 90% Gasoline or diesel fuel).
- When compared to gas crude oil, the results of these biodiesels were all within an appropriate range, according to ASTM testing specifications.
- When the composite measure of prepared biodiesel to petroleum-based diesel surpasses 10%, the procured biofuel's flash arguments fall below ASTM standards (less than 52 °C).

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