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Preparation, characterisation of the biodiesel of the oil from seeds and its blends

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Abstract
The aim of this paper is to study the physical and chemical properties of *Moringa oleifera* biodiesel and its blends of 10%-95% by volume with petro-diesel according to the American society for testing and materials (ASTM D6751) standards and European standards (EN 14214). Moringa biodiesel was found to be blended with diesel fuel, the result show that, Density was (860 g/cm^3), kinematic viscosity at 40C (3.18 cp), Water content (500 Mg/Kg), Acid value (0.5 mg), Iodin value (120 g I_2/100 g), Peroxide value (6.50 Meq/kg), Flash point (4.76 %), Phosphorus content (10 mg/Kg), Alkali (K+Na) (5 mg/Kg), Ester content (96.5 m/m%),

Keywords: preparation, characterisation, biodiesel, oil, seeds, blends

Introduction
Renewable energy is natural process energy supply. Both renewable energy primarily comes from the sun as in solar heating systems, or indirectly as in hydroelectric, wind, and biomass fuels. The number of developing countries with renewable energy has increased since the 20th century [1]. Biofuels are one of the most renewable sources of energy used to reduce fossil fuel reliance and to protect the atmosphere by reducing carbon emissions. Biodiesel is classified as a fuel consisting of long chain mono-alkylic esters of fatty acids derived from vegetable oils or animal fats [2]. *M.Oleifera* oil is of excellent quality and can be used as the raw material for the production of biodiesel using the existing process. Vegetable oils for the production of biodiesel differ considerably with climate position and feedstock availability [3]. Despite their rising demand each day, the reserves of petroleum-derived fuels are diminishing. In addition, the products of combustion resulting from the burning of these fuels are deemed environmentally hazardous. Several factors such as petroleum-derived fuel depletion, climate change, and the rise in the price of petroleum products have created interest in researchers discovering alternative energy sources [4, 6].
Biodiesel is produced by reaction of lipids with an alcohol through transesterification. Triglycerides are the primary components of lipids (oil / fats). Triglycerides are three fatty acid esters, and one glycerol. Thus, lipid alcoholysis produces monoalkyl esters, commonly referred to as biodiesel, and glycerol as a by-product. figure1. Shows the transesterification reaction, which is a reversible reaction [7].

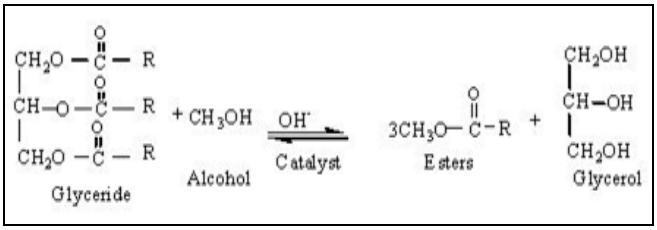

Fig 1: Transesterification of triglyceride [7].

Materials and Methods
Materials
Fossil Diesel was collected from AL-NAHLA Petro Station in Khartoum, Sudan (2018).

Methods
Biodiesel production
M. Oleifera oil was treated with acid to decrease the composition of high fatty acids using 2% sulfuric acid in 0.60 w / w methanol, the mixture was applied to the heated oil at (60 ° C) and kept steering at 2500 rpm for 2 hours, then the material was kept in separation funnel for 24 hours. The upper layer of low fatty acid treated oil was transferred to a 500 ml beaker and heated up to 60 ° C at a steering speed of 2500 rpm, methanolic NaOH was applied to the oil with ratio of 6:1 methanol to oil and the mixture was left steering for 2 hours. The mixture was withdrawn from the hot plate and transferred to a separation funnel [8, 9].

Biodiesel blending
Diesel-Biodiesel blend
Biodiesel and fossil diesel were kept at 25 ° C temperature to ensure the homogeneity of the blends during blending. The temperature of the blends maintains above the cloud point by minimum 25-30 °C. Before starting blending, biodiesel should also be free from water and sediments [10]. B20 blend which contains 20% biodiesel and 80% fossil diesel.

Diesel-Biodiesel-Ethanol blends
Blends of Diesel-Biodiesel-Ethanol were prepared using the same procedure of Biodiesel-Diesel blend. Three blends were prepared with various ratios and kept in tightly closed bottles to minimize ethanol evaporation.

Physical and chemical properties of *M. Oleifera* Biodiesel and its blends
In accordance with ASTM D 6751, the physical and chemical properties of biodiesel were determined. Blends of diesel-biodiesel-ethanol were characterized in accordance with ASTM D7467 “Standard Specification for Diesel Fuel

Oil, Biodiesel Blend (B6 to B20)" following additional tests were carried out also for the set of the samples; Kinematic Viscosity at 40 oC, Density at 15 ºC, water content, pour point (PP), Color and cold filter plugging point (CFPP). Table 1 shows the methods and instruments used for physical and chemical properties [11, 12, 13]

Table 1: Methods and Equipment used for physical and chemical properties.

Tests	Method	Instrument	Equipment Model
CFPP, ºC	ASTM D 6371	Normalab analis	Cloud and Pour test cabinet
Total Acid Number, mgKOH/g	ASTM D 974	Si analytic	Titro Line 7000
Flash Point, ºC	ASTM D93	Stanhope-seta	1366-3 P
Copper Strip Corrosion (3 Hours @ 100ºC), Rating	ASTM D130	Stanhope-seta	15157-0 T
Phosphorus content, mg/kg	ASTM D4951	Agilent icp	5110 ICP-OES
Sulfur Content, mg/kg	ASTM D 4294	Oxford	TWIN-X

Results and discussion

Physical and chemical properties of biodiesel blends

Table 2 shows the physical and chemical properties of Fossil Diesel in comparison with the limits of standard method ASTM D 7467. The results show that all parameters of Fossil diesel within the limit of ASTM D 7467.

Table 2: Physical and Chemical properties of Diesel.

Test Name	ASTM D 7467	Fossil Diesel
Kinematic Viscosity at 40 ºC, cSt	1.9 – 4.1	3.589
Density at 15 ºC, g/cm3	——	0.8526
Specific Gravity	——	0.8234
Flash Point, ºC	Min. 93	81.00
Distillation Temperature		
10% recovered	Max. 343	227.6
20% recovered		247.7
50% recovered		290.9
90% recovered		324.8
95% recovered		340.4
Recovery at 365^{0}C		94.5
Color, ASTM	——	L1.0 ASTM color
Cloud Point, ºC	REPORT	+3
Copper Strip Corrosion (3 Hours @ 50ºC), Rating	Max. 3	1 A
Sulfur Content, % mass	Max. 0.05	0.0119
Water Content, wt%	Max. 0.05	<0.03

Table 3 shows the physical and chemical properties of Biodiesel, biodiesel blends in comparison with ASTM D 7467. The results show that the Kinematic viscosity of Biodiesel, D80B20, D60E20B20 were obtained at 12.53, 3.175 and 2.924 respectively which the *M. Oleifera* methyl ester had met the kinematic Viscosity is out of the standard level. The density of Biodiesel, D80B20, D60E20B20 were obtained at 0.8805, 0.8581 and 0.8454 g/cm^3, respectively. The cloud point of Biodiesel, D80B20, D60E20B20 was obtained at -7.5, +5 and +9 ºC, respectively. Water content is an important parameter, and it is within the limit in Biodiesel blends D80B20, D60E20B20 as shown in table 3. Color is an important feature of a quality indicator. In the ASTM D 7467, the Sulfur Content must be less than 0.05 and the result of Biodiesel blends D80B20, D60E20B20 was all within the standard limit. Flash Point was obtained 137 ºC for Biodiesel, 87.00 ºC for D80B20, and D60E20B20 the ethanol blends 15ºC. The distillation of the blends was performed according to ASTM D86-96 standard: "Standard Test Method for distillation of petroleum products at atmospheric pressure", distillation temperature increases strongly with distilled percentage, the result of D60E20B20 could not be done due to sample nature.

Table 3: Physical and Chemical properties of *M.Olefera* Biodiesel Blends

Test Name	ASTM D 7467	Biodiesel	D80 B20	D60 E20 B20
Kinematic Viscosity at 40 ºC, cSt	1.9 – 4.1	12.53	3.175	2.924
Density at 15 ºC, g/cm^3	——	0.8805	0.8581	0.8454
Specific Gravity	——	——	0.8589	0.8462
Flash Point, ºC	Min. 52	137	87.00	15
Distillation Temperature				
10% recovered	Max. 343	——	235.8	——
20% recovered		——	261.5	——
50% recovered		——	308.3	——
90% recovered		——	358.8	——
95% recovered		——	370.8	——
Recovery at 365^{0}C		——	93.5	——
Water Content, Wt%	Max. 0.05	< 0.05	< 0.05	< 0.05
Color, ASTM	——	L 1.5 ASTM color	1.0 ASTM color	L1.0 ASTM color
Cloud Point, ºC	REPORT	-7.5	+5	+9

Copper Strip Corrosion (3 Hours @ 100ºC), Rating	Max. 3	1A	1A	1A
Sulfur Content, %mass	Max. 0.05	0.025	0.0145	0.0179

Conclusion

1. The following conclusions can be drawn from this study.
2. Biodiesel-Diesel and Biodiesel-Diesel-Ethanol all parameters were within the limit of ASTM D 7467.
3. The flash point is very low in Ethanol blend it is less than the room temperature due to the volatility of ethanol will assist the combustion of the blend in the CI engine, but it will be dangerous for storing and transporting.
4. *M.Oleifera* biodiesel was produced Successfully and prove that the triglycerides were converted to methyl ester.
5. The fossil diesel all parameters were within the limit of ASTM D 7467.

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