HOSTED BY

Available online at www.sciencedirect.com
ScienceDirect
Journal of Radiation Research and Applied Sciences
journal homepage: http://www.elsevier.com/locate/jrras

Production, optimization and quality assessment of biodiesel from *Ricinus communis* L. oil

Maryam Ijaz [a], *Khizar Hayat Bahtti* [a], *Zahid Anwar* [b,*], *Umar Farooq Dogar* [a], *Muhammad Irshad* [b]

[a] *Department of Botany, University of Gujrat, Pakistan*
[b] *Department of Biochemistry and Molecular Biology, Institute of Life Sciences, University of Gujrat, Pakistan*

ARTICLE INFO

Article history:
Received 29 October 2015
Accepted 15 December 2015
Available online 12 January 2016

Keywords:
Biodiesel
Ricinus communis L. oil
Product optimization
Feedstock

ABSTRACT

At present, biodiesel is gaining tremendous attention due to its eco-friendly nature and is possible substitute for diesel fuel. Biodiesel as renewable energy source can be produced from edible and non-edible feedstock. Non-edible resources are preferred to circumvent for food competition. In the present study FAME was produced from *Ricinus communis* L. oil by transesterification with methanol and ethanol in the presence of potassium hydroxide. The practical optimal condition for the production of biodiesel from castor bean was found to be: methanol/oil molar ratio, 6:1; temperature, 60 °C; time, 45 min; catalyst concentration 0.32 g. Quality assessment of biodiesel showed comparable results with ASTM standards. The values of specific gravity (SG) were 0.5, kinematic viscosity 2.45 cSt, acid values 0.13 mg KOH/g, carbon residue 0.03%, flash point 119 °C, fire point 125 °C, cloud point −10 °C and pour point −20 °C of Ricinus FAME, respectively. Based on our data, it is suggested that to overcome prevailing energy crisis this non-edible plant is useful for production of biodiesel, which is an alternate to fossil fuel and may be used alone or in blend with HSD in engine combustion.

Copyright © 2015, The Egyptian Society of Radiation Sciences and Applications. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

1. Introduction

Biodiesel is a renewable alternate source of petroleum and can be used in engine. It is eco-friendly, nontoxic and it is thought to be future diesel. Petroleum is natural source that is rapidly depleted. Biofuel is obtained from vegetable oil, algae, edible and non-edible beans like, Helianthus, Jatropha, Pongamia and Ricinus. It is derived from triglycerides and fatty acids by transestrification and esterification, respectively (Bari, Yu, & Lim, 2002).

Fossil based petroleum is not renewable stored in earth with limited reserves. World heavily depends on petroleum for transport vehicles, industrial and agricultural machinery. Increase in population, industries and urbanization causes of increase in fuel combustion. It leads to removal of petroleum fuel from earth reservoirs. This higher expenditure will lead to industrial catastrophe. In cities, air contamination increases because diesel engine is a big pollution source by traffic in urban areas. Carbon monoxide and carbon dioxide are rapidly increases and many other gasses from smoke are releases.

* *Corresponding author*. Tel.: +92 345 5463838.
E-mail addresses: zahid.anwar20@gmail.com, zahid.anwar@uog.edu.pk (Z. Anwar).
Peer review under responsibility of The Egyptian Society of Radiation Sciences and Applications.
http://dx.doi.org/10.1016/j.jrras.2015.12.005
1687-8507/Copyright © 2015, The Egyptian Society of Radiation Sciences and Applications. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Oxides of carbon and nitrogen causes headache, low blood pressure, acute bronchitis, pulmonary diseases and throat problems. Because of air contamination many respiratory diseases are causes in animals and also harmful for plants. Now societies are aware about air pollution caused by diesel engine, so pressure on researchers to search alternate way of diesel to reduce environmental pollution (Atadashi, Aroua, &Aziz, 2010). At the present time, the world demand of energy rapidly increasing because of increasing population, industrialization, and over urbanization (Vasudevan & Briggs, 2008).

As increase in consumption of oil emission of pollutants increases, it will affect human health badly such as respiratory, skin, and nervous system. Increasing population and over urbanization causes energy crisis, because of energy crisis biodiesel from non-edible oil-seeds are highly in concern as alternate source of petroleum. It is non-toxic, biodegradable, renewable source, eco-friendly and cause reduction in use of petroleum. Carbon that is released from burning will use by plants, enhances the life of engine, no change in engine by its use enhances rural economics. Biodiesel prepared directly from fat of animal and oil from seeds of plants by transestrification method using alcohol and catalyst (Hazell & Pachauri, 2006).

2. Material and methods

For the present research, *Ricinus communis* L. seeds were purchased from Makah Traders Pasroor, Sialkot, Punjab, Pakistan. Determination of oil or fat content from seeds has great importance on industrial scale as it effects price of raw material. Soxhlet apparatus gives oil content extracted from solid source. Damirchi, Habibi-Nodeh, Hesari, Nemati, & Achachlouei, 2009 protocol of soxhlet apparatus was followed. In order to get massive quantities of oil, electrical oil expeller was used. Then, oil was filtered with help of filter paper. After filtration titration was done to measure free fatty acid contents in it.

2.1. *Pre-tests for Ricinus oil*

In pre-tests oil quality was measured such as acid value, gravity, density, saponification and viscosity, refractive index and peroxide value. These tests were used to find out oil quality (Patil and Deng, 2009). Physical characterization of *R. communis* was carried out according to the methods given in association of analytical chemistry (AOACS).

2.2. *Transesterification*

Transesterification is a process in which conversion of fatty acid methyl ester from crude oil occurs (Ahmad, Khan, Zafar, Sultana, & Gulzar, 2009). Oil from plants is esters of triglyceroides. During alcoholysis, triglyceroides is converted into di and then in monoglyceroids. On each step it needed 1 mol of fatty acid but in experiment greater amount of alcohol added because it is a reversible reaction (Dennis, Wu, & Leung, 2009). Alkali alcoholysis is existing method that is frequently using for production of biodiesel, Sinha, Agarwal, and Garg (2008); Meher, Vidya Sagar, and Naik (2006); Ahmad et al. (2010). Ma and Hanna (1999) stated that in transesterification butanol, propanol, methanol, amyl alcohol and ethanol any alcohol can be used and used alkali catalyst. Methanol is mostly used because it is cheap and it has chemical and physical advantages. It can easily react with alkali catalyst.

In transesterification, after filtration crude filtered oil was heated in order to breakdown of triglycerides into di and mono-glycerids and to remove free fatty acids from filtered oil. It was heated on hot plate (VWR, VELP- Scientifica Germany) at 100 °C for 1 h till oil temperature became 120 °C, and then left it on room temperature to cool until 60 °C. Then mixture of methanol and KOH and NAOH were added to heated oil separately to find out the maximum FAME production.

Then it was stirred at 600–700 rpm for 45 min at 60 °C. Stirring time and temperature has direct effect on ester yields. It was left to settle down on room temperature for 1 h to overnight. Three layers were formed upper layer was thin soap layer, second layer was methyl/ethyl ester, third layer was glycerol. Glycerol and soap were by product of transesterification. Distilled hot water was used to purify crude methyl/ethyl ester. Water amount was lowered to maximum of 0.05% according to ASTM standard of biodiesel (v/v). This step was repeated 3–4 times. In order to neutralize soap and residual catalyst, washing was done at pH 4.5, Du, Xu, Liu, Zeng, and Molcatal (2004). Then Na_2SO_4 was added to prepared biodiesel in order to remove water.

2.3. *Optimization*

Optimization is a process in which different trail applied with variables of temperature, methanol to oil ratio, time and catalyst to examined variable effects on yield (%) were noted. Optimization was done to attain the maximum ester yield.

2.4. *Fuel properties*

Fuel properties of Ricinus FAME are presented in Table .1 and results were matched with ASTM.

3. Results and discussion

Biodiesel is non-toxic, free of sulfur, renewable and alternative green fuel. Commonly it is produced by transesterification reaction of non-edible oil, vegetable oil and waste oil using small amount of alcohol as methanol or ethanol. Its demand is rather high to produce as alternative energy sources, because availability of fossil based petroleum is rapidly decreasing. Biodiesel is a potential substitute of energy because it is obtained from renewable energy sources. In the current study, biodiesel was extracted from castor. Oil percentage was in *R. communis* 48%.

3.1. *Characterization of oil*

Oil percentage was from *R. communis* 48. For physicochemical characterization oil qualities were measured such as acid

Download English Version:

https://daneshyari.com/en/article/1570351

Download Persian Version:

https://daneshyari.com/article/1570351

Daneshyari.com