Chapter 15
Comparative Studies on Neem and Jatropha Oil-Derived Biodiesels

Sunil Kulkarni
https://orcid.org/0000-0002-5988-3448
Gharda Institute of Technology, Lavel, India

Ajaygiri Goswami
University Institute of Chemical Technology, Jalgaon, India

Ghayas Usmani
University Institute of Chemical Technology, Jalgaon, India

ABSTRACT

Sustainable development is a key aspect of modern-day development. Reducing fuel cost and emissions is considered as the most important research area in sustainable development. Biodiesel has the potential to reduce the requirement of petroleum diesel if blended in suitable proportion. Various feedstocks are being explored for biodiesel production. Oils derived from neem and jatropha can be utilized for biodiesel production. In the current investigation, optimum parameters for the production, namely catalyst proportion, temperature, and oil-to-alcohol ratio were optimized. Experiments were carried out at different blend proportions to study fuel properties, namely kinematic viscosity, aniline point, diesel index, flash and fire points, specific and API gravity, cetane number, and ASTM distillation characteristics.

INTRODUCTION

Sustainable development is key aspect of modern-day development. Reducing fuel cost and emissions is considered as the most important research area in sustainable development. Most commonly fuels used across the world for vehicles, railways, boilers and majority of industrial applications are derived from fossil fuel. These fossil fuels are non-renewable. Alternative fuel sources are being explored such as wind and solar energy, hydrogen fuel, tidal energy and biodiesel from renewable feedstocks like

DOI: 10.4018/978-1-6684-5269-1.ch015

Copyright © 2023, IGI Global. Copying or distributing in print or electronic forms without written permission of IGI Global is prohibited.

vegetable oil, cellulose, fats and chitosan. Viability of biodiesel synthesis depends on raw material and biodiesel properties. Waste food, vegetables, nonedible crops are suitable raw materials for biodiesel synthesis. Advantages of biodiesel include reduced toxicity, improved emission, rapid degradation and high flash point (Romano and Sorichetti, 2011). Predojevic et al. utilized Linoleic and oleic sunflower oils for biodiesel by (Predojevic et al.,2012). They used calcium oxide as solid base catalyst (Predojevic et al.,2012). Low-cost feed stocks are important for economic viability of biodiesel synthesis. Waste minimization through energy synthesis can serve the sustainable development goal (Ray et al., 2013; Stephane Bungener, 2016). Selection of appropriate catalyst is also very crucial aspect. Use of strong basic catalyst such as zeolite is being explored as promising method for transesterification (Ejikeme et al., 2010). Sodium methoxide and sodium hydroxide found to have good catalytic properties(Foon et al., 2004). Use of waste cooking oil for biodiesel can serve twin purpose, one of disposal and other of the raw material (Raqeeb and Bhargavi, 2015).

The fatty acid alkyl esters have characteristics very similar to diesel derived from fossil fuel (European Tech. and Innovation Platform, 2022). Acid or base catalysts can be used for the transesterification (Patel and Shah, 2015). The functional group of the catalyst attacks the carbonyl carbon. Catalytic and non-catalytic pathways are available for transesterification (Patel and Shah, 2015). Transesterification temperature depends on the raw material (Mekala et al., 2014). High temperature favors reaction but need to be controlled to avoid denaturation.

Neem is a tree in a mahogany family found in abundance in India (Elkadi et al., 2013). It has pesticidal and insecticidal application. Neem seeds find application in remedial therapy. Neem oil is extracted from the fruits and seeds of the neem. This neem oil is being explored for its use as a feedstock for synthesis as the alkyl ester by transesterification process. The composition of the oil depends on processing method. The neem oil yield that can be obtained from neem seed kernels varies widely from 25% to 45% (Anya et al.,2013; Sathya and Manivannan, 2013). Jatropha grows widespread in world in the tropical and subtropical areas. Jatropha oil finds applications in soapmaking. *Jatropha curcas* oil plays important role in cosmetic industry (Pandey et al., 2012). For transesterification, homogeneous catalysts such as NaOH, KOH can be employed (De Oliveira et al., 2009; Wang et al., 2006, Berchaman et al., 2010). The two-step method with an acid and basic-catalysed reactions can be used to produce biodiesel from oil containing high amount of free fatty acid (FFA) such as Jatropha oil (Choudhury, 2013; Ngo et al., 2008). Before the investigations, parameters for the production, namely catalyst proportion, temperature, oil to alcohol ratio were optimized. Experiments were carried out at these optimized parameters with different blend proportions to study fuel properties namely kinematic viscosity, aniline point, diesel index, flash and fire points, specific and API gravity, cetane number and ASTM distillation characteristics.

METHODOLOGY

Oil Extraction

Neem Oil

Transesterification by alkali catalyst is one of the most effective methods (Ibrahim et al., 2021.; Ramasubramanian *et al.,* 2017). Hexane was used as solvent and Soxhlet apparatus was used for extraction. 200 ml of hexane and neem powder (70 gm thimble) was taken in Whitman paper. Round bottom flask

14 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:
www.igi-global.com/chapter/comparative-studies-on-neem-and-jatropha-oil-derived-biodiesels/314368

Related Content

A Brief History of Prosthetics and Orthotics of the Lower Body and Their Types
Dheeman Bhuyanand Kaushik Kumar (2019). *Design, Development, and Optimization of Bio-Mechatronic Engineering Products (pp. 36-56).*
www.irma-international.org/chapter/a-brief-history-of-prosthetics-and-orthotics-of-the-lower-body-and-their-types/223405

Green House Gases: Challenges, Effect, and Climate Change
Kannadhasan S.and Nagarajan R. (2023). *Biomass and Bioenergy Solutions for Climate Change Mitigation and Sustainability (pp. 65-74).*
www.irma-international.org/chapter/green-house-gases/314358

Hydrocarbon Biodegradation Using Agro-Industrial Wastes as Co-Substrates
Abdullah Mohammed El Mahdiand Hamidi Abdul Aziz (2019). *Biotechnology: Concepts, Methodologies, Tools, and Applications (pp. 1635-1665).*
www.irma-international.org/chapter/hydrocarbon-biodegradation-using-agro-industrial-wastes-as-co-substrates/228687

Environmental Fluoride: Impact on Humans, Animals and Its Remediation Strategies
Junaid Ahmad Malik (2021). *Recent Advancements in Bioremediation of Metal Contaminants (pp. 165-188).*
www.irma-international.org/chapter/environmental-fluoride/259571

Higher Order Sliding Mode Control for Blood Glucose Regulation of Type 1 Diabetic Patients
Mounir Djouima, Ahmad Taher Azar, Saïd Dridand Driss Mehdi (2019). *Biotechnology: Concepts, Methodologies, Tools, and Applications (pp. 1126-1148).*
www.irma-international.org/chapter/higher-order-sliding-mode-control-for-blood-glucose-regulation-of-type-1-diabetic-patients/228661