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Biodiesel synthesis from mixed non-edible oil feedstock using K_2CO_3 in NH_4OH Catalyst mixture

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ABSTRACT

In the present study, a new approach has tried to synthesize and optimize biodiesel production from mixed oils (*Pongamia* and *Mahua*) using an in-situ generated KOH from K_2CO_3 in an NH4OH catalyst mixture using response surface methodology (RSM). A maximum biodiesel yield of 96.5 v/v% was obtained at a catalyst concentration (CC) of 1.5 g K_2CO_3 in 0.75 g of NH_4OH, oil to methanol molar ratio (M:O) of 7:1 at a reaction temperature (RT) of 55°C in 75 min reaction time (Rt). The obtained biodiesel yield is compared and found to be maximum (96.5 v/v%) for K_2CO_3 in NH_4OH catalyst mixture than K_2CO_3 in H_2O, direct K_2CO_3 and Conventional KOH methods. Furthermore, the presence of carbonate and ammonium ions in the reaction medium resulted in an increased biodiesel yield due to the less possibility for free water molecules formation and with a minimal amount of KOH to drive the reaction toward the right-hand side. The GC-MS, 1HNMR and FTIR techniques were used to confirm the conversion of esters.

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Introduction

Energy is a critical parameter to boost the economy of any nation. As per British Petroleum statistical review of the world's energy sources (2020), the contribution from fossil fuels (Crude oil-33.1%, Coal-27.0%, Natural gas-24.2%) was found to be paramount, and the rest is from Nuclear-4.3%, Hydro-6.4% and other renewable sources-5%. The challenges from fossil fuels are sustenance in the current scenario due to the high consumption rate and global warming (Ntaribi and Ikwaba 2019). At present, biodiesel is considered one of the best potent substitute sources of fuel for transport vehicles as well as gas turbine applications (Chiong et al. 2020) produced from first-generation and second-generation oils (Ayoob and Fadhil 2015). However, first-generation oils such as peanuts, palm, sunflower, etc., are highly requisites for food sources and cannot be used for fuel purposes (Demirbas 2009; Kumar and Sharma 2011). Consequently, several investigations have been focused on the production of biodiesel from second-generation non-edible feedstock such as *Mahua* (Sharma Dugala 2022), *Jatropha curcas* (Asnake Ewunie et al. 2021), *Pongamia* (Dalemans et al. 2022), *Neem* (Chhabra et al. 2021), *Castor* (Carlos et al. 2020), Milkscum (Srikanth, Venkatesh, and Godiganur 2018), Poultry fat (Santhosh et al. 2023) etc. These feedstocks can be made available to grow in non-arable lands with low maintenance costs. However, the availability of non-edible oils is highly region-specific and unevenly distributed (Harish et al. 2020). Hence uninterrupted biodiesel production could be achieved by using hybrid oil

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