Biomass: A sustainable source for aviation fuel production

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Background & Aim: There has been a growing effort to reduce the use of fossil fuels, and biomass appears to be a sustainable alternative that could replace oil derivatives due to its low cost [1,2,3].

Methods: The process of converting palmitic acid (a microalgae bio-oil model compound) through a hydrodeoxygenation reaction was studied, where the main goal was the formation of hydrocarbons in the aviation fuels range (C_8-C_{16}). So, bi- and monometallic catalysts composed of 1-4% Mo and 2.5-10.5% Ru supported on carbon nanotubes (CNT) were synthesized. These materials were characterised by temperature programmed reduction and N_2 adsorption isotherms. Catalytic tests were carried out, in which 0.5 g of palmitic acid, 50 mL of solvent (decane or dodecane) and 0.25 g of catalyst were introduced into a Parr batch reactor under stirring at 150 rpm and H_2 pressure of 30 bar. After heating to 350 °C, the reaction was started and carried out for 6 h, after which the reaction mixture was analysed by gas chromatography-mass spectrometry.

Results: The conversion of palmitic acid and the yield of hexadecane (C_{16}) were calculated, and the effects of the support (CNT and CNT_{ox}), solvent and metal content were assessed. The catalyst metal content proved to be a determining factor to obtain a higher C_{16} yield. Among the prepared monometallic catalysts, 10.5%Mo/CNT and 2.5%Ru/CNT_{ox}, the former led to the formation of 29.7% yield of C_{16} and 84% conversion of palmitic acid, while the latter resulted in a C_{16} yield of 3.1% and complete palmitic acid conversion. As for the other parameters evaluated, it was concluded that the use of CNT_{ox} as support and decane as solvent did not significantly affect the results obtained.

Conclusions: The catalysts with a higher metal content, 2.5%Ru-10.5%Mo/CNT_{ox} and 2.5%Ru-10.5%Mo/CNT, allowed to attain the best results: 60.2% and 57.6% yield of C_{16}, respectively. These results show that biomass could possibly be used to produce sustainable aviation fuels in the future.

Keywords: palmitic acid, hydrodeoxygenation, heterogeneous catalysts, aviation fuels

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