Optimization Of Biodiesel Production From Used Cooking Oil Via Microwaved Assisted Transesterification Using A Nano-Catalyst Derived From The Shells Of The Rice Field Snail (Pilla ampulaceae)

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ABSTRACT

The demand for biodiesel as an alternative fuel is increasing due to the depletion of fossil fuels and high greenhouse gas emissions. This study aims to optimize the production of biodiesel from used cooking oil via Microwave-Assisted Transesterification (MAT) using a CaO nano-catalyst synthesized from rice field snail shell waste (Pila ampullaceae). The process optimization was evaluated using Response Surface Methodology (RSM) with a three-factor Box-Behnken Design (BBD): nano-catalyst concentration (2.5, 3, 3.5%), reaction time (9, 11, 13 minutes), and microwave power (40, 220, 400 Watt). ANOVA results showed that the Two-Factor Interaction (2FI) model was significant ($p < 0.05$). Microwave power and the interaction between reaction time and microwave power had significant effects on the biodiesel yield. The optimum operating conditions were determined at a nano-catalyst concentration of 3.5%, a reaction time of 11.52 minutes, and a microwave power of 81.89 Watt, yielding a predicted maximum biodiesel yield of 96.26%. Characterization of the biodiesel produced under optimum conditions showed a density of 876.63 kg/m^3*, an acid value of 0.995 mg-KOH/g , an iodine value of 59.50* g-I_2/100g*, and a sediment content of 0.0149% v/v. Based on these results, density, iodine value, and sediment content successfully met the SNI 7182:2015 quality standards. However, the product did not meet the standards for water and volatile content (2.69% V/V), and methyl ester content (66.69% m/m).*

Keywords*:Biodiesel, Used Cooking Oil, Microwaved Assisted Transesterification, Nano-Catalyst Rice Field Snail Shells, Response Surface Method.*