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Abstract	:	<p>The present study explores the effective conversion of lipids extracted from discarded fish waste into biodiesel using a CaO(Ca₃Al₂O₆) as a heterogeneous catalyst. The properties and the catalyst structure were explored using XRD, FT-IR, SEM, and EDX analyses. The lipid extraction from discarded fish waste was performed through Soxhlet extraction utilizing methanol as a solvent. The catalytic transesterification of biodiesel from discarded fish waste lipids was conducted employing CaO(Ca₃Al₂O₆) as a heterogeneous catalyst by varying lipids-to-methanol ratio (1:6-1:16), catalyst doses (1-6 wt%), reaction time (1-6 h), and temperature (40-70 °C). The experimental conditions were optimized using response surface methodology (RSM) and validated using an artificial neural network (ANN). The highest biodiesel yield obtained was about 93% at optimal experimental conditions of lipid to methanol ratio of 1:8.79, reaction time of 4.11 h, reaction temperature of 65.49 °C, and catalyst loading of 4 wt%. Kinetic and thermodynamic studies discovered that the transesterification reaction is non-spontaneous and endothermic, and it requires a low activation energy (12.787 kJ/mol). Physicochemical properties of the synthesized biodiesel complied with the biodiesel standard specifications of EN 14214 and ASTM D6751, highlighting its suitability as a renewable alternative to conventional diesel fuels.</p>