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Properties of Biodiesel Produced by Enzymatic Transesterification of Lipids Extracted from Microalgae in Supercritical Carbon Dioxide Medium

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Abstract : Biodiesel, as an alternative renewable fuel, has been receiving increasing attention due to the limited supply of fossil fuels and the increasing need for energy. Microalgae is a promising source for lipids, which can be converted to biodiesel. The biodiesel production from microalgae lipids using lipase catalyzed reaction in supercritical CO2 medium has several advantages over conventional production processes. However, identifying the optimum microalgae lipid extraction and transesterification conditions is still a challenge. In this study, the lipids extracted from Scenedesmus sp. and their enzymatic transesterification using supercritical carbon dioxide have been investigated. The effect of extraction variables (temperature, pressure and solvent flow rate) and reaction variables (enzyme loading, incubation time, methanol to lipids molar ratio and temperature) were considered. Process parameters and their effects were studied using a full factorial analysis of both. Response Surface Methodology (RSM) and was used to determine the optimum conditions for the extraction and reaction steps. For extraction, the optimum conditions were 53 °C and 500 bar, whereas for the reaction the optimum conditions were 35% enzyme loading, 4 h reaction, 9:1 molar ratio and 50 oC. At these optimum conditions, the highest biodiesel production yield was found to be 82 %. The fuel properties of the produced biodiesel, at optimum reaction condition, were determined and compared to ASTM standards. The properties were found to comply with the limits, and showed a low glycerol content, without any separation step.

Keywords : biodiesel, lipase, supercritical CO2, standards
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