Biodiesel production from Cannabis sativa oil from Pakistan

ABSTRACT

The present study was appraised using response surface methodology for process optimization owing to strong interaction of reaction variables: NaOCH3 catalyst concentration (0.25–1.50%), methanol/oil molar ratio (3:1–9:1), reaction time (30–90 min), and reaction temperature (45–65°C). The quadratic polynomial equation was determined using response surface methodology for predicting optimum methyl esters yield from Cannabis sativa oil. The analysis of variance results indicated that molar ratio and reaction temperature were the key factors that appreciably influence the yield of Cannabis sativa oil methyl esters. The significant ($p < 0.0001$) variable interaction between molar ratio × catalyst concentration and reaction time × molar ratio was observed, which mostly affect the Cannabis sativa oil methyl esters yield. The optimum Cannabis sativa oil methyl esters yield, i.e., 86.01% was gained at 53°C reaction temperature, 7.5:1 methanol/oil molar ratio, 65 min reaction time, and 0.80% catalyst concentration. The results depicted a linear relationship between observed and predicted values. The residual analysis predicted the appropriateness of the central composite design. The Cannabis sativa oil methyl esters, analyzed by gas chromatography, elucidated six fatty acid methyl esters (linoleic, α-linolenic, oleic, palmitic, stearic, and γ-linolenic acids). In addition, the fuel properties, such as kinematic viscosity at 40°C; cetane number; acid value; flash point; cloud, pour, and cold filter plugging points; ash content; density; and sulphur content, of Cannabis sativa oil methyl esters were evaluated and discussed with reference to ASTM D 6751 and EU 14214 biodiesel specifications.

Keyword: Cannabis sativa seed oil; Fuel properties; Methyl esters; Optimization; Response surface methodology; Transesterification