Optimization of Biodiesel Production from Vegetable Oils Using Selected Catalysts

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ABSTRACT

There is a growing interest in expanding the biodiesel industry due to the fact that fossil energy reserves are limited and there is an increase in environmental pressure resulting from their use. Biodiesel has drawn attention as nontoxic, biodegradable and renewable source of energy. This research is focused on improving the biodiesel quality, yields in the transesterification process and increasing the use of different raw materials as feedstocks. Transesterification was carried out on *Gossypium hirsutum* L (Malvaceae) commonly known as cotton and *Croton megalocarpus* Hutch (Euphorbiaceae) seed oils using sodium hydroxide (NaOH) and potassium hydroxide (KOH) as catalysts. Production of biodiesel from both seed oils was optimized by varying the amounts of methanol and temperature. Transesterification of *Croton megalocarpus* seed oil to produce biodiesel was also carried out using immobilized *Candida antarctica B-lipase (CALB)* as a catalyst. Effects of amounts of enzyme, methanol and temperature on transesterification of the same seed oil were studied.

Transesterification of cotton seed oil using NaOH as catalyst showed optimum conditions at 150 % excess methanol and 60 ^{0}C and a yield of 68.60 % was obtained. The biodiesel produced had a viscosity of 4.14 mm^2/s and acid value 0.26 mg KOH/g. When KOH was used as a catalyst the optimum conditions were shown at 150 % excess methanol, room temperature and yield of 83.94 % was obtained. The biodiesel produced had a viscosity of 4.27 mm^2/s and acid value 0.26 mg KOH/g. Transesterification of *Croton megalocarpus* seed oil using NaOH as a catalyst showed optimum conditions at

150 % excess methanol, room temperature and a yield of 80.30 % was obtained. The biodiesel produced had a viscosity of 3.76 mm^2/s and acid value 0.22 mg KOH/g. When KOH was used as a catalyst the optimum conditions, which yielded 88.11 % conversion were 150 % excess methanol and at room temperature. The biodiesel produced had a viscosity of 3.81 mm^2/s and acid value of 0.22 mg KOH/g.

Enzymatic transesterification was carried out successfully with *Croton megalocarpus* seed oil and the Optimum conditions obtained were 30 % enzyme (m/m), temperature 50 ^0C and oil alcohol molar ratio of 1:4. The biodiesel obtained had a viscosity of 4.74 mm^2/s, acid value 13.69 mg KOH/g and a yield of 98.71 %. KOH was found to be a better catalyst compared to NaOH, as it gave higher yields under optimum conditions for the two vegetable oils. Although enzymatic transesterification resulted to a cleaner glycerol by-product and a higher yield, the biodiesel from this process had a relatively high acid value as compared to alkali catalysed transesterification, while all the other fuel properties measured were within the range stipulated in the American Society for Testing and Materials (ASTM) and International Standards Organization (ISO) standards.