Novel Glycerol-Free Biodiesel Production using Enzyme Catalysis

Haddad, Martha

Biodiesel production from vegetable oil and ethanol (EtOH) has become a demonstrated alternative energy source. Current processes convert triglycerides to biodiesel, from which 90 million pounds of crude glycerol, a waste product, is extracted per annum in the US. Last year, a new method of production was formulated to avoid glycerol formation using selective partial transesterification; preliminary data required additional research to verify early findings and support the method reliably. This project investigates the effectiveness of the addition of acetic acid (AcOH) to the enzymatic process to prevent the formation of glycerol by inducing faster transesterification of the terminal alcohols. Gas chromatography and mass spectrometry (GC/MS) analyses were applied in order to identify intermediate compounds' structures dependably. Using GC/MS and dodecane, an internal standard (IS), to track formation of the new products, the reaction's stability was demonstrated. Glycerol was continually absent from the invented EtOH+AcOH reaction, supporting the hypothesis that stopping the process at the monoacylglycerol (MG) stage results in a 100% yield of good-quality biodiesel. Furthermore, the reaction of MG acetate, formed under anhydrous conditions, was tracked after the addition of water, experimentally verifying its structure. In the EtOH+AcOH experiment, 8% MG acetate was formed; its complete hydrolysis in the presence of water resulted in a 10% increase in biodiesel and 0.12% increase in MG. These results indicate that the EtOH+AcOH method for biodiesel production is a sound, efficient, and applicable process to prevent waste glycerol formation at minimal cost.

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