PRODUCTION OF ETHYL LEVULINATE FROM OIL PALM FRONDS USING HETEROPOLY ACID AS CATALYST

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To my beloved parents, siblings, family and friends
for their Love, Prayer and Support
ABSTRACT

Ethyl levulinate is a versatile chemical with numerous industrial applications. The production of ethyl levulinate from glucose and oil palm fronds (OPF) were investigated. The optimization of the effects of parameters was conducted by response surface methodology (RSM), and the data obtained was performed the regression analysis. In this study, three different heteropoly acids (HPAs) were screened and tested for glucose conversion to ethyl levulinate. The heteropoly acids; phosphomolybdc acid (H₃PMo₁₂O₄₀), silicotungstic acid (H₄SiW₁₂O₄₀) and phosphotungstic acid (H₃PW₁₂O₄₀) were tested and the experimental results shown that phosphotungstic acid produced highest ethyl levulinate yield. Optimization of ethyl levulinate was conducted using the potential heteropoly acid catalyst meanwhile glucose was used as model compound. The conducted experiment for glucose conversion to ethyl levulinate produced 19.01% ethyl levulinate yield at 183 °C in 200 min and 5.66 wt% of reaction temperature, time and catalyst loading, respectively. The optimization of the OPF for producing ethyl levulinate at the optimum conditions at 198 °C in 166 min and 1.44 wt% of reaction temperature, time and catalyst loading, respectively, was established wherein 4.65% of ethyl levulinate yield was produced from OPF. Additionally, the high acidity of phosphotungstic acid was significantly can increase the ethyl levulinate yield with increase the amount of catalyst load and reduce the reaction temperature for the OPF conversion into ethyl levulinate. This study demonstrated that the heteropoly acid has potential to be applied in biomass conversion to ethyl levulinate under adequate process conditions.
**ABSTRAK**

Etil levulinat adalah bahan kimia yang serba boleh dengan pelbagai aplikasi industri. Penghasilan etil levulinat dari glukosa dan pelepah kelapa sawit (OPF) telah dikaji. Pengoptimuman kesan parameter telah dijalankan oleh metodologi permukaan sambutan (RSM), dan data yang diperolehi telah dijalankan analisis regresi. Dalam kajian ini, tiga asid heteropoly berbeza (HPAs) telah diperiksa dan diuji untuk penukaran glukosa kepada etil levulinat. Asid heteropoli; asid fosfomolibdik \( (H_3PMO_{12}O_{40}) \), asid silikotungstik \( (H_4SiW_{12}O_{40}) \) dan asid fosfotungstik \( (H_3PW_{12}O_{40}) \) telah diuji dan keputusan eksperimen menunjukkan bahawa asid fosfotungstik menghasilkan etil levulinat yang terbanyak. Pengoptimuman etil levulinat telah dijalankan menggunakan asid heteropoli yang berpotensi sebagai pemangkin. Glukosa telah digunakan sebagai model bahan di dalam eksperimen. Eksperimen yang dijalankan untuk penukaran glukosa kepada etil levulinat menghasilkan 19.01% hasil etil levulinate pada suhu 183 °C dengan masa 200 min dan sebanyak 5.66 wt%. Pengoptimuman OPF untuk menghasilkan etil levulinat pada keadaan optimum iaitu pada suhu tindak balas 198°C dengan masa tindak balas 166 min dan jumlah pemangkin yang digunakan sebanyak 1.44 wt%, telah menghasilkan 4.65% hasil etil levulinat daripada OPF. Selain itu, asid fosfotungstik yang mempunyai keasidan yang tinggi ketara boleh meningkatkan hasil etil levulinate dengan meningkatkan jumlah pemangkin dan mengurangkan suhu tindak balas bagi penukaran OPF ke etil levulinat. Kajian ini menunjukkan bahawa asid heteropoli mempunyai potensi untuk digunakan dalam penukaran biojisim kepada etil levulinat di bawah keadaan proses yang optimum.