Produksi Antioksidan Fenolik Melalui Hidrogenolisis Lignin Menggunakan Pd/C dan Deep Eutectic Solvent Berbantuan Gelombang Mikro = Production of Phenolic Antioxidants Through Microwave-Assisted Lignin Hydrogenolysis Using Pd/C and Deep Eutectic Solvent

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Abstrak

Penggunaan antioksidan alami sebagai penyerap radikal bebas diperkirakan akan terus meningkat terutama dengan adanya peningkatan permintaan global pada industri kesehatan, farmasi, cat, dan pelapisan. Lignin dari biomassa lignoselulosa tandan kosong kelapa sawit (TKKS) akan melalui hidrogenolisis pada kondisi operasi optimum hingga dapat menghasilkan senyawa fenolik sebagai antioksidan alami. Pra perlakuan TKKS menggunakan NaOH dilanjutkan dengan isolasi lignin teknis menggunakan HCl. Lignin yang diperoleh kemudian dihidrogenolisis menggunakan katalis Pd/C dan deep eutectic solvent choline chloride/ethylene glycol dengan dilakukan variasi rasio katalis dengan lignin (1:5, 1:7,5, 1:10 b/b), rasio lignin dengan DES (1:10, 1:20, 1:30 b/v), serta waktu reaksi (1, 3, 5, 7, 9 menit) yang akan diamati kontribusinya terhadap derajat depolimerisasi, yield bio-oil, karakterisasi kandungan senyawa, total kandungan fenolik, dan aktivitas antioksidan. Penelitian ini menemukan bahwa derajat depolimerisasi dan yield bio-oil terbaik bernilai 44,8% dan 31,0%. Berdasarkan nilai total kandungan fenolik, kondisi operasi optimum adalah 1:10 (b/b), 1:10 (b/v), dan 7 menit. Berdasarkan nilai aktivitas antioksidan, kondisi operasi optimum adalah 1:5 (b/b), 1:20 (b/v), dan 3 menit. Berdasarkan nilai yield bio-oil, kondisi operasi optimum adalah 1:10 (b/b), 1:30 (b/v), dan 9 menit. Berdasarkan analisis kandungan senyawa, sampel terbaik memiliki 4 senyawa kumarin dan lignanoid serta 2 senyawa fenol.

.....The use of natural antioxidants as free radical scavengers is expected to increase continuously especially with the increasing global demand in the health, pharmacy, paint, and coating industries. Lignin from oil palm empty fruit bunches (OPEFB) lignocellulosic biomass will undergo hydrogenolysis at optimum operating conditions to produce phenolic compounds as natural antioxidants. The pre-treatment of OPEFB using NaOH is followed by technical lignin isolation using HCl. The lignin obtained is then hydrogenolyzed using Pd/C catalyst and deep eutectic solvent choline chloride/ethylene glycol by varying the ratio of catalyst to lignin (1:5, 1:7,5, 1:10 w/w), the ratio of lignin to DES (1 :10, 1:20, 1:30 w/v), as well as reaction time (1, 3, 5, 7, 9 minutes) which will be observed for their contribution to the degree of depolymerization, bio-oil yield, the characterization of compounds contained, the total phenolic content, and the antioxidant activity. This study found that the best degree of depolymerization and bio-oil yield was 44,8% and 31,0%. Based on the total phenolic content value, the optimum operating conditions are 1:10 (w/w), 1:10 (w/v), and 7 minutes. Based on the antioxidant activity value, the optimum operating conditions are 1:5 (w/w), 1:20 (w/v), and 3 minutes. Based on the bio-oil yield value, the optimum operating conditions are 1:10 (w/w), 1:30 (w/v), and 9 minutes. Based on the compounds analysis, the best sample had 4 coumarin and lignanoid compounds and 2 phenol compounds.