RINGKASAN

PEMBUATAN BIOETANOL DARI LIMBAH KULIT NANAS MELALUI *PRETREATMENT* DES C*HOLINE CHLORIDE-LACTIC ACID* DAN HIDROLISIS ENZIMATIK

(Ade Tamara, 2026, 57 Halaman, 14 Tabel, 34 Gambar)

Limbah kulit nanas merupakan biomassa lignoselulosa yang berpotensi dimanfaatkan sebagai bahan baku bioetanol karena mengandung selulosa yang dapat dikonversi menjadi gula fermentabel. Namun, keberadaan lignin dapat menghambat proses hidrolisis sehingga diperlukan *pretreatment* untuk meningkatkan aksesibilitas enzim terhadap selulosa. Penelitian ini bertujuan untuk menganalisis pengaruh *pretreatment Deep Eutectic Solvent* (DES) *Choline Chloride–Lactic Acid* terhadap hidrolisis enzimatik kulit nanas, menentukan kondisi optimum hidrolisis berdasarkan variasi waktu dan konsentrasi enzim, serta menganalisis kualitas bioetanol yang dihasilkan. *Pretreatment* dilakukan menggunakan DES *Choline Chloride–Lactic Acid* dengan rasio molar 1:9 selama 1 jam. Biomassa hasil *pretreatment* kemudian dihidrolisis menggunakan enzim selulase dengan variasi konsentrasi 5%, 10%, dan 15% selama 12, 18, 24, 48, dan 72 jam. Hidrolisat difermentasi menggunakan *Saccharomyces cerevisiae* dan dilanjutkan dengan proses distilasi. Analisis lignoselulosa dilakukan menggunakan metode Chesson-Datta, sedangkan kadar glukosa dan etanol dianalisis menggunakan refraktometer glukosa dan alkohol. Hasil penelitian menunjukkan bahwa *pretreatment* DES meningkatkan kandungan selulosa dari 57% menjadi 65,54% dan menurunkan kandungan lignin dari 23% menjadi 8,05%. Kondisi terbaik diperoleh pada waktu hidrolisis 48 jam dan konsentrasi enzim 15%, yang menghasilkan kadar glukosa tertinggi sebesar 16,6% Brix dan kadar etanol sebesar 45,0%. Densitas bioetanol yang dihasilkan berada pada rentang 0,851–0,933 g/mL dengan pH 6,2–6,7. Hasil penelitian menunjukkan bahwa *pretreatment* DES *Choline Chloride–Lactic Acid* efektif meningkatkan ketersediaan selulosa sehingga berpotensi meningkatkan produksi bioetanol dari limbah kulit nanas.

Kata kunci: Bioetanol, Kulit nanas, Lignoselulosa, Deep Eutectic Solvent, Hidrolisis enzimatik.

ABSTRACK

BIOETHANOL PRODUCTION FROM PINEAPPLE PEEL WASTE THROUGH DEEP EUTECTIC SOLVENT (DES) CHOLINE CHLORIDE–LACTIC ACID PRETREATMENT AND ENZYMATIC HYDROLYSIS

(Ade Tamara, 2026, 57 Pages, 14 Tables, 34 Figures)

Pineapple peel waste is a lignocellulosic biomass with significant potential as a feedstock for bioethanol production due to its cellulose content, which can be converted into fermentable sugars. However, the presence of lignin inhibits the hydrolysis process; therefore, a pretreatment step is required to improve enzyme accessibility to cellulose. This study aimed to evaluate the effect of Deep Eutectic Solvent (DES) Choline Chloride–Lactic Acid pretreatment on the enzymatic hydrolysis of pineapple peel, determine the optimum hydrolysis conditions based on hydrolysis time and enzyme concentration, and evaluate the quality of the produced bioethanol. Pretreatment was carried out using DES Choline Chloride–Lactic Acid with a molar ratio of 1:9 for 1 hour. The pretreated biomass was subsequently hydrolyzed using cellulase enzyme at concentrations of 5%, 10%, and 15% for 12, 18, 24, 48, and 72 hours. The resulting hydrolysate was fermented using *Saccharomyces cerevisiae*, followed by a distillation process. Lignocellulosic composition was analyzed using the Chesson-Datta method, while glucose and ethanol contents were determined using a refractometer and an alcoholmeter, respectively. The results showed that DES pretreatment increased the cellulose content from 57% to 65.54% while reducing the lignin content from 23% to 8.05%. The best hydrolysis condition was achieved at 48 hours of hydrolysis with a 15% cellulase enzyme concentration, producing the highest glucose content of 16.6% Brix and an ethanol content of 45.0%. The density of the produced bioethanol ranged from 0.851 to 0.933 g/mL, with a pH of 6.2–6.7. These findings indicate that DES Choline Chloride–Lactic Acid pretreatment effectively enhances cellulose accessibility, thereby improving the potential for bioethanol production from pineapple peel waste.

Keywords: Bioethanol, Pineapple Peel, Lignocellulosic Biomass, Deep Eutectic Solvent, Enzymatic Hydrolysis.