

RINGKASAN

Lignin merupakan salah satu komponen biomassa lignoselulosa penyusun dinding sel tanaman yang secara alami cukup sulit didegradasi. Lignin berasal dari beberapa sumber alami seperti limbah pertanian, biomasa dan residu kayu, produksi *pulp* dan kertas, serta industri biorefineri. Pemanfaatan lignoselulosa perlu melalui proses delignifikasi untuk menghilangkan lignin yang menjadi pembatas dalam pemanfaatan serat. Proses delignifikasi dapat dilakukan dengan menggunakan bakteri lignolitik yang dapat menghasilkan enzim ligninase. Aktivitas enzim ligninase ditentukan oleh aktivitas enzim lakase (Lac), mangan peroksidase (MnP), dan/atau lignin peroksidase (LiP). Sebanyak 33 isolat bakteri asal serasah daun, tanah, kotoran sapi, dan sampah dapur berpeluang bersifat lignolitik. Penelitian ini bertujuan untuk menyeleksi 33 isolat bakteri yang berpotensi mendegradasi lignin, mengetahui kemampuannya dalam menghasilkan enzim lakase, mangan peroksidase, dan lignin peroksidase, serta mengidentifikasi isolat bakteri yang memiliki kemampuan lignolitik.

Penelitian dilaksanakan di Laboratorium Mikrobiologi Fakultas Biologi Universitas Jenderal Soedirman dengan menggunakan metode survei. Seleksi isolat bakteri yang berpotensi mendegradasi lignin dilakukan secara kualitatif dengan menumbuhkan isolat bakteri pada medium L-MSM Agar. Pengujian aktivitas enzim lignin peroksidase, mangan peroksidase, dan lakase dilakukan secara kuantitatif dengan metode spektrofotometri. Karakterisasi bakteri berdasarkan pada karakterisasi fenetik yang meliputi morfologi, fisiologi dan biokimia. Hasil karakterisasi dibandingkan dengan buku determinasi *Bergey's Manual of Determinative Bacteriology* untuk mengetahui identitas isolat.

Hasil penelitian diperoleh tujuh isolat bakteri yang memiliki aktivitas lignolitik yaitu isolat KS5, KS2, SD5, TN5, TN7, TN11, dan TN13. Dua isolat dengan aktivitas lignolitik terbaik, yaitu isolat KS5 dan SD5. Isolat KS5 menghasilkan aktivitas LiP, MnP, dan Lac berturut-turut sebesar $46,45 \pm 7,56$ U. mL⁻¹, $3,11 \pm 0,38$ U. mL⁻¹, dan $8,54 \pm 0,09$ U. mL⁻¹. Isolat SD5 menghasilkan aktivitas enzim LiP, MnP, dan Lac berturut-turut sebesar $49,45 \pm 4,59$ U. mL⁻¹, $6,39 \pm 1,07$ U. mL⁻¹, dan $6,22 \pm 0,55$ U. mL⁻¹. Hasil identifikasi isolat SD5 menunjukkan bahwa isolat tersebut termasuk anggota genus *Bacillus* dan isolat KS5 belum dapat merujuk pada karakter genus tertentu.

Kata kunci: *bakteri lignolitik, lakase, lignin, lignin peroksidase, mangan peroksidase*

SUMMARY

Lignin is a component of lignocellulosic biomass that makes up plant cell walls which is naturally quite difficult to degrade. Lignin comes from several natural sources such as agricultural waste, biomass and wood residues, pulp and paper production, and biorefinery industries. The utilization of lignocellulose needs to go through a delignification process to remove lignin, which is a limiting factor in fiber utilization. The delignification process can be carried out using lignolytic bacteria that can produce ligninase enzymes. Ligninase enzyme activity is determined by the enzyme activity of laccase, manganese peroxidase, and/or lignin peroxidase. Bacterial isolates from leaf litter, kitchen waste, soil and cow dung. Bacterial isolates derived from materials containing lignin have the opportunity to obtain bacterial isolates that are lignolytic. This study aims to select bacterial isolates that have the potential to degrade lignin, determine their ability to produce laccase, manganese peroxidase, and lignin peroxidase enzymes, and identify bacterial isolates that have the lignolytic ability.

The study was carried out at the Microbiology Laboratory, Faculty of Biology, Universitas Jenderal Soedirman using the survey method. Selection of bacterial isolates that have the potential to degrade lignin was done qualitatively by growing bacterial isolates on L-MSM Agar medium. Testing the enzyme activity of lignin peroxidase, manganese peroxidase, and laccase is done quantitatively by spectrophotometric method. Bacterial characterization will be based on phenetic characterization which includes morphology, physiology and biochemistry. Characterization results are compared with Bergey's Manual of Determinative Bacteriology to determine the identity of the isolates.

The results obtained seven bacterial isolates that have lignolytic activity, namely isolates KS5, KS2, SD5, TN5, TN7, TN11, and TN13. Two isolates with the best lignolytic activity were isolate KS5 and SD5. Isolate KS5 produced LiP, MnP, and Laccase activities of 46.45 ± 7.56 U. mL⁻¹, 3.11 ± 0.38 U. mL⁻¹, and 8.54 ± 0.09 U. mL⁻¹, respectively. Isolate SD5 produced LiP, MnP, and Laccase enzyme activities of 49.45 ± 4.59 U. mL⁻¹, 6.39 ± 1.07 U. mL⁻¹, and 6.22 ± 0.55 U. mL⁻¹, respectively. The isolates identification showed that isolate SD5 was belong to Bacillus and isolate KS5 has not been able to refer to certain genera.

Keywords: *laccase, lignin, lignolytic bacteria, lignin peroxidase, mangan peroxidase*