ANALISIS SEM DAN XRD TERHADAP PERUBAHAN STRUKTUR PERMUKAAN DAN KRISTALINITAS JERAMI PADI DAN ENCENG GONDOK AKIBAT AKTIVITAS α-L- ARABINOFURANOSIDASE REKOMBINAN

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ABSTRACT

Scanning Electron Microscope and X-ray Diffraction Analysis of Surface Structure Modification and Crystallinity of Rice Straw and Water Hyacinth after recombinant α-L-arabinofuranosidase treatment

The purpose of this research were to investigate surface structure modification and crystallinity of rice straw and water hyacinth after recombinant α-L-arabinofuranosidase treatment. Analysis of surface structure modification and crystallinity were done by SEM and XRD. In the process of rice straw and water hyacinth hydrolysis were determined optimation of intracellular enzyme (P) and extracellular enzyme mixture ratio and optimation of incubation time. The optimum ratio of rice straw was 1:1 and water hyacinth was 1:2. The optimum incubation time of rice straw and water hyacinth hydrolysis was 8 hours. Rice straw and water hyacinth after recombinant α-L-arabinofuranosidase treatment were analyzed by SEM and XRD, Rice straw and water hyacinth before recombinant α-L-arabinofuranosidase treatment were used as control. The conclusion of this research indicated that enzymatic hydrolysis damaged surface structure of rice straw and water hyacinth. Enzymatic hydrolysis showed effect on cristallinity of water hyacinth.

Keywords : α-L-arabinofuranosidase, rice straw, water hyacinth, scanning electron microscope, x-ray diffraction.

SUMMARY

Scanning Electron Microscope and X-ray Diffraction Analysis of Surface Structure Modification and Crystallinity of Rice Straw and Water Hyacinth after recombinant α-L-arabinofuranosidase treatment

Lignocellulosic biomass, such as rice straw and water hyacinth generally contain lignin, hemicelluloses and cellulose. Xylan is a major component of hemicellulose is rich in xylose. It has a backbone of β-1,4-linked D-xylopyranoside residues with branches containing acetyl, arabinofuranosyl, and 4-O-methylglucuronosyl residues. The complete degradation of xylan into monosaccharides requires the synergistic action of several hydrolytic enzymes. One of the enzymes is α-L-arabinofuranosidase. It catalyze the hydrolysis of arabinofuranosidic bonds in hemicelluloses such as arabinoxylan, arabinan, and other arabinose containing polysaccharides. Gene where coding α-L-arabinofuranosidase (Abfa) has been cloning at *Escherichia coli* DH5α host which called pTP510. This 3 gene can also succed to separate and sub-cloning in system pET (pET-abfa). The purpose of this research were to investigate surface structure modification and crystallinity of rice straw and water hyacinth after recombinant α-L-arabinofuranosidase treatment. Analysis of surface structure modification and crystallinity were done by SEM and XRD. In the process of rice straw and water hyacinth hydrolysis were determined optimation of intracellular enzyme (P) and extracellular enzyme (S) mixture ratio, P : S = 1 : 1, 1 : 2, 1 : 4, 1 : 8 and 1 : 10, then were determined optimation of hydrolysis incubation time, 1 hour, 2 hours, 4 hours, 8 hours, 12 hours and 24 hours. The optimum ratio of rice straw was 1 : 1 and water hyacinth was 1 : 2. The optimum incubation time of rice straw and water hyacinth hydrolysis for 8 hours. Hydrolysis of rice straw and water hyacinth were done on optimum condition of rice straw and water hyacinth. Rice straw and water hyacinth after recombinant α-L-arabinofuranosidase treatment were analyzed by SEM and XRD, Rice straw and water hyacinth before recombinant α-L-arabinofuranosidase treatment were used as control. The conclusion of this research are enzymatic hydrolysis can damage surface structure of rice straw and water hyacinth, enzymatic hydrolysis also can change crystallinity of water hyacinth.

RINGKASAN

Analisis SEM dan XRD terhadap Perubahan Struktur Permukaan dan Kristalinitas Jerami Padi dan Enceng Gondok akibat aktivitas α-L-arabinofuranosidase Rekombinan

Limbah berlignoselulosa seperti jerami padi dan enceng gondok secara kimiawi banyak mengandung lignin, hemiselulosa, dan selulosa. Xilan merupakan komponen utama hemiselulosa, gulanya tersusun atas monomer D-xilosa dengan kerangka dasar residu ikatan 1,4-β-D-xilopiranosil yang rantai sampingnya disubstitusi dengan asetil, 4-*o*-metil-D-glukuronosil dan α-arabinofuranosil. Degradasi lengkap dari struktur xilan yang kompleks menjadi monomernya memerlukan kerja sinergi dari beberapa enzim xilanolitik (xilanase). Salah satu enzim yang berperan penting dalam degradasi xilan adalah enzim α-L-arabinofuranosidase. Enzim α-L-arabinofuranosidase menghidrolisis ujung non-pereduksi antara ikatan α-L-arabinofuranosida dengan berbagai polisakarida yang mengandung arabinofuranosa. Gen penyandi α-L-arabinofuranosidase (Abfa). telah berhasil diklonkan pada inang *Escherichia coli* DH5α yang dinamakan pTP510 yang dipisahkan dan disub-kloningkan dalam pET sistem yaitu pET-abfa.

Penelitian ini bertujuan untuk mengetahui perubahan struktur permukaan dan kristalinitas jerami padi dan enceng gondok menggunakan α-L-arabinofuranosidase rekombinan. Analisis perubahan struktur permukaan dan kristalinitas dilakukan dengan SEM dan XRD. Pada penelitian ini dilakukan optimasi perbandingan campuran enzim intraseluler (P) dan enzim ekstraseluler (S) dengan perbandingan P : S = 1 : 1, 1 : 2, 1 : 4, 1 : 8 dan 1 : 10, kemudian dilakukan optimasi waktu inkubasi dalam menghidrolisis jerami padi dan enceng gondok dengan variasi waktu inkubasi 1 jam, 2 jam, 4 jam, 8 jam, 12 jam dan 24 jam. Perbandingan campuran P dan S yang optimum untuk jerami padi 1 : 1 dan enceng gondok 1 : 2. Waktu inkubasi optimum selama 8 jam. Hidrolisis jerami padi dan enceng gondok dilakukan pada perbandingan campuran P : S optimum dan waktu inkubasi optimum. Analisis SEM dan XRD dilakukan terhadap jerami padi dan enceng gondok yang telah diperlakukan dengan α-L-arabinofuranosidase rekombinan, jerami padi dan enceng gondok yang tidak diperlakukan dengan α-L-arabinofuranosidase rekombinan digunakan sebagai kontrol.

Kesimpulan dari penelitian ini adalah terjadi perubahan struktur permukaan jerami padi dan enceng gondok setelah diperlakukan dengan α-L-arabinofuranosidase rekombinan serta terjadi perubahan kristalinitas enceng gondok.