CONVERSION OF WOOD BIOMASS TO VARIOUS USEFUL CHEMCALS

Lab. Biomass Conversion (Research Institute for Sustainable Humanosphere)
Prof.: Watanabe, T., Assistant Prof.: Watanabe, T., Assistant Prof.: Nishimura, H.

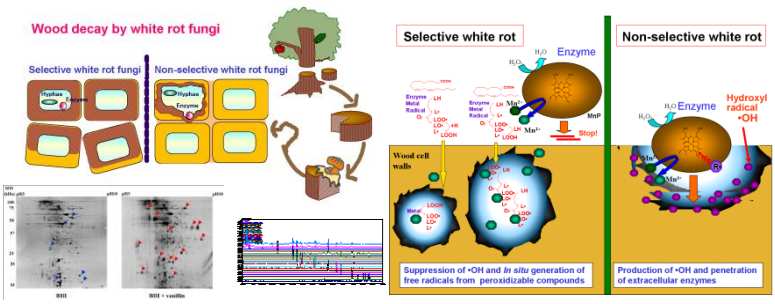
Biomass is a sole renewable organic resource. Toward preventing global warming and developing a sustainable society, we are trying to develop efficient processes for the utilization of woody biomass as useful chemical resources. We analyze functions of lignin-degrading fungi, breed the strain, and apply them for the conversion of woody biomass to chemical resources. We also study bio- and synthetic catalysts for lignin degradation and fine structure of the biomass using advancing analytical apparatus. We also study biomass-derived antivirus compounds.

Development of eco-friendly systems for wood biomass conversion

We study the conversion of woody biomass to bioethanol and functional chemicals, using a selective lignin-degrading basidiomycete and microwave reactions. We also study the production of antivirus compounds from biomass for our safe and healthy life.

White rot fungi and a bench-scale plant for bioethanol production

Molecular analysis of selective lignin-degrading systems in basidiomycetes

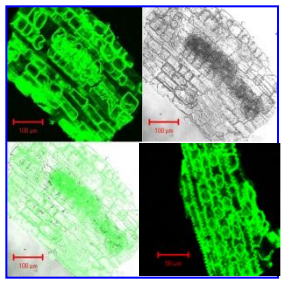


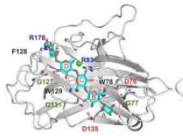
Selective lignin biodegradation at a distance far from enzymes

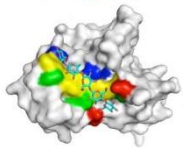
Selective white rot fungi decompose lignin in wood cell walls, without intensive damage to cellulose. To elucidate the unique mechanism at the molecular level, omics analyses of secondary metabolites, enzymes, and genes are conducted. We also improve the strain by molecular biological methods.

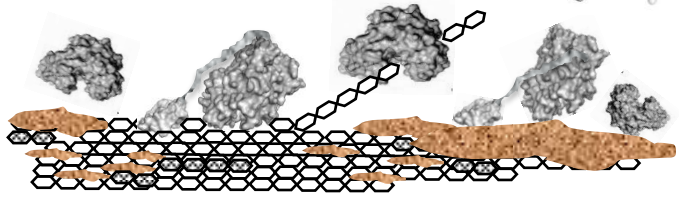
Development of bio- and synthetic catalysts and fine structural analysis for biorefinery

We develop biomass-degrading enzymes and synthetic catalysts by analyzing affinity of lignin with proteins and peptides. Using advanced analytical tools such as crio-NMR and ultra high resolution mass spectrometer, we analyze the process of chemical and biological degradation of biomass in real time and elucidate their fine structure.









Keywords

Lignocellulose, biomass conversion, selective lignin degradation, bioethanol, basidiomycetes, genetic engineering, enzymology, biochemistry, lipid metabolic system, molecular breeding

Recent Publications

Alkadienyl and alkenyl itaconic acids (ceriporic acids G and H) from the selective white fungus *Ceriporiopsis subvermispora*: A new class of metabolites initiating ligninolytic lipid peroxidation
Nishimura, H., M. Sasaki, H. Seike, M. Nakamura, T. Watanabe (2012)
Org. Biomol. Chem. in press (On line)

Comparative genomics of *Ceriporiopsis subvermispora* and *Phanerochaete chrysosporium* provide insight into selective ligninolysis
Fernandez-Fueyoa, E. et al. (2012).
Proc. Natl. Acad. Sci. USA. 109: 5458-5463

Diverse rare lipid-related metabolites including <omega>-7 and <omega>-9 alkenylitaconic acids (ceriporic acids) secreted by a selective white rot fungus, *Ceriporiopsis subvermispora*
Nishimura, H., K. Murayama, T. Watanabe, Y. Honda, T. Watanabe (2012)
Chem. Phys. Lipids 165: 97-104

A comparative study of matrix- and nano-assisted laser desorption/ionization time-of-flight mass spectrometry of isolated and synthetic lignin
Yoshioka, K., D. Ando, T. Watanabe (2012)
Phytochem. Anal. 23: 248-253

Epoxy ceriporic acid produced by selective lignin-degrading fungus *Ceriporiopsis subvermispora*
Nishimura, H., Y. Setogawa, T. Watanabe, Y. Honda, T. Watanabe (2011)
Chem. Phys. Lipids 164: 707-712

Alkoxyl and carbon-centered radicals are primary agents to degrade non-phenolic lignin substructure model compounds
Ohashi, Y., Y. Uno, R. Amirta, T. Watanabe, Y. Honda, T. Watanabe (2011).
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Surface carbohydrate analysis and bioethanol production of sugarcane bagasse pretreated with the white rot fungus, *Ceriporiopsis subvermispora* and microwave hydrothermolysis,
Sasaki, C., R.Takada, T. Watanabe, Y. Honda, S. Karita, Y. Nakamura, T. Watanabe (2011)
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Treatment of rice straw with selected *Cyathus stercoreus* strains to improve enzymatic saccharification
Yamagishi K., T. Kimura, T. Watanabe (2011)
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Microwave-assisted pretreatment of woody biomass with ammonium molybdate activated by H_2O_2
Verma, P., T. Watanabe, Y. Honda, T. Watanabe (2011)
Biores. Technol. 102: 3941-3945

Pretreatment of Japanese cedar wood by white rot fungi and ethanolysis for bioethanol production
Baba, Y., T. Tanabe, N. Shirai, T. Watanabe, Y. Honda, T. Watanabe (2011)
Biomass & Bioenergy 35: 320-324

Near-infrared chemometric approach to exhaustive analysis of rice straw pretreated for bioethanol conversion
Horikawa, Y., T. Imai, R. Takada, T. Watanabe, K. Takabe, Y. Kobayashi, J. Sugiyama (2011)
Appl. Biochem. Biotechnol. 164: 194-203

Recognition of cellooligosaccharides by a family 28 carbohydrate-binding module
Tsukimoto, K., R. Takada, Y. Araki, K. Suzuki, S. Karita, T. Wakagi, H. Shoun, T. Watanabe, S. Fushinobu (2010)
FEBS Lett. 584: 1205-1211

Characterization of a Δ12-fatty acid desaturase gene from *Ceriporiopsis subvermispora*, a selective lignin-degrading fungus
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Analysis of exposed cellulose surfaces in pretreated wood biomass using carbohydrate-binding module (CBM)-cyan fluorescent protein (CFP)
Kawakubo, T. S. Karita, Y. Araki, S. Watanabe, M. Oyadomari, R. Takada, F. Tanaka, K. Abe, T. Watanabe, Y. Honda, T. Watanabe (2010)
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Kaida, R., T. Kaku, K. Baba, M. Oyadomari, T. Watanabe, K. Nishida, T. Kanaya, Z. Shani, O. Shoseyov, T. Hayashi (2009)
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Sato, S., Y. Ohashi, M. Kojima, T. Watanabe, Y. Honda, T. Watanabe (2009)
Chemosphere 77: 798-804

Loosening Xyloglucan accelerates the enzymatic degradation of cellulose in wood
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Molecular Plant 2: 904-909

***Threo*-2-(2,6-Dimethoxyphenoxy)-1-(4-ethoxy-3-methoxyphenyl)propane-1,3-diol**
Ishizuka, K., D. Ando, T. Watanabe and M. Nakamura (2009)
Acta Cryst E 65: o1389-o1390

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Chem Phys Lipids 159: 77-80

De novo* synthesis of (*Z*)- and (*E*)-7-hexadecenylitaconic acids by a selective lignin-degrading fungus, *Ceriporiopsis subvermispora
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Tsukihara, T., Y. Honda, R. Sakai, T. Watanabe and T. Watanabe (2008)
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Kohzu A, Miyajima T, Tateishi T, Watanabe Takashi, Takahashi M, Wada E (2007)
Isotopes in Environmental and Health Studies 43: 83-94

Effect of Lignocellulose-Derived Inhibitors on Growth of and Ethanol Production by Growth-Arrested *Corynebacterium glutamicum* R$^{\nabla}$
Sakai S, Tsuchida Y, Okino S, Ichihashi O,Kawaguchi H, Watanabe Takashi, Inui M, Yukawa H (2007)
Appl Environ Microbiol 73: 2349-2353

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Tsukihara T, Honda Y, Watanabe Takahito, Watanabe Takashi (2006)
Appl Microbiol Biotechnol 71: 114-120

Exclusive overproduction of recombinant versatile peroxidase MnP2 by genetically modified white rot fungus, *Pleurotus ostreatus*
Tsukihara T, Honda Y, Sakai R, Watanabe Takahito, Watanabe Takashi (2006)
J Biotechnol 126: 431-439