2.3.16 Laboratory : Biomass Conversion

Member :	Professor	Watanabe, Takashi, Dr. Agric. Sci.
	Associate Professor	Honda, Yoichi, Dr. Agric. Sci.
	Assistant Professor	Watanabe, Takahito, Dr. Agric. Sci.
	Doctor's program	1
	Master's Program	6
	Post-Doctoral fellow	1
	Program-Specific Researcher	7
	Researcher	1

A. Research Activities (2009.4-2010.3)

A-1. Main Subjects

a) Conversion of wood biomass to energy and functional materials by microorganisms and enzymatic reactions

Wood biomass and its components are converted to energy and useful materials including ethanol, chemicals, feedstuff and others by using microorganisms and their enzymes. The research subjects include pretreatments of wood by selective white rot fungi, solvolysis and milling. The research includes enzymatic decomposition of inhibitors for ethanol fermentation, and analysis of physiological response of alcohol-producing microorganisms to the inhibitors of ethanol fermentation.

b) Molecular biological characterization of white rot fungi

Extracellular enzymes are isolated from the culture of white rot basidiomycetes and genes encoding these enzymes are cloned and characterized. Regulation of gene expression, overexpression with gene engineering techniques, a reaction mechanism of the enzymes, and their application in degradation of polymers are studied. New strategies for transformation and gene-targeting system are under development.

c) Development of efficient biocatalysts for wood biomass conversion

Isolation of biocatalysts for efficient conversion of wood biomass is aimed by modifying microorganisms including bacteria, yeasts, and lignin-degrading basidiomycetes with gene engineering techniques. These include construction of basidiomycetes with higher and more selective ligninolytic activities, and alcohol-producing microorganisms with higher tolerance

to the fermentation inhibitors.

d) Analysis and application of free radical-regulating systems of selective white rot fungi
Ligninolytic systems of selective white rot fungi including functions of key metabolites in the selective lignolysis are studied. Molecular cloning and expression of the genes encoding enzymes responsible for the biosynthesis of key metabolites are also studied.
Gene-engineered white rot fungi and biomimetic lignin-degrading reactions are applied to the degradation of organopollutants and pretreatments for enzymatic saccharification and fermentation of wood biomass.

A-2.Publications and presentations

a) Publications

Books

- Conversion of carbohydrates
Watanabe Takashi (2009)
Advanced Technologies for Woody Organic Resources II, CMC Publishing, 222-234 (in Japanese)
- Degradation of lignin by white rot fungi
Watanabe Takashi (2009)
Biomass handbook 2nd edition,
Ohmsha, Ltd.: 189-196 (in Japanese)
- Chemistry of hemicelluloses, Reactions of hemicelluloses
Watanabe Takashi (2010)
Wood Chemistry, Buneido Publishing 136-153 (in Japanese)
- Enzymatic pretreatments of woody biomass using selective degradation of lignin by white rot fungi
Watanabe Takashi (2010)
Technologies of cellulosic bioethanol production- Toward avoidance of food depletion crisis, NTS Publishing133-145 (in Japanese)
- Methan fermentaion from recalcitrant biomass resources such as wood
Watanabe Takashi (2009)
Development and application of the second generation biofuels, CMC Publishing, 209-219 (in Japanese)
- Impact of Biorefineries on Industrial Structure
Watanabe Takashi (2010)
Earth sphere, Life sphere, Humanosphere, Towards sustainable basis for life, Kyoto

University Press, 281-300 (in Japanese)
- High performance bioethanol production system by combined pretreatments of basidiomycetes/ microwave irradiation, and ethanologenic bacteria, Watanabe Takashi and Yanase Takashi (2010)
Recent technologies and industrialization of 2nd generation bioethanol
Frontier Publishing: 287-294 (in Japanese)
- Pretreatments for enzymatic saccharification of lignocellulosics
Watanabe Takashi (2010)
Recent technologies and industrialization of 2nd generation bioethanol
Frontier Publishing:123-139 (in Japanese)

Original Papers

- Nishimura, H., K. Murayama, Takahito Watanabe, Y. Honda and Takashi Watanabe, Absolute configuration of ceriporic acids, the iron redox-silencing metabolites produced by a selective lignin-degrading fungus, Ceriporiopsis subvermispora, Chem. Phys. Lipids, 159, 77-80, 2009
- Ishizuka, K., D. Ando, Takashi Watanabe and M. Nakamura, threo-2-(2,6-Dimethoxyphenoxy)-1-(4-ethoxy-3-methoxyphenyl)propane-1,3-diol, Acta Cryst E, 65, 1389-1390, 2009
- Kaida, R., T. Kaku, K. Baba, M. Oyadomari, Takashi Watanabe, S. Hartati, E. Sudarmonowati and T. Hayashi, Loosening Xyloglucan accelerates the enzymatic degradation of cellulose in wood, Molecular Plant., 2, 904-909 , 2009
- Sato, S., Y. Ohashi, M. Kojima, Takahito Watanabe, Y. Honda and Takashi Watanabe, Degradation of sulfide linkages between isoprenes by lipid peroxidation catalyzed by manganese peroxidase, Chemosphere, 77, 798-804, 2009
- Kaida, R., T. Kaku, K. Baba, M. Oyadomari, Takashi Watanabe, K. Nishida, T. Kanaya, Z. Shani, O. Shoseyov and T. Hayashi, Enzymatic saccharification and ethanol production of Acacia mangium and Paraserianthes falcataria wood, and Elaeis guineensis trunk, J. Wood Sci., 55, 381-386, 2009
- Kawakubo, T. S. Karita, Y. Araki, S. Watanabe, M. Oyadomari, R. Takada, F. Tanaka, K. Abe, Takahito Watanabe, Y. Honda, Takashi Watanabe, Analysis of exposed cellulose surfaces in pretreated wood biomass using carbohydrate-binding module (CBM)-cyan fluorescent protein (CFP), Biotechnology and Bioengineering, 105, 499-508, 2010
- Watanabe, Takahito, S. Tsuda, H. Nishimura, Y. Honda, Takashi Watanabe, Characterization of a Δ12-fatty acid desaturase gene from Ceriporiopsis subvermispora, a selective lignin-degrading fungus, Appl. Microbiol. Biotechnol., 87, 1, 215-224, 2010

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

Reviews

- Analysis and application of selective degradation of lignin by basidiomycetes for lignocellulosic biorefinery
Watanabe Takashi (2010)
Green Spirits 5: 3-11 (in Japanese)

b) Conference and seminar papers presented

- The 23rd Cellulase Symposium: 1 presentation
- The 54th Lignin Symposium: 4 presentation
- The 60th Annual Meeting of Japan Wood Research Society: 6 presentations
- The 81st Annual Meeting of The Gnetics Society Japan: 1 presentation
- The 3rd Meeting of Japan Society of Electromagnetic Wave Energy Applications: 1 presenation
- Renewal Energy Forum 2009: 1 presentation
- Lignobiotech one, 1st Symposium on Biotechnolgy Applied to Lignocellulses: 3 presenations
- The Mushroom Society of Korea's 50th Anniversary International Symposium on Microbiology 2009: 1 presenation
- Finnish-Japanese Workshop on Functional Material: 1 presenation
- Bio Fuels World 2009: 1 presenation
- Society for Industrial Microbiology, 2009 Annual Meeting and Exhibition: 1 presenation
- An International Forum ASEAN-Korea Symposium and Workshop on Biorefinery Technology for Sustainable Production of Biofuel and Industrial Biochemicals: 1 presenation

A-3.Off-campus activities

Membership in academic societies

- Watanabe, Takashi : Japan Society of Bioscience, Biochemistry and Agrochemistry (Council of Kansai branch), Japan Wood Research Society (Committee member), Japan Wood Research Society (Committee of grobal environment), Japan Wood Research Society

(Committee of promotion of research)

- Honda, Yoichi : Japanese Society of Mushroom Science and Biotechnology (Council member and board), Japan Wood Research Society (Secretary of the Institute.)
- Watanabe, Takahito : Japan Society for Bioscience, Biotechnology, and Agrochemistry (delegate)

Membership in Science Council of Japan, etc.

- Watanabe, Takashi : Japan Bioindustry Association (Counsillor), Japan Bioindustry Association (Committee of Research and Development of Platform for Integrated Production using Function of Microorganisms), Japan Technical Association of the Pulp and Paper Industry (Committee of Wood Science)

Research grants

1. Grants-in-aid for Scientific Research(KAKENHI)

- Challenging Exploratory Research : Watanabe, Takashi : Production of biofuels by biomechanochemical reactions from wood by iron chelators which suppress active oxytgen species, hydroxyl radical
- Scientific Research (B) : Watanabe, Takashi : Elucidation of structure, functions and biosynthetic pathway of hydrophobic metabolites produced by white rot fungi
- Scientific Research (C) : Honda, Yoichi : What prevents hetorogous expression of ligninolytic enzymes?
- Young Scientists (B) : Ohashi, Yasunori (Researcher) : Elucidation of mechanism of lignin model degradation by radical reactions using electron spin resonance spectroscopy
- Young Scientists (Start-up) : Nishimura, Hiroshi (Program-Specific Researcher) : Analysis of extracellular peroxidized metabolites from the glucan matrix involved in lignin biodegradation by white rot fungi
- Grant-in-Aid for JSPS Fellows : Tsuda, Saeko (JSPS Postdoctoral Fellow) : Functional analysis of the genes encoding lipid-related metabolites from selective lignin-degrading fungus
- Grant-in-Aid for JSPS Fellows : VERMA, Pradeep(JSPS Postdoctoral Fellow) : Development of biomimetic enzymatic system for lignocellulosic biomass conversion

2.Other Research Grants

- NEDO Grant for Frontier Research and Technology of biomass energy : Watanabe, Takashi : Highly efficient conversion system of wood biomass into bioethanol
- NEDO Grant for Frontier Research and Technology of biomass energy : Watanabe, Takashi : Basic studies for efficient enzymatic saccharification and fermentation
- RITE Research grant for advanced research : Watanabe, Takashi : Aanaysis and molecular

breeding of selective white rot fungi for the production of ethanol

A-4.International cooperation and overseas activities

International meetings(country,roles)

- Watanabe, Takashi ：Lignobiotech one, 1st Symposium on Biotechnolgy Applied to Lignocellulses（International Scientific Committee Member）

Visiting Research Scholars

- Program-Specific Researcher 1（China）
- JSPS PD fellow 1（India）

B.Educational Activities(2009.4-2010.3)

B-1.On-campus teaching

a) Courses given

- Undergraduate level： Science of Humanosphere –Conversion of Solar Energy- (Takashi Watanabe, Honda), Mushroom Biology Seminar (Honda), Mushroom Science (Honda)
- Graduate level： Sminar on Chemistry of Wood Biomass Conversion (Takashi Watanabe, Honda, Takahito Watanabe), Experimental Course in Chemistry of Wood Biomass Conversion (Takashi Watanabe, Honda, Takahito Watanabe), Science for diagnostics and control of the Humonosphere (Honda)

B-2.Off-campus teaching etc.

Open lectures, etc.

- Watanabe, Takashi: Special Seminar at Kao Corp.
- Watanabe, Takashi: Special Lecture at Committee for Investigation of Advancd Components of Wooden Buildings using Biomass Resources in View of Getting Rid of Dependence on Oil
- Watanabe, Takashi: Special Lecture at Union of Forestory Workers in Fukuoka Prefecture
- Honda, Yoichi: Special Lectures by OBs of Fujishima High School

B-3.Overseas teaching

Lectures and seminars

- Watanabe, Takashi

Microbial and microwave-assisted degradation of lignin for lignocellulosic biorefinery (special seminar) : Åbo Akademi University(Finland)

Microbial and microwave-assisted degradation of lignin for lignocellulosic biorefinery (special seminar) : VTT(Finland)

- Honda, Yoichi

A post-genomic approach to P. ostreatus: a transcriptome analysis of lignin degrading system(special seminar) : National Institute of Biological Resources(Korea)

C.Other Remarks

- Watanabe, Takashi：The Institute of Applied Energy (Committee of Biofuel Challenge), The University of Tokushima (Committee of Promotion of Research and Development in Creation of New Businesses using Forest Resources), (NPO) Agro-High- Tech in Kinki (Chairman of Biomass Section, Technical Counsilor)

- Honda, Yoichi：Research Institute of Innovative Technology for the Earth (Promotion of programmed researches for CO2 fixation and effective utilization committee member)