The JASTIP project and joint approaches toward sustainable utilization of bioresources

130th Anniversary of Japan-Thailand Diplomatic Relations 2017

JASTIP
Japan - ASEAN Science, Technology and Innovation Platform

Takashi Watanabe

Research Institute for Sustainable Humanosphere (RISH)
Kyoto University

The 4th JASTIP symposium, Bangkok, July 3-4, 2017

JASTIP
Japan-ASEAN Science, Technology, Innovation Platform

- Implementation of advanced international joint research with high visibility
- Promotion of societal implementation of research results with high diversity
- Fostering human resources

JASTIP Head Office @ (Bangkok)

WP1

Support from Kyoto ASEAN Center
ASEAN Center Director・URA・Admin Staff・Local Staff

Joint Laboratories for Joint Research

Satellite Centers established at national research institutions in ASEAN countries, forming a hub for universities and research institutes in each country. Japanese researcher permanently stationed.

Promotion of international joint research projects

Environment・Energy

National Science and Technology Development Agency (Thailand) (NSTDA)

WP2

Bioresources・Biodiversity

Indonesian Institute of Sciences (LIPI)

WP3

Disaster Prevention

Malaysia-Japan International Institute of Technology (MJIIT)

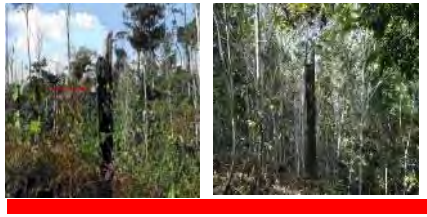
WP4

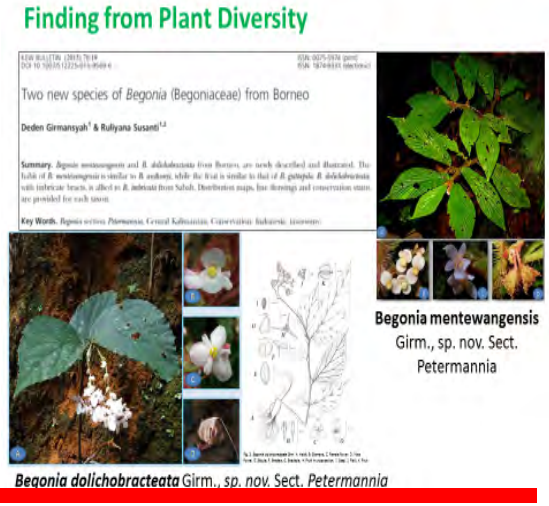
Platform Connecting Japan and ASEAN
Bioresources and Biodiversity

Biodiversity Study in JASTIP WP3

- Biological resource research based on ownership of the bio-diversity
- Strengthening of the biological diversity information database

- Genome Resource Bank Centre as the Backbone of Future Indonesian Wildlife
- Plant diversity of Kalimantan: Profiling and Mapping of habitat loss
- Bioprospecting of plant resources in South East Asia to produce highly value-added products





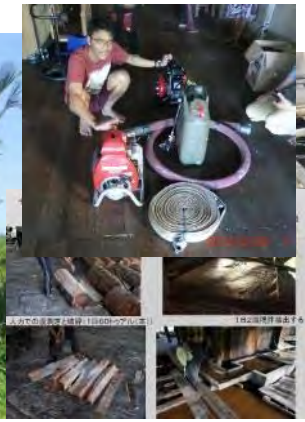
Dissemination of Innovation in JASTIP WP3

- Development and Diffusion of Innovation for Conservation and Sustainable Utilization of Peat Lands in Indonesia: An Ecosystem-Based Approach







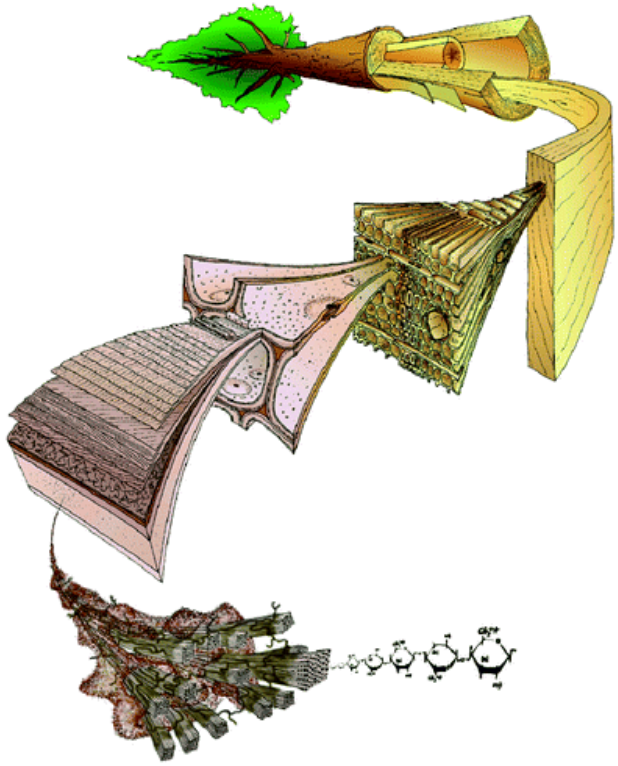



Bioresource Utilization: Creation of maximum values from the assembled structures of biomass

Bioresources

Keywords

Screening of useful
- Plant
- Microorganism



Macrostructure

Wood architecture with high safety and low cost

Microstructure

New wood and bamboo materials

Lignin grafting
synthetic polymer

Nanostructure

New carbon materials

Cellulose nanofibers

Molecules

Aromatic chemicals

Bioactive compounds

Energy

Bioethanol

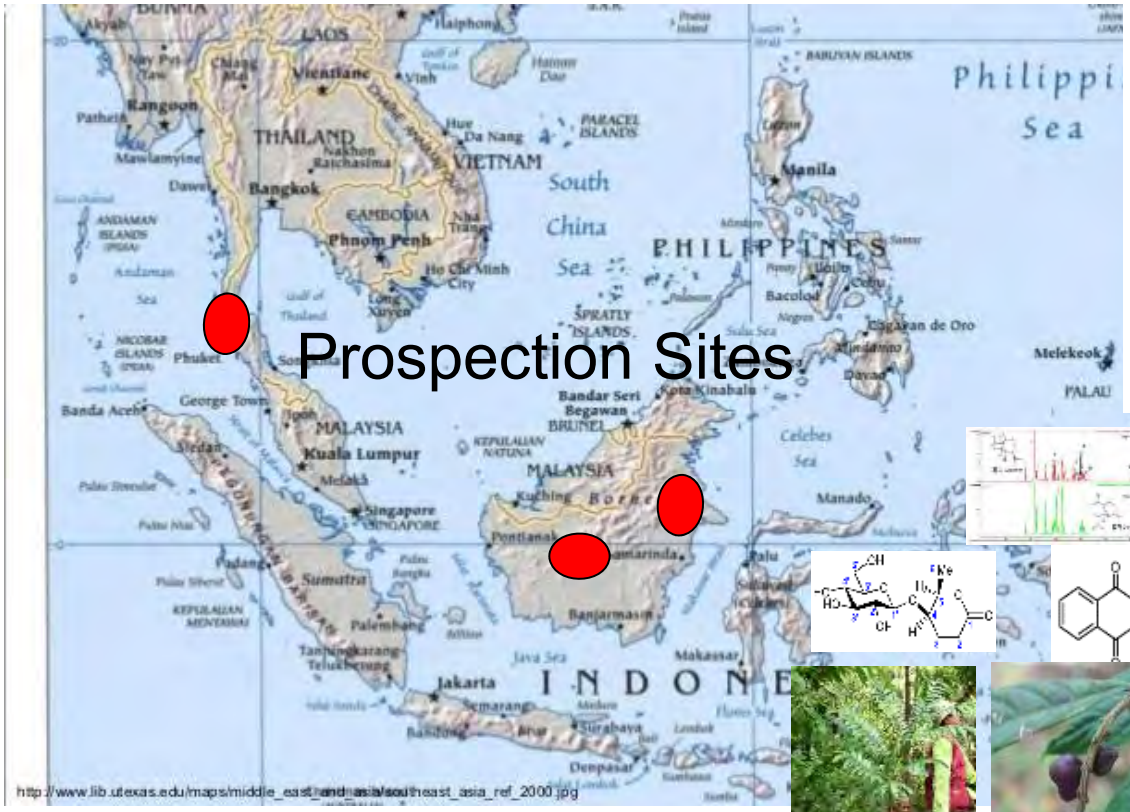
Cellulase

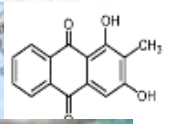
Pyrolysis

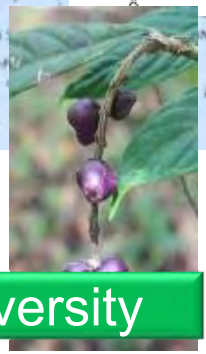
Bioprospecting of plant resources in ASEAN countries to produce highly value-added products

Wichan Eiadthong[1], Andria Agusta[2], Toshiyuki Takano[3], Hiroshi Kamitakahara[3]

[1]*Faculty of Forestry, Kasetsart University, Thailand*
[2]*Research Institute for Biology, Indonesian Institute of Sciences, Indonesia*
[3]*Graduate School of Agriculture, Kyoto University, Japan*







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WP3: Bioresources and Biodiversity

Structural analysis and chemical derivatization of 1,4-*trans*-polyisoprene and 1,4-*cis*-polyisoprene

Wichan Eiadthong[1], Andria Agusta[2], Toshiyuki Takano[3], Hiroshi Kamitakahara[3]

[1]*Faculty of Forestry, Kasetsart University, Thailand*
[2]*Research Institute for Biology, Indonesian Institute of Sciences, Indonesia*
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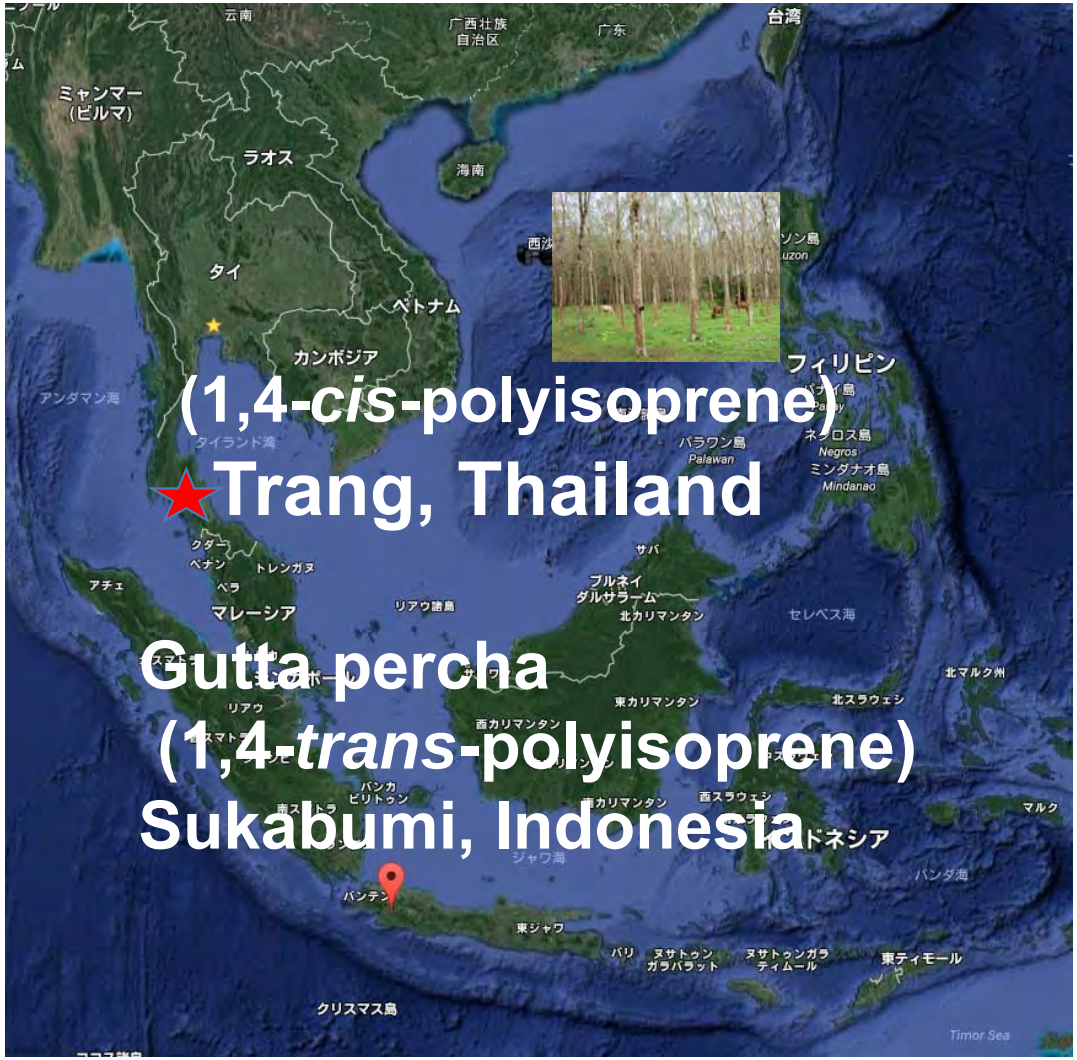
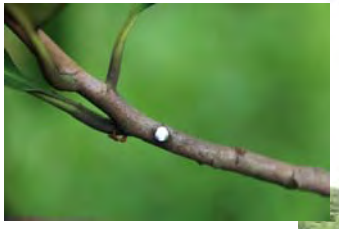


Grafting of cellobiose acetate using thiol-ene reaction

JASTIP-NET



Palaquium gutta

Screening and Characterization Tropical Wood and Bamboo Species for Economical Utilization

Wahyu Dwianto, M.Agr.*, Danang Sudarwoko Adi, Teguh Darmawan, Eka Lestari,
Adik Bahanawan, Dwi Ajias Pramasari, Darmawan, T., W. Dwianto, LIPI
Junji Sugiyama*, Kyoto Univ. and Takuro Mori, Hiroshima Univ.

- Identification and Characterization of Wood Species from Sumba and Simeuleu Island
- Density Prediction Model of Fast Growing Platinum Teak Wood Using NIR-Partial Least Squares Regression
- Natural Durability test of Fast Growing Teak Wood
- Performance of Bamboo Lamination as Construction Materials
- Development of Curve Shape Cross-section Bamboo Lamination

http://www.maps-of-the-world.net/maps/maps-of-asia/maps-of-indonesia/large-physical-map-of-indonesia.jpg

High Durable Wood Structure and Low Cost Wooden House

Agung Sumarno*, Eko Widodo *, Ananto Nugroho *, Triastuti *, Subyakto *, Takuro Mori**

*)Research Center for Biomaterials-Indonesian Institute of Sciences, Indonesia

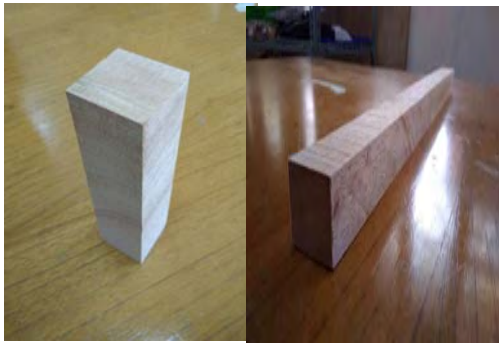
**)Hiroshima University, Japan

This research develop fast growing wood in Indonesia as an anternative materials for high durable wood structure and low cost wooden house

Platinum Teak (*Tectona grandis*)

Jabon (*Antochepalus cadamba*)

Fast Growing Wood



Sample Preparation

Universal Testing Machine and LVDT

Development of environmentally friendly wood-based composites using lignocellulose and natural adhesives

Subyakto, K. W. Praseiyo, F. A. Syamani, L. Astari, LIPI
K. Umemura, S. S. Kusumah, RISH, Kyoto Univ.

To develop particleboard using bamboo, waste of corn and citric acid adhesive.

Bamboo or corn particles

Mixing with Citric Acid

Oven drying 80°C, 15 h

Mat forming

Hot pressing

Particleboard

Development of Advanced Composite Products Using Wood Charcoal

Subyakto[1], Y. Amin[1], J. Sulistyo[2], Y. Nurhamiyah[1], N. Indayanngsih[1]
T. Hata[3], Y. Onishi[3], I. Ide[4], T. Saito[5]

[1]LIPI, 2 Gadjahmada Univ., RISH, Kyoto Univ., Lygnite Co. Ltd., Osaka Pref. Univ.

Wood charcoal will be made from several Indonesian fast growing and community forest wood species, and agricultural wastes.

Jabon (*Anthocephalus cadamba Miq.*)

Rambutan (*Nephelium lappaceum*)

Platinum - Teak wood (*Tectona grandis*), LIPI

Candlenut shell (*Aleurites moluccana*) #Kemiri

- **Preparation of Charcoal:**

  Carbonization temperatures: 600-900 ºC

- **Caharacterisation of Charcoal:**

  - Morphological and crystaline properties of charcoal (SEM and XRD)

  - Chemicals and other properties (thermal properties, calorific values, etc.)

- **Product Development:**

  - Fire retardant material

  - Fuel Cell

  - Others

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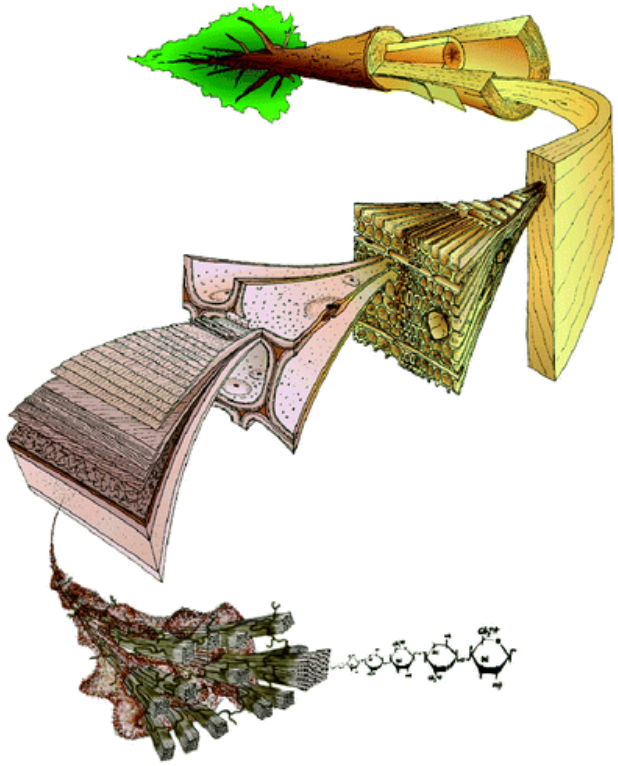

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Aromatic chemicals

Bioactive compounds

Energy

Bioethanol

Cellulase

Pyrolysis

Bio-attractant and Bio-repellent from wood decay fungi for managing wood-attacking Insects

S. Yusuf, T. Kartika, D. Zulfiana, T. Yoshimura, D. Zulfiana, A. H. Prianto, A. Zulfitri, M. P. Ratna Ayu K., A. S. Lestari, B. Wikantyoso

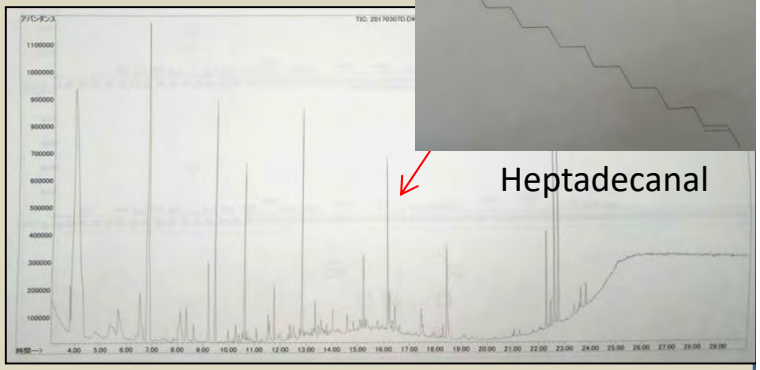
Research Purpose

To investigate natural attractant from bioresources → to develop insect bait targeting on powderpost beetles and termites

Results

Testing on Female of *Lyctus africanus*

Agregation Index Value : 0.67



Heptadecanal

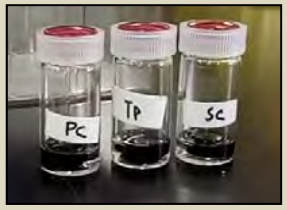
Extract of decay fungi

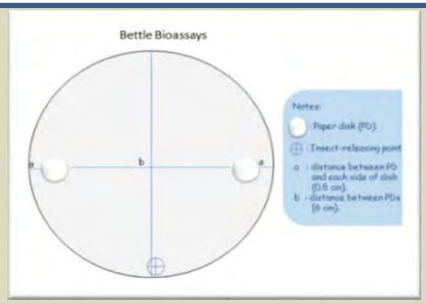
***note : Extract of wood species still in progress**

Methods

Wood species and/or isolated decay fungi

Compounds trapped by using Head space method

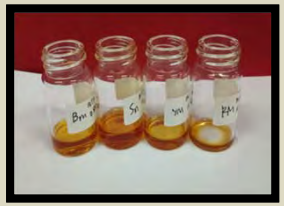




Insect Bioassay

Potential Compound Extraction Process

Compounds extracted by using Maceration method

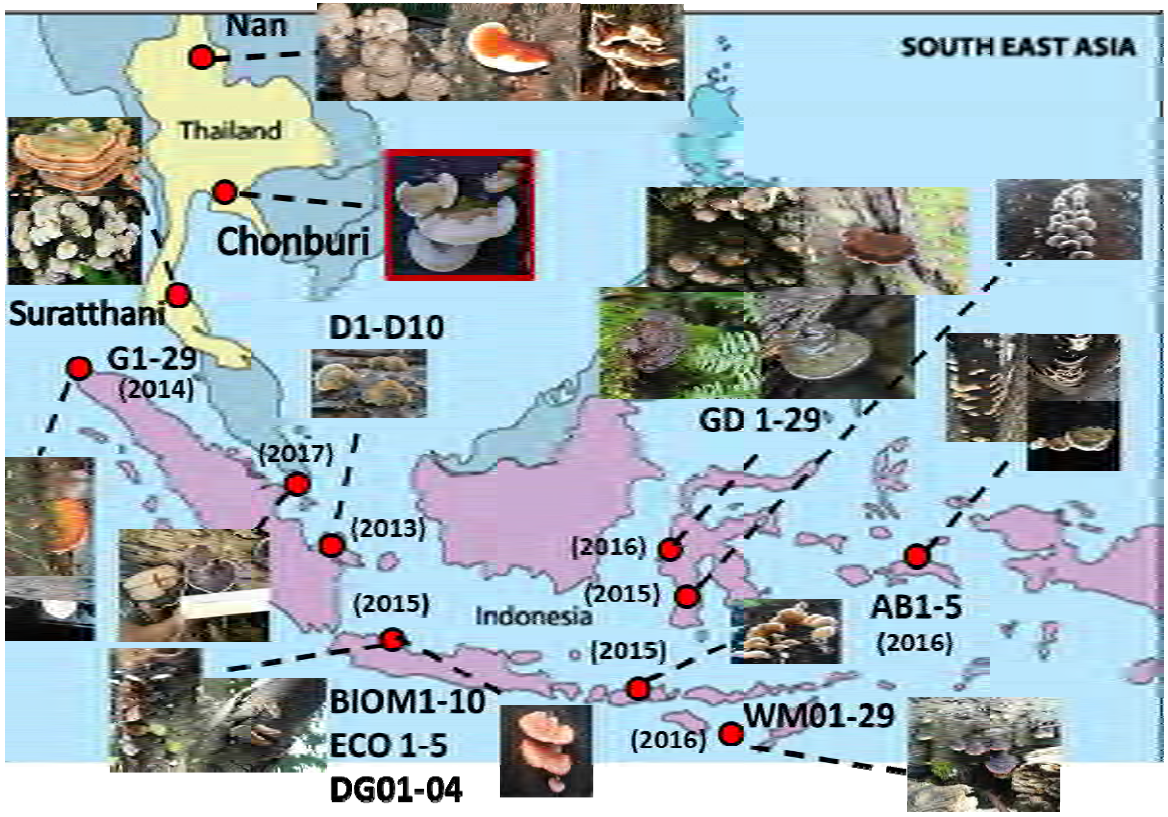


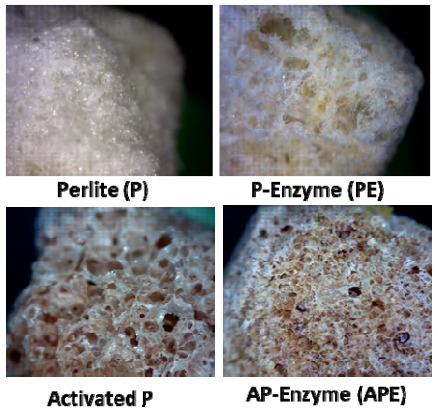
GC Analysis

Decolorization and detoxification of synthetic dyes by enzymes immobilized on activated perlite (APE)

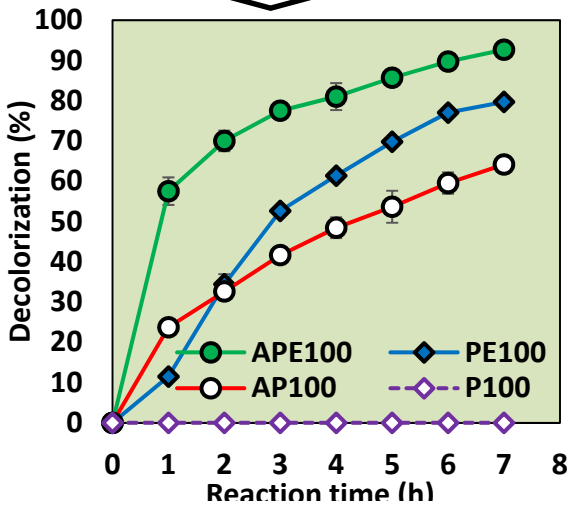
Dede Heri Yuli Yanto[1,*], Wichanee Bankeeree[2], Takashi Watanabe[3], Raden Permana Budi Laksana[1], Hunsa Punnapayak[2], Maulida Oktaviani[1], Fahriya Puspita Sari[1], Sita Heris Anita[1], Hiroshi Nishimura[3], Satoshi Oshiro[3], Ruibo Li[3], Chen Qu[3], and Sehanat Prasongsuk[2]

[1]*Research Center for Biomaterials, Indonesian Institute of Sciences (LIPI), Indonesia*
[2]*Plant Biomass Utilization Research Unit, Department of Botany, Faculty of Science, Chulalongkorn University, Thailand*
[3]*RISH, Kyoto University, Japan*





RBBR 10 mg/l



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WP3: Bioresources and Biodiversity

BIOREMEDIATION of textile dyes and PAHs using laccase immobilized by cross-linking on perlite

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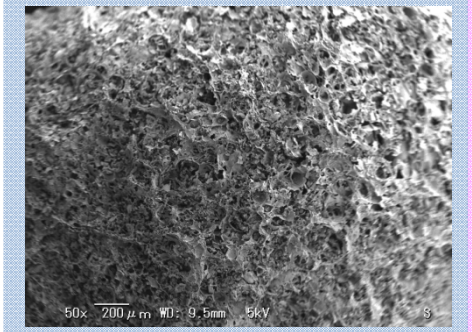
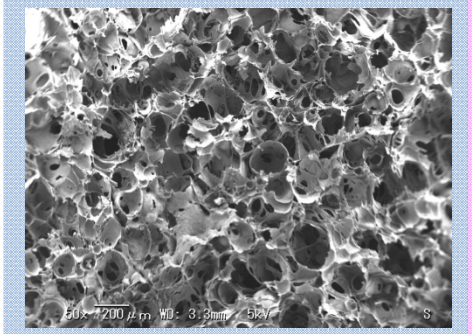
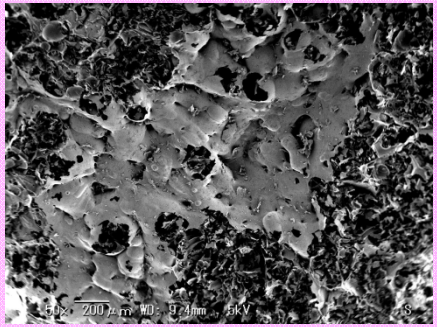
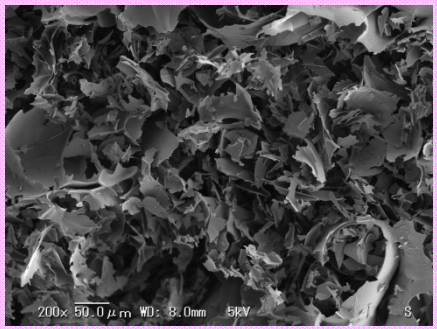
Perlite





Immobilized laccase

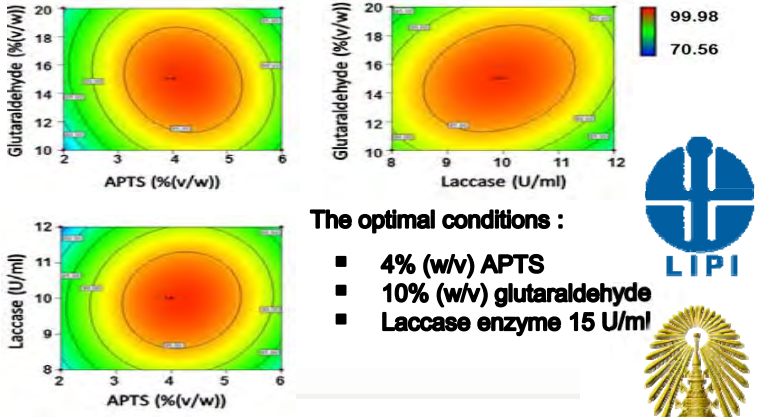




Decolorization (%) = $[(A_{initial}-A_{final})/A_{final}] \times 100$

where $A_{initial}$ = the initial absorbance

A_{final} = the final absorbance at 595 nm

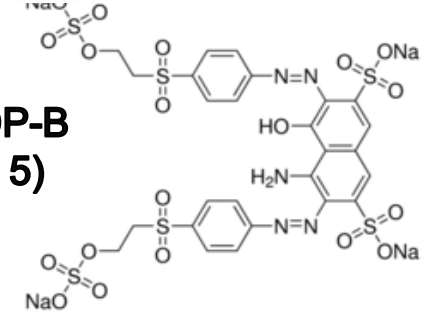


The optimal conditions :

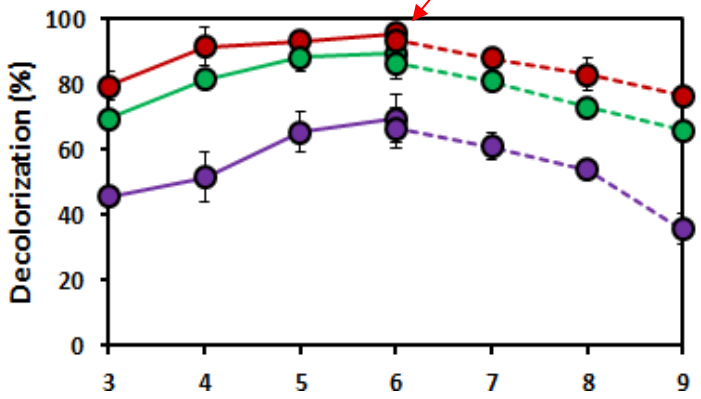
- 4% (w/v) APTS
- 10% (w/v) glutaraldehyde
- Laccase enzyme 15 U/ml

LIPI

Cibacron Navy DP-B (Reactive black 5)



98.65 ± 1.49%



Decolorization of RB 5 using immobilized laccase

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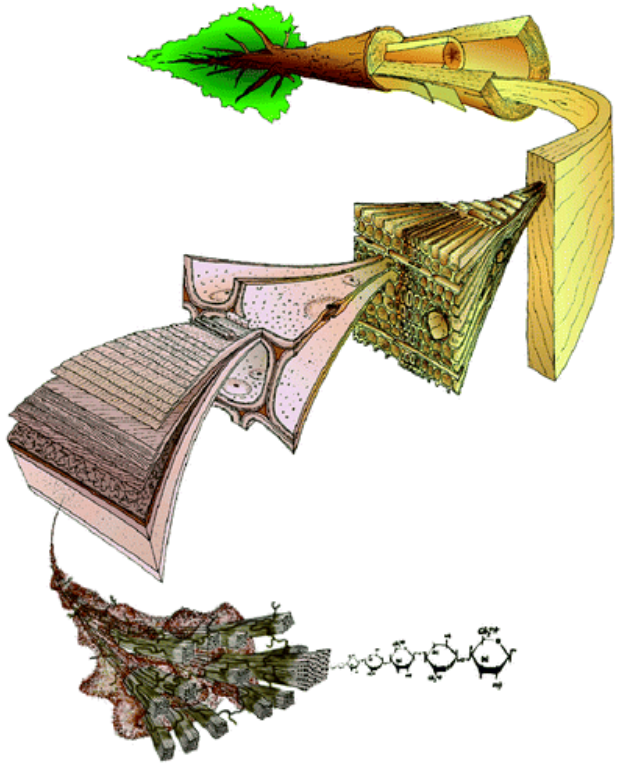

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Bioactive compounds

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Bioethanol

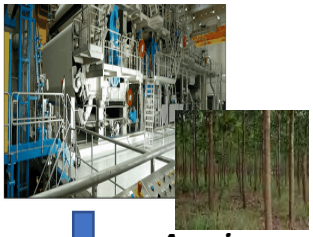
Cellulase

Pyrolysis

Functionalization of Lignin Isolated from *Acacia mangium* Black Liquor by Polymer Blending and Grafting

Widya Fatriasari *, Euis Hermiati *, Triyani Fajriutami *, Nissa Nurfajrin S *, R.Permana Budi Laksana *, Muhammad Ghozali *, Deddy Triyono Nugroho Adi **, Takashi Watanabe***

***Research Center for Biomaterials LIPI, **Research Center for Chemistry LIPI, ***Lab. Conversion Biomass, RISH-Kyoto University**

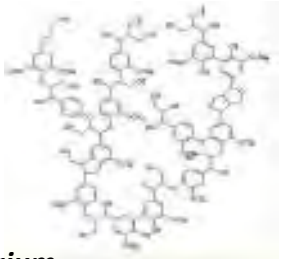


Acacia mangium **plantation**

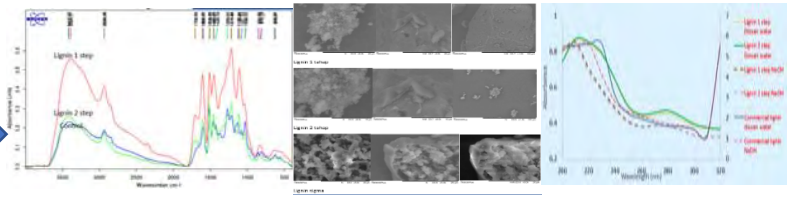
Black liquor from pulp&paper mill

Isolation

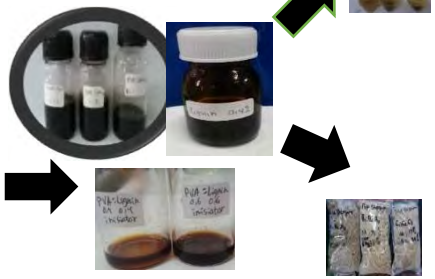
Isolated lignin



Lignin characterization

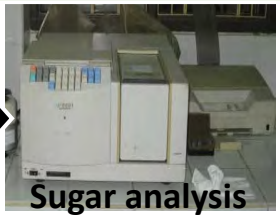


Polymer Blending with or without initiator

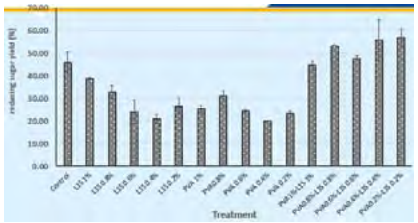


Biosurfactant

Biosurfactant characterization (FTIR and surface tension)



Sugar analysis



Evaluation of Enzymatic hydrolysis performance

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4th JASTIP Symposium, "Biomass to Energy, Chemicals, and Functional Materials", 3rd and 4th July 2017 NSTDA, Thailand

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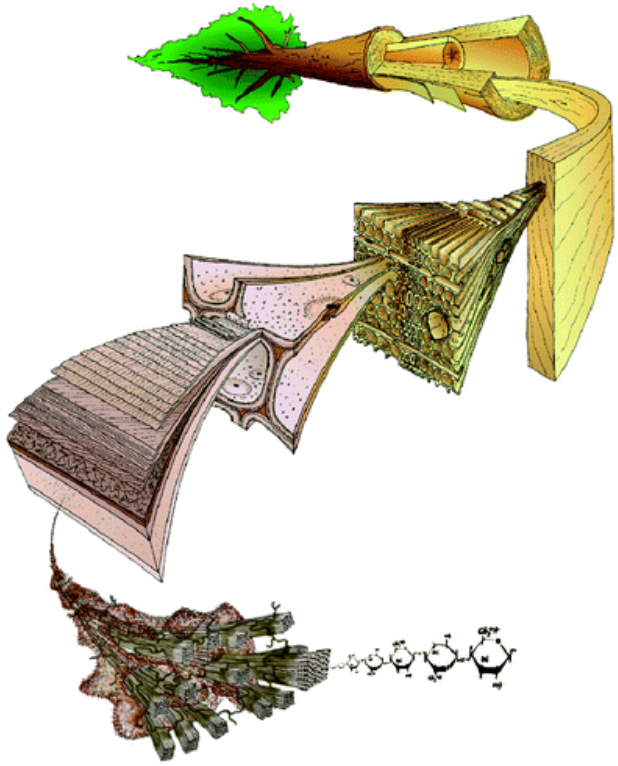

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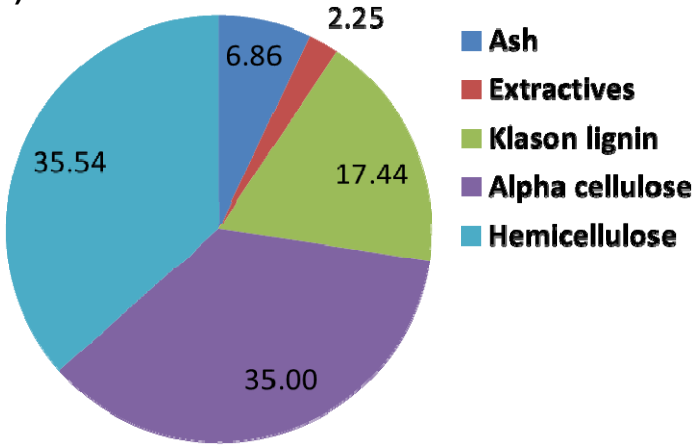
Development of Integrated Process for Conversion of Sugarcane Trash to Bioethanol and Value-Added Chemicals

E. Hermiati, W. Fatriasari, T. Fajriutami, S. H. Anita, M. Ghozali, RP B. Laksana
LIPI, Indonesia
V. Champreda, P. Kanokratana, P. Unrean, B. Bunterngsook, A. Poonsrisawat
NSTDA, Thailand
T. Watanabe, H. Nishimura, S. Oshiro, M. Katahira, T. Nagata, K. Kondo, H. Ohgaki
Kyoto University, Japan

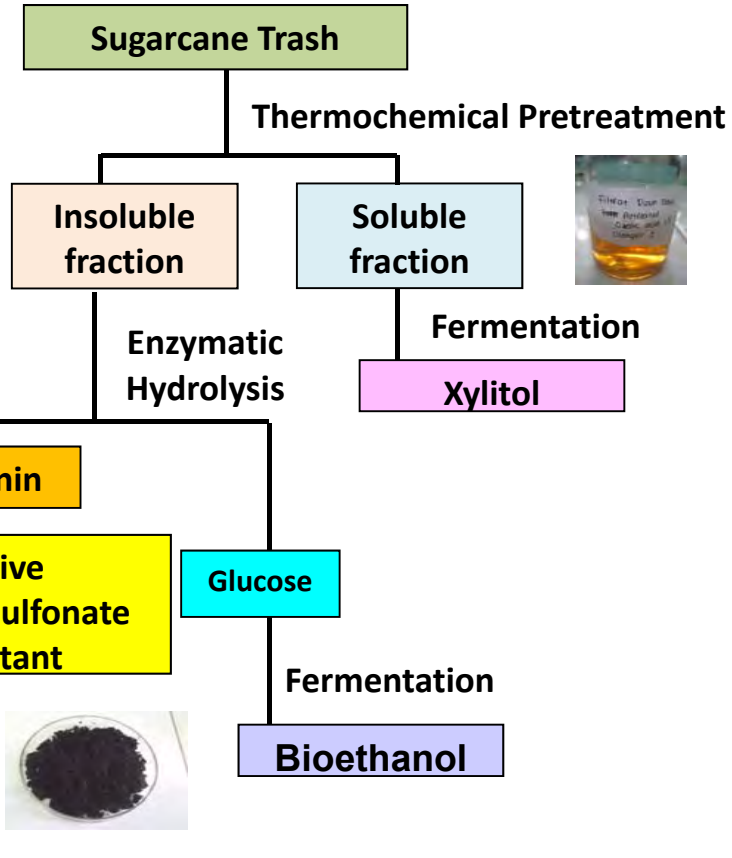
Sugarcane Production in million tonnes

Year	Indonesia	Japan	Thailand
2012	28.7	1.1	98.4
2013	28.4	1.2	100.0
2014	28.6	1.2	104.0

(FAOSTAT, 2016)



- Hydrothermolysis with organic acid
- Steam explosion
- Solvolysis (Glycerolysis)



JASTIP-NET

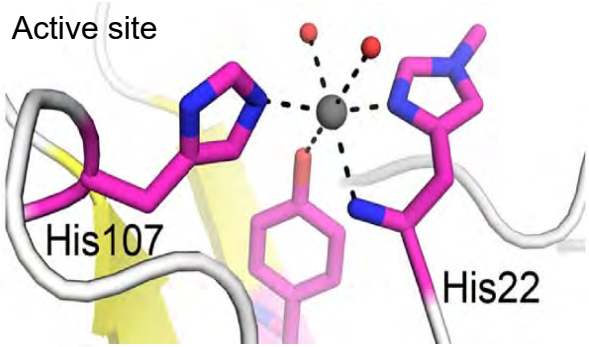
WP3: Bioresources and Biodiversity

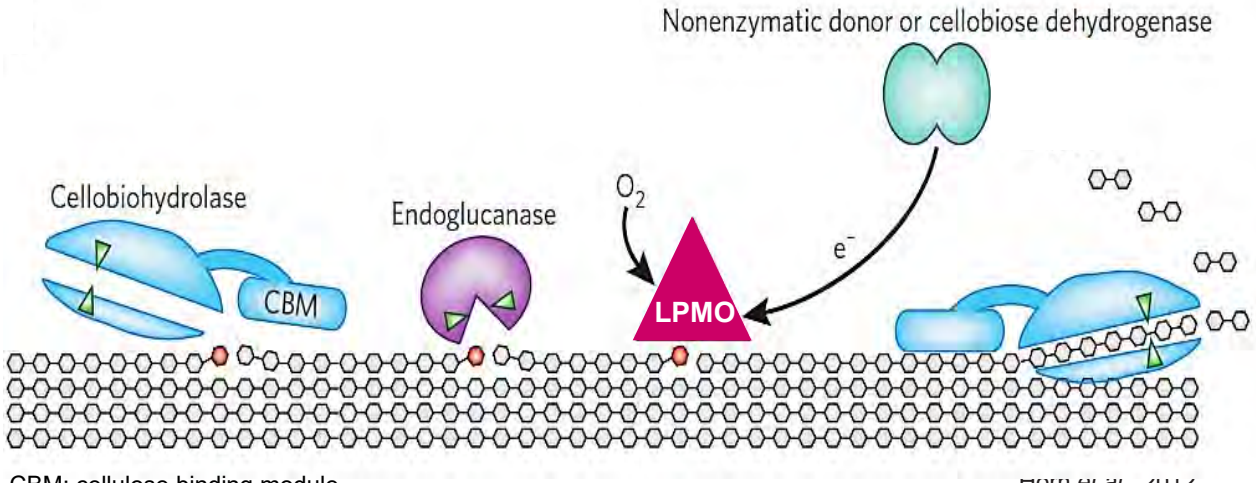
WP2: Environment and Energy

LPMOs: A NEW FACE FOR BIOMASS BREAKDOWN

- Lytic polysaccharide monooxygenases (LPMOs) were classified into auxiliary enzyme family (AA9 and AA10)
- LPMOs have emerged as key enzymes utilized in biology for the degradation of biomass.

Active site

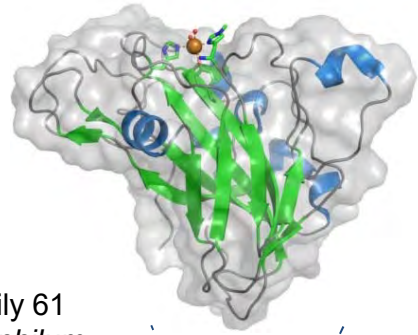




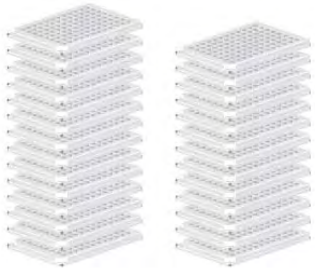
CBM: cellulose binding module

Horn *et al.*, 2012
Hemsworth *et al.*, 2014

LPMOs from bagasse metagenome



Glycoside hydrolase family 61
from *Chaetomium thermophilum*
% identity: 275/313(88%)
% similarity: 295/313(94%)



Fosmid metagenomic library
(insert size ~26-40 kb)
Total: 3,360 clones

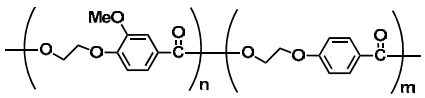
Joint approaches for lignocellulosic biorefinery

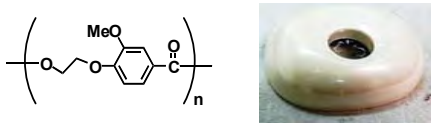
Bioactive compounds

Antiviral compounds
Anti-stress compounds

Insect attractants and repellent

Chemicals

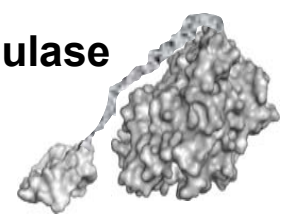




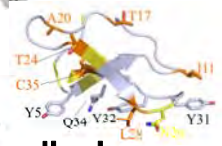
Functional polymer

Cellulase / hemicellulase coctails for enz. saccharification

cellulase



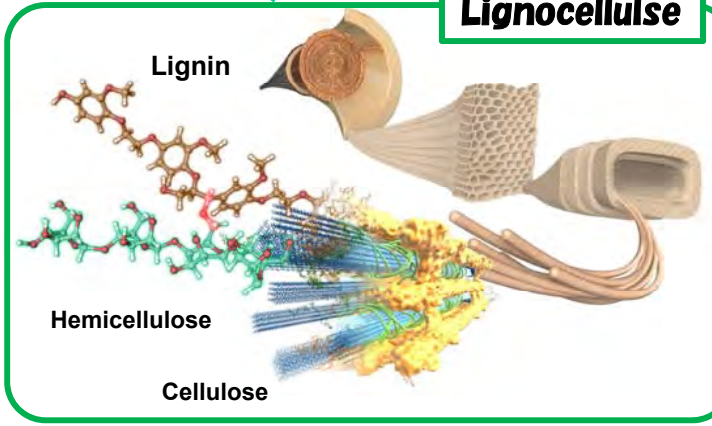
LPMO



Metagenome
Protein engineering
Control of adsorption on lignin

Functional and durable materials and construction

Lignocellulse



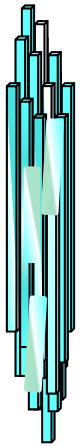
lignin

hemicellulose

Pretreatment

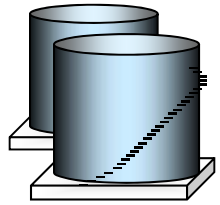
Steam explosion

Microwave



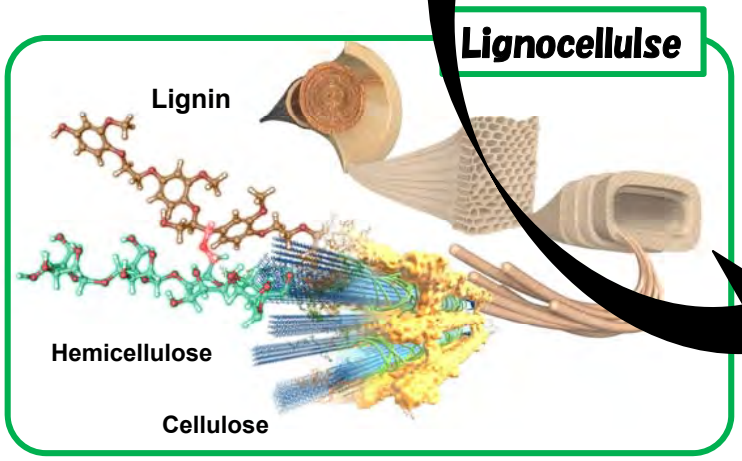
Enz. Saccharification & fermentation

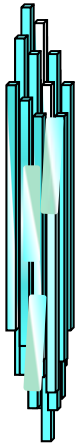
cellulose

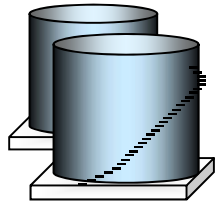


Bioethenol Chemicals

Bench-scale plant for biomass conversion using microwave processing & gene-engineered microbes







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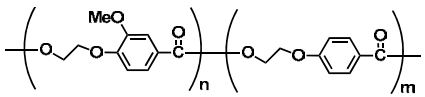

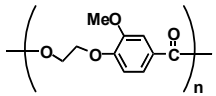

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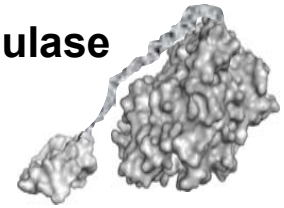
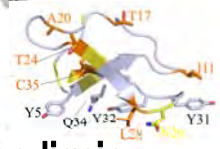


LPMO



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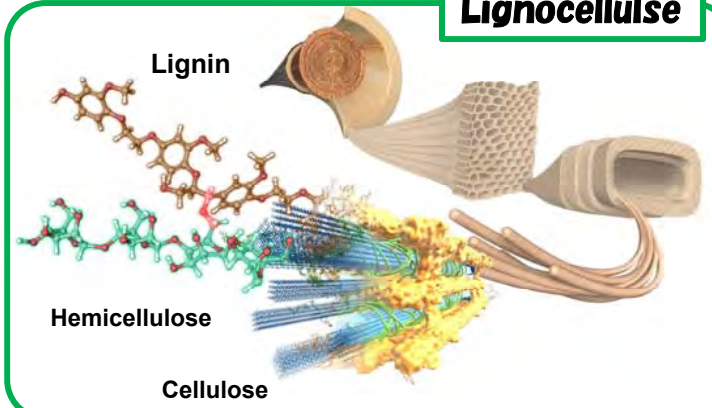

lignin

hemicellulose

Molecular breeding of microbes for biorefinery

Pretreatment

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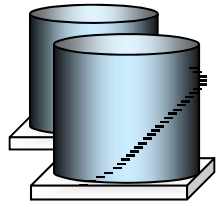
Enz. Saccharification & fermentation



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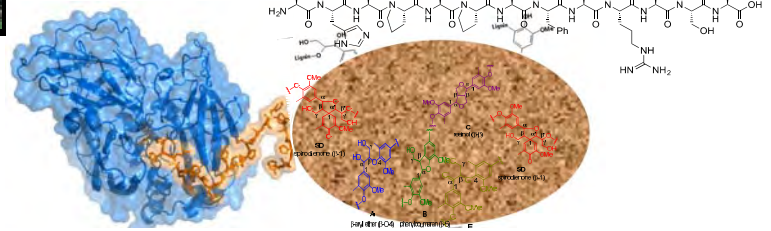
cellulose



Sustainable land usage for renovation of society

Advanced structural analysis

Hyper lignin-degrading (Bio)catalysts

SATREPS
Science and Technology Research Partnership for Sustainable Development Program

NEDO

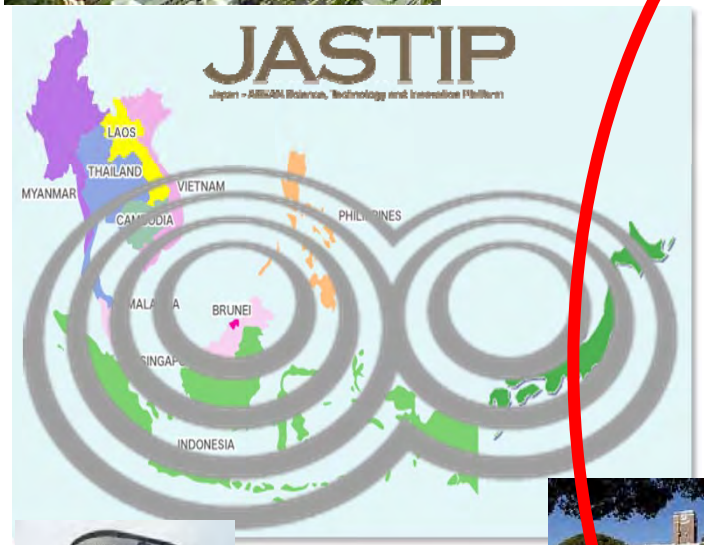
JICA

JST

MEXT

Bioresource Utilization: Creation of maximum values from the assembled structures of biomass

NSTDA



LIPI.

Kyoto Univ.

- Create maximum values from assembled structures of biomass through international joint research
- Promote societal implementation of the maximized research output with younger generations

Bioresources

Macrostructure

Microstructure

Nanostructure

Molecules

Energy