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

Bio-refinery Strategy for Fuel Production in Indonesia

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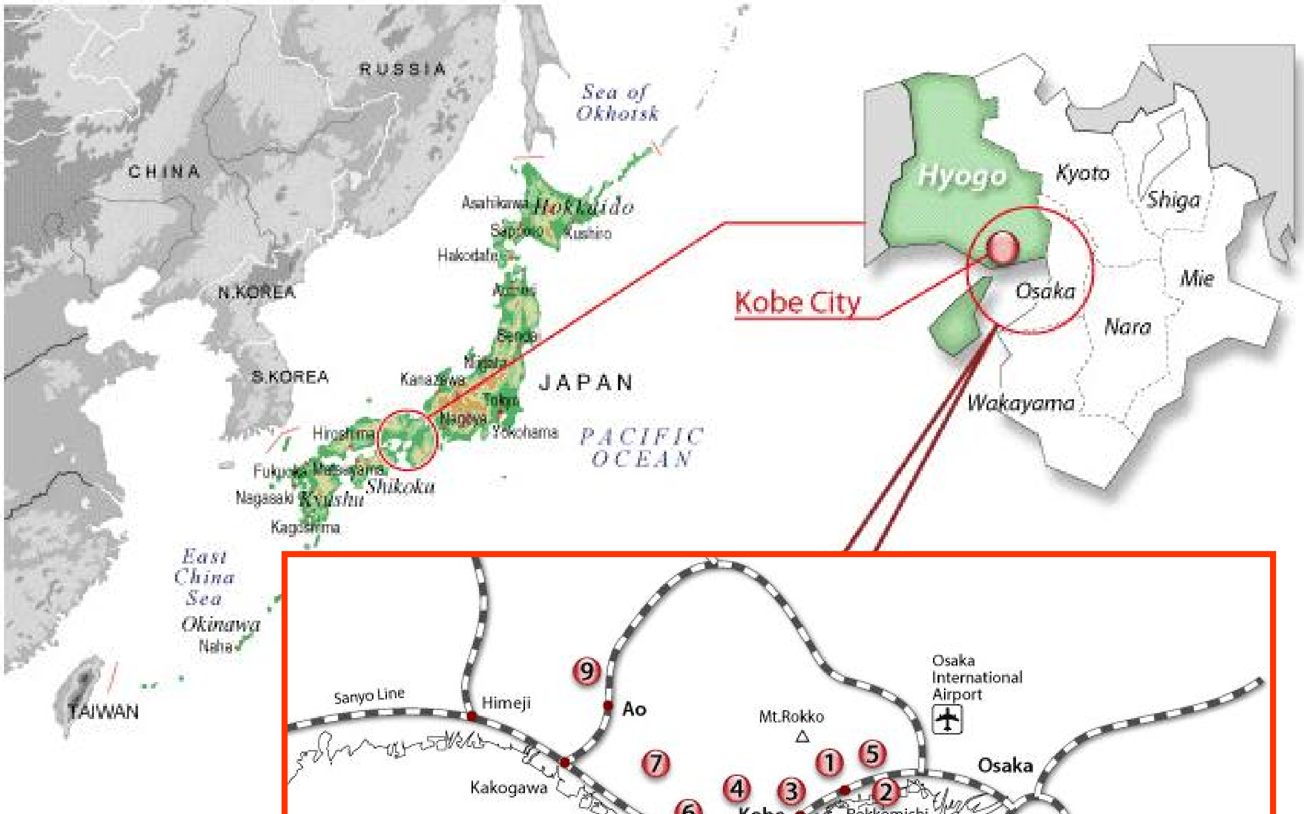
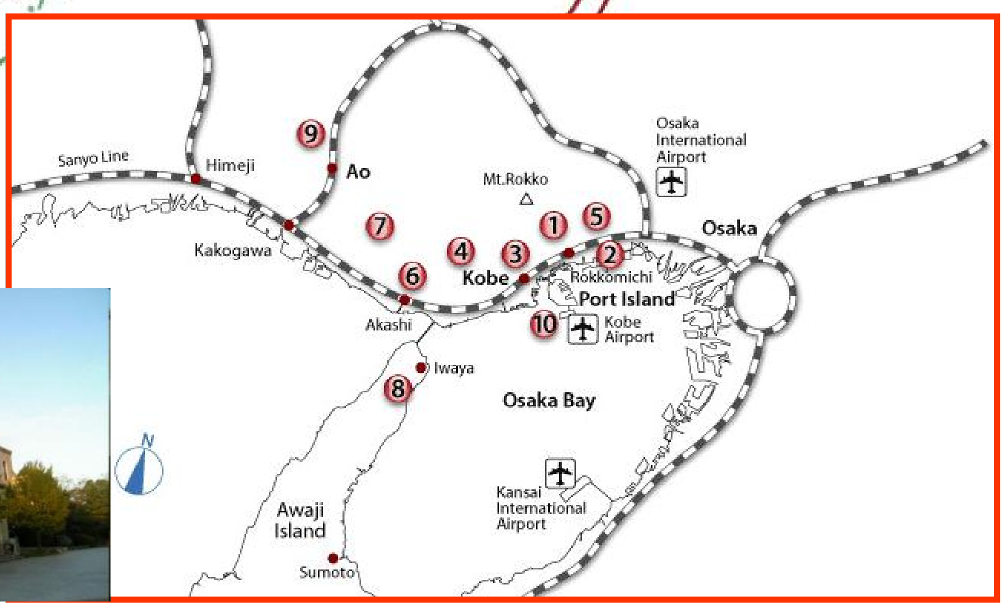
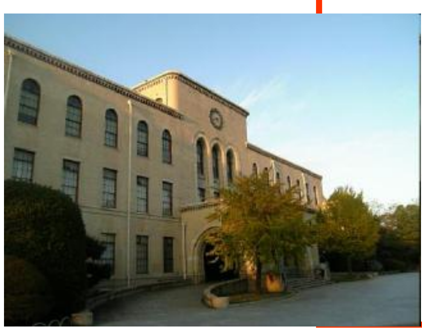
[3]*National Standardization Agency of Indonesia, Gedung I BPPT Jl. M.H. Thamrin No.8, Kebon Sirih, Jakarta Pusat 10340*

About Kobe and our University







Kobe University

Bio-production Research Group

(Team Leader: Prof Akihiko Kondo)

Many Thanks to all member in our Lab.

32 academic staffs including post-doc

43 students including PD candidate

35 technical assistants

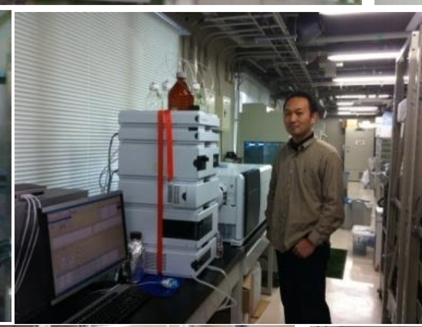
Many other peoples   Total 140 (?)

Integrated Biorefinery Research Institute in Kobe University

Only research institute in Japan

→ Collaborations with more than 20 Japanese Companies.

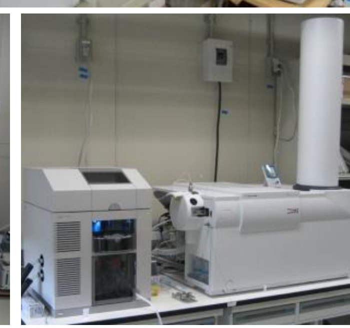



Research equipment

Bioreactor (2L – 100L)
Pretreatment equipment
DNA sequencer
Metabolite analysis equipment

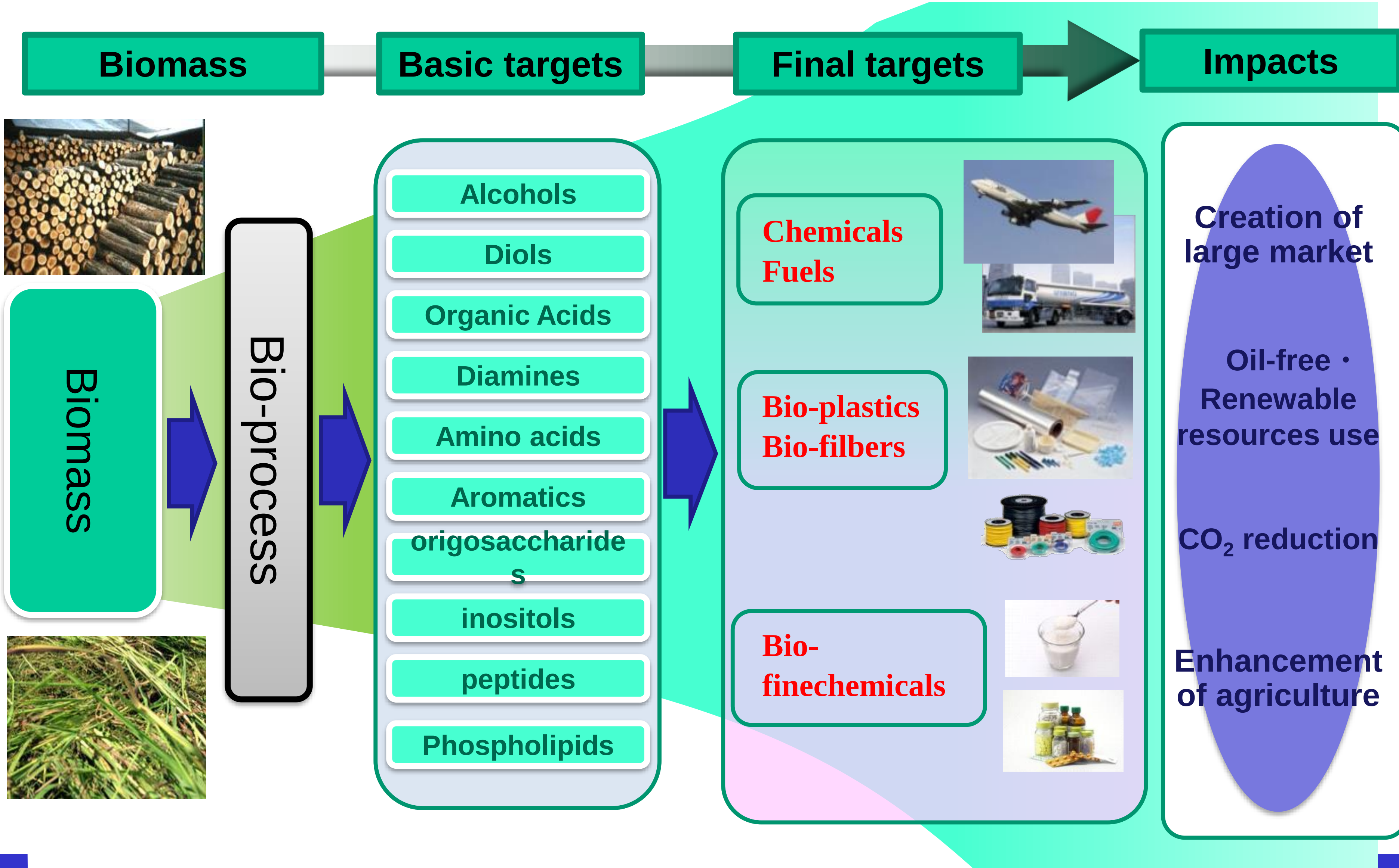




Collaboration with LIPI (2011～)

→ We focused on the utilization possibility of Indonesian's biomass for biorefinery

Systemized bio-refinery process



Utilization possibility of Indonesian's Biomass

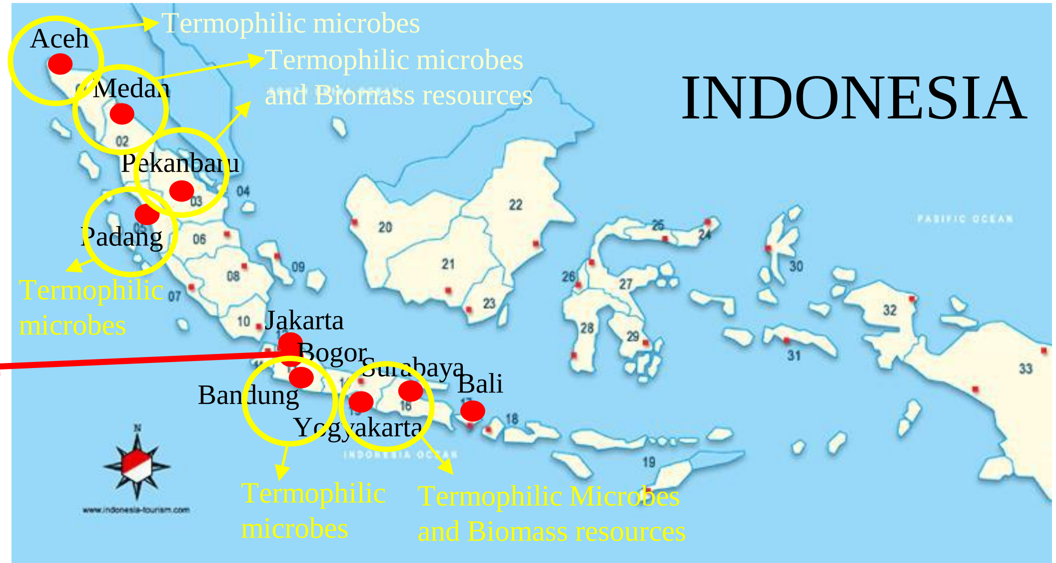
→ Most of waste cellulosic biomass have been burned

Biomass	Generated Place	Productivity [million t/year]	Energy potential [million GJ/year]
Rubber wood (ゴムの木)	Sumatera, Kalimantan, Java	41 (５年間隔で置換)	120
Logging residues （伐木）	Sumatera, Kalimantan	4.5	19
Sawn timber residues （製材残基）	Sumatera, Kalimantan	1.3	13
Plywood and veneer production residues （合板残材）	Kalimantan, Sumatera, Java, Irian Jaya, Maluku	1.5	16
Sugar residues （サトウキビ残渣）	Java, Sumatera, South Kalimantan	**Bagasse (バガス)**: 10 Cane tops: 4 Cane leaves: 9.6	78
Rice residues （稲わら残渣）	Java, Sumatera, Sulawesi, Kalimantan, Bali/Nusa Tenggara	Husk: 12 Bran 2.5 Stalk: 2 Straw: 49	150
Coconut residues （ココナッツ残差）	Sumatera, Java, Sulawesi	Shell: 0.4 Husk: 0.7	7
Palm oil residues （パームオイル残差）	Sumatera new areas: Kalimantan, Sulawesi, Maluku, Nusa Tenggara, Irian Jaya	**Empty fruit bunch (EFB)**: 3.4 Fibres: 3.6 Palm shells (**PKC**): 1.2	67

→ There are various kinds of biomass for bio-refinery industry

Source: ZREU (Zentrum fur rationell Energieanwendung und Umwelt GmbH), 2000. Biomass in Indonesia–Business Guide

Innovative Bio-Production in Indonesia(iBioI) and Indonesia Culture Collections (InaCC)

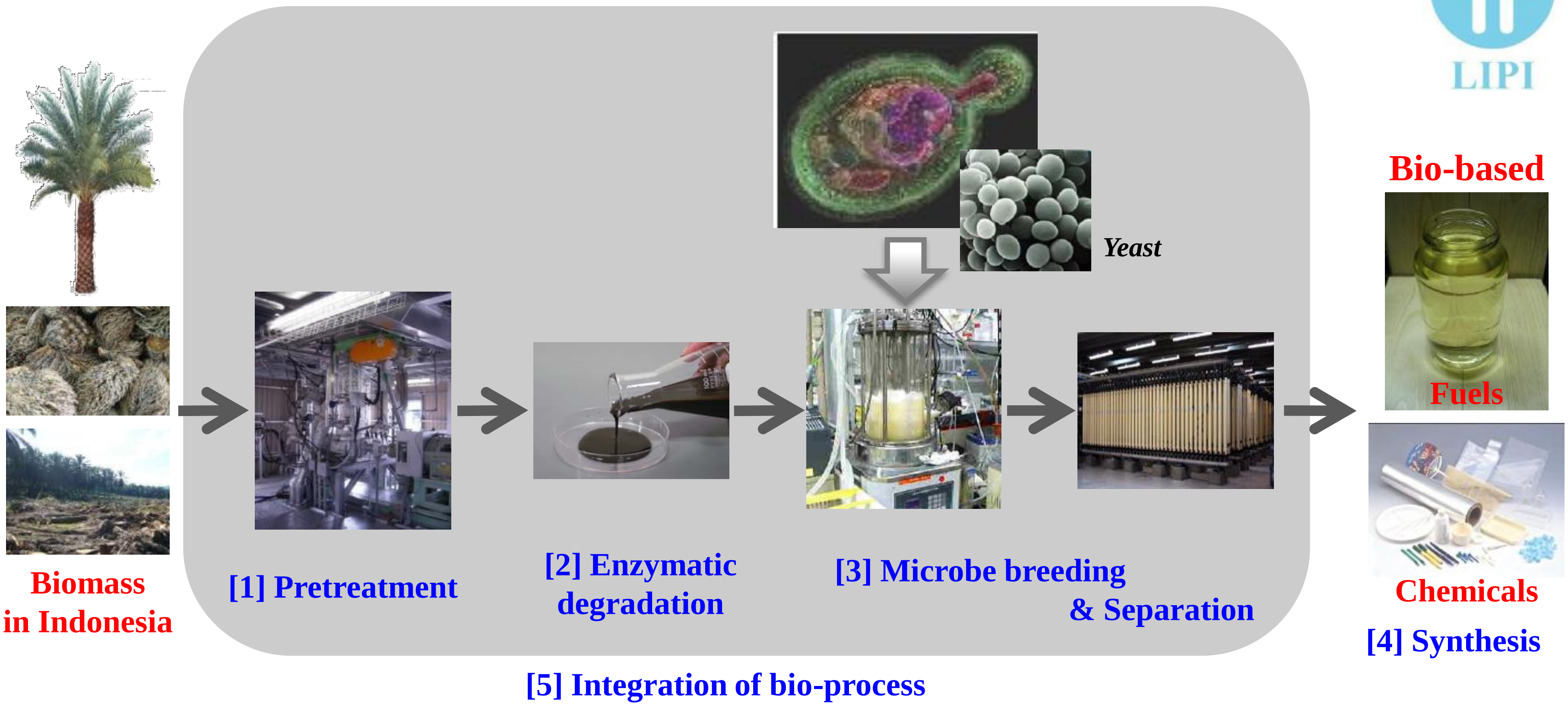


IBioI promotes Biomass-based Production of high-valued materials in Indonesia using Indonesia Culture Collection.

InaCC Building in LIPI Cibinong

IBioI members

Five Key Technologies in SATREPS project



Innovative Bio-production in Indonesia (iBioI) from 2012

KOBE UNIVERSITY 長崎大学 NAGASAKI UNIVERSITY NBRC NITE Biological Resource Center

Chiaki Ogino (Japan side)

- Ryosuke Yamada
- Hideki Nakayama, Lee JaeMin
- Jun Ishii, Kiyotaka Hara, Prihardi Kahar
- Tatsuo Maruyama

[1] Pretreatment

[2] Enzymatic degradation

[3] Microbe breeding and Separation

Bio-based Chemicals

[4] Synthesis

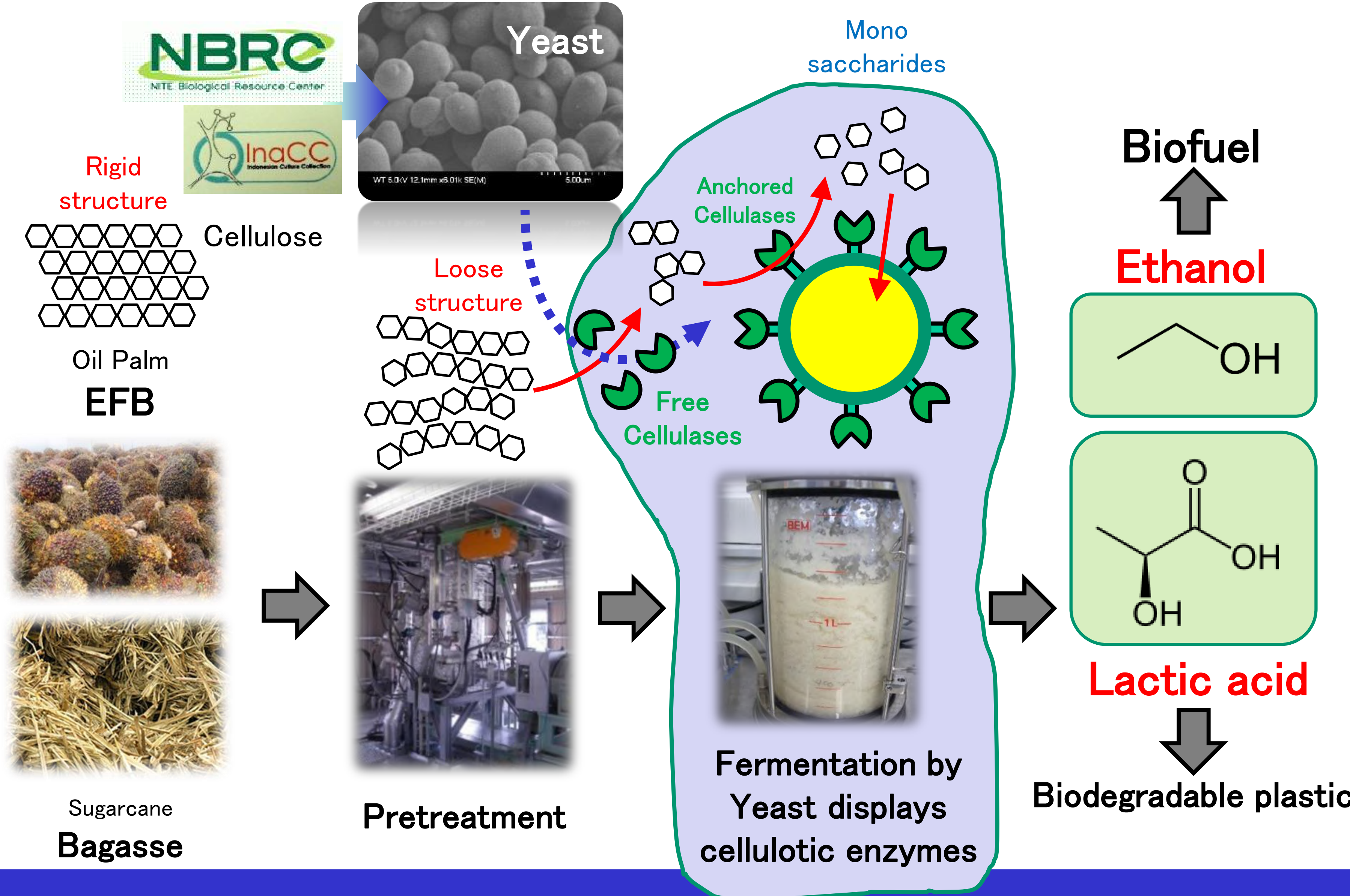
[5] Integration of bio-process

LIPI InaCC

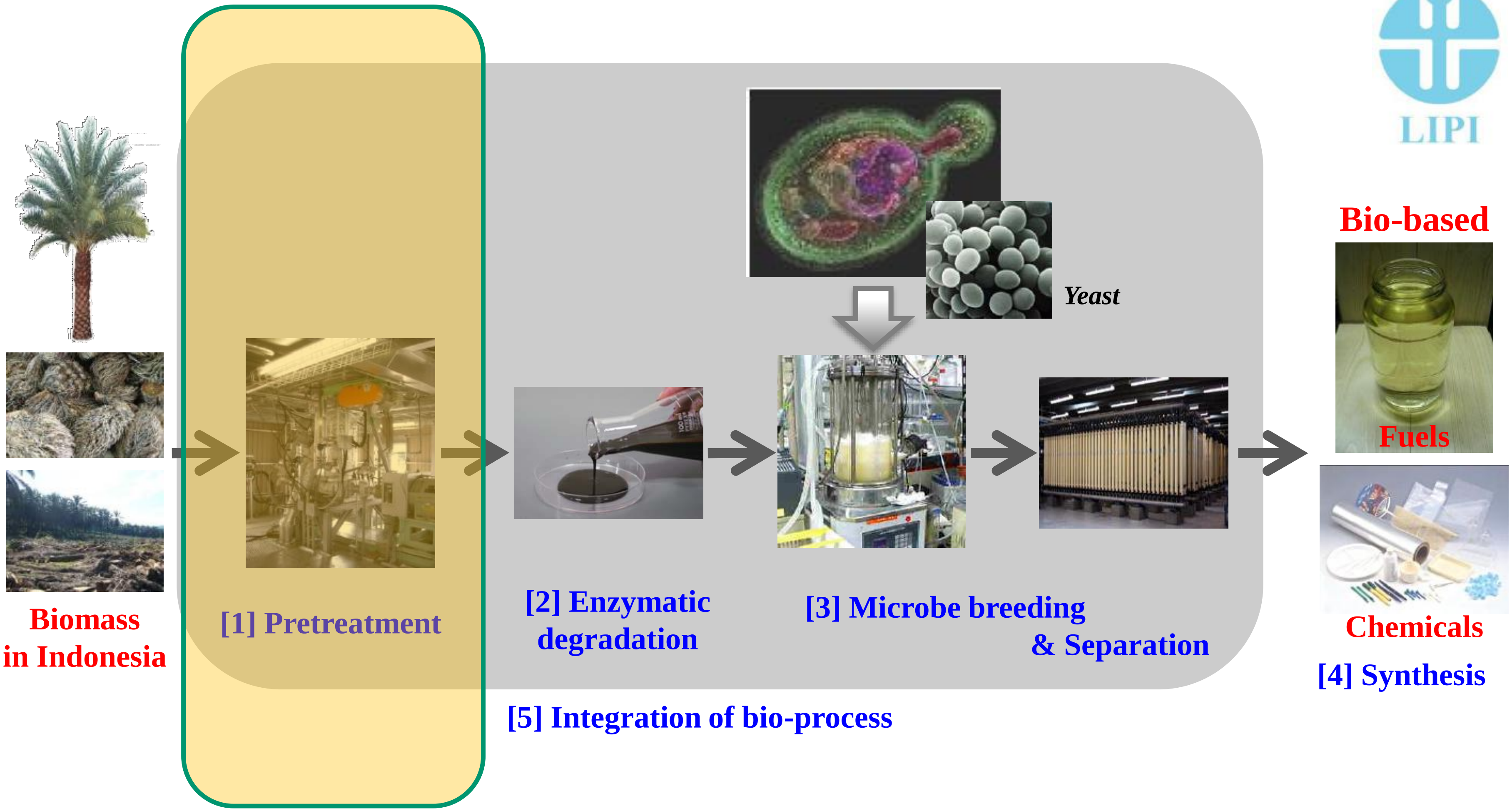
Prof. Dr. Bambang Prasetya (Indonesia side)

Research & Development of Biomaterial LIPI	Research Center for Biotechnology LIPI	Faculty of Chemical Engineering University Indonesia	Research Center for Chemistry LIPI
Sub-coodinator Dr. Euis Hermiati	Sub-coodinator Dr. Yopi	Sub-coodinator Dr. Misri Gozan	Sub-coodinator Dr. Agus Haryono
Dr. Subyakto	Dr. Puspita Lidiyanti	Prof. Anondo Wijanarko	
Dr. Wahyu	Dr. Desriani	Dr. Hery Hermansyah	
Dr. Sasa	Nanik Rahmani	Dinursanti	
	Awan Purnawan		

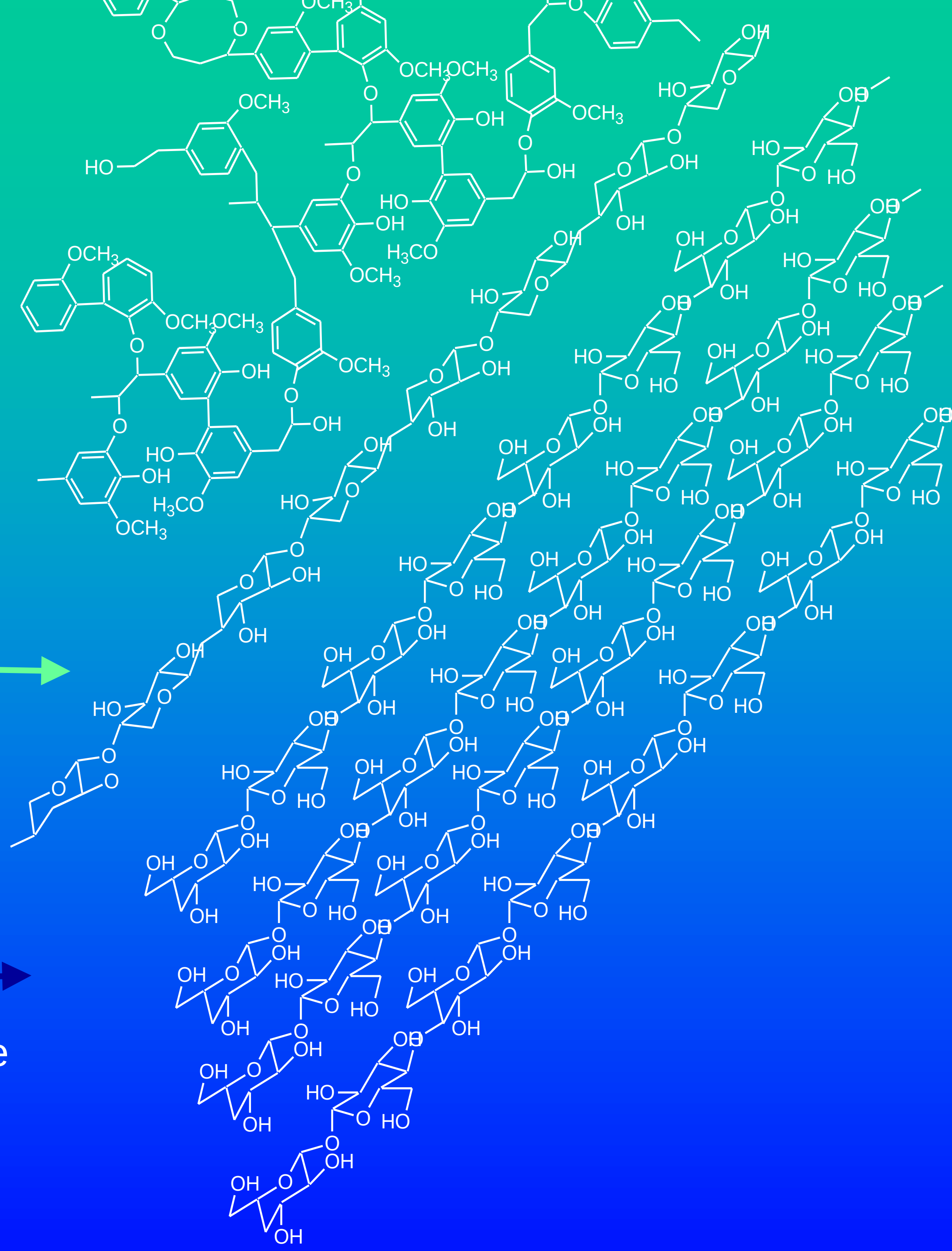
Consolidated Conversion of Lignocellulosic Biomass into High-Valued Starting Materials (Ethanol and Lactic Acid)



Five Key Technologies in SATREPS project



Key Cellulosic Constituents



Lignin: 15-25%

- Complex aromatic structure
- Very high energy content
- Resists biochemical conversion

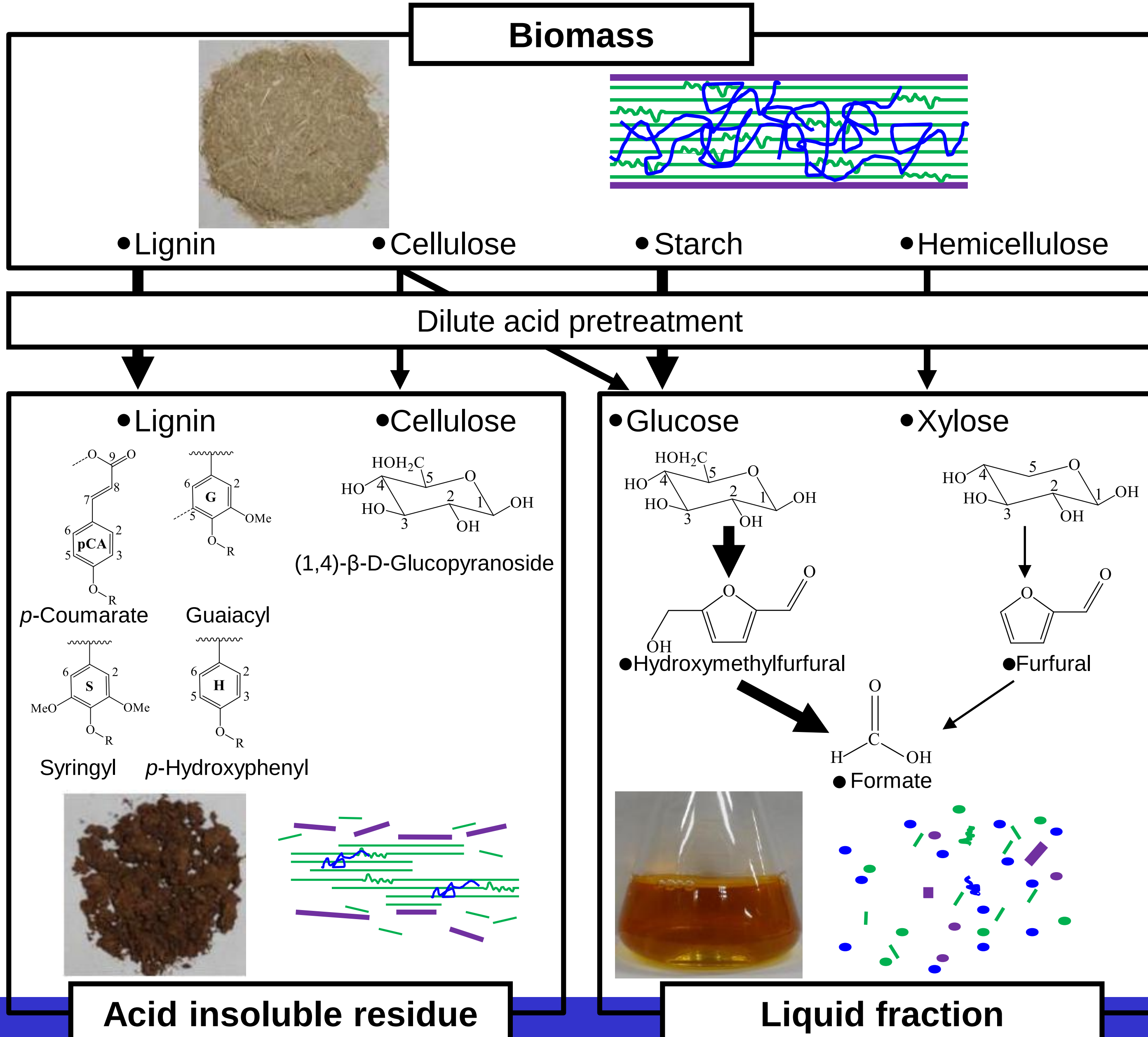
Hemicellulose: 23-32%

- Xylose is the 2nd most abundant sugar in biosphere
- Polymer of 5C and 6C sugars
- Readily hydrolyzed

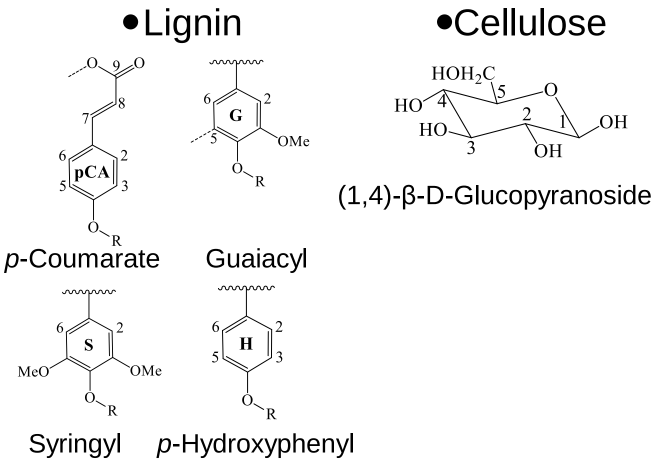
Cellulose: 38-50%

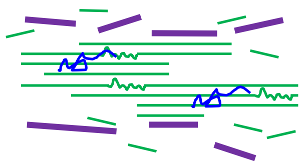
- Most abundant form of C in biosphere
- Polymer of glucose
- Resistant to hydrolysis

Material follow of dilute acid pretreatment



Problem of dilute acid pretreatment





Acid insoluble residue

Dilute acid pretreatment can not separate cellulose and lignin.

Lignin inhibit enzymatic hydrolysis of cellulose.

Organosolv pretreatment can separate cellulose and lignin. But, this method require high amount of organic solvent.

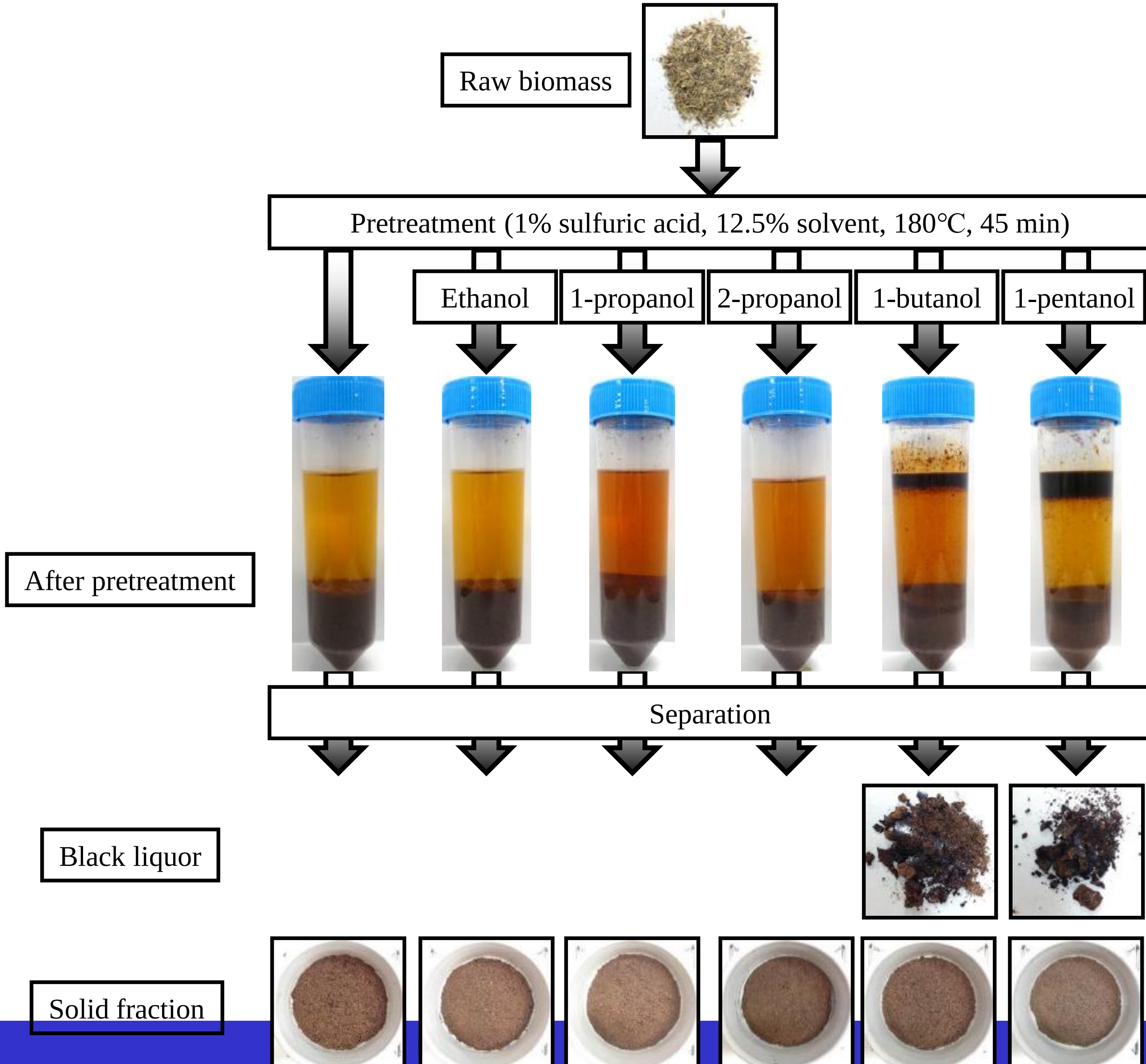
||

High cost.

Decreasing the concentration of organic solvent is necessary to reduce the pretreatment cost.

Which of the organic solvent is suitable for pre-treatment?

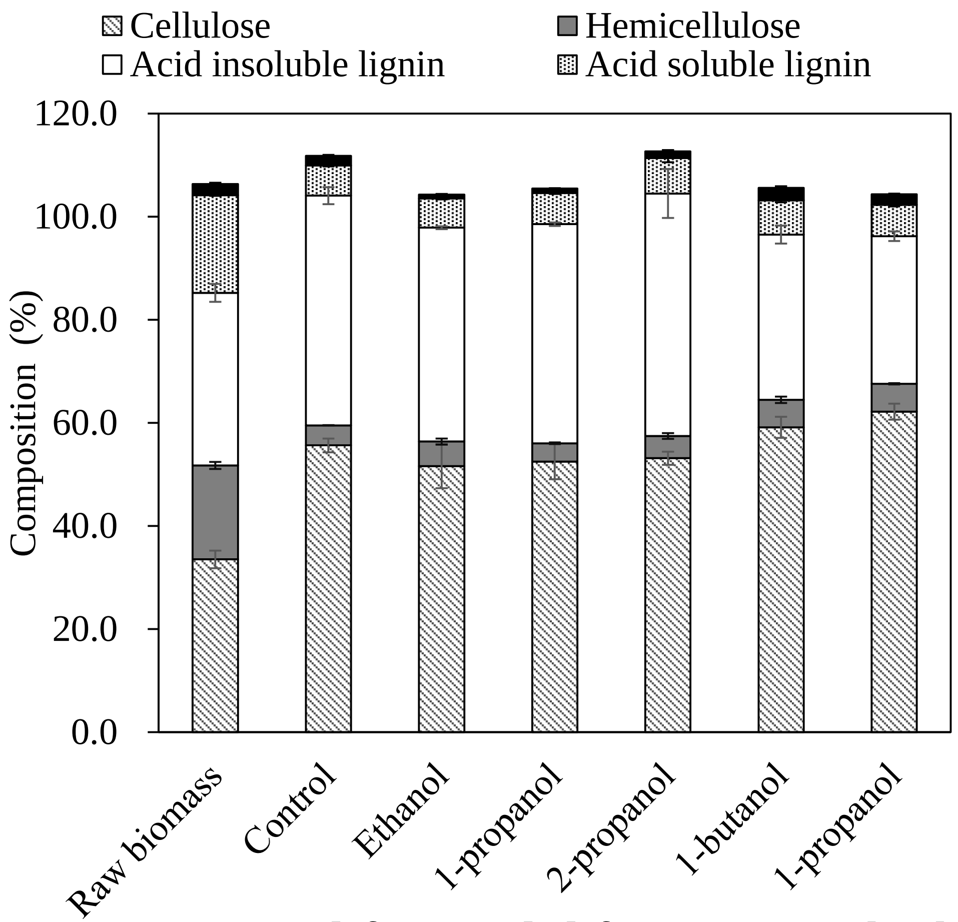
Influence of solvent type on organosolv fractionation of sorghum bagasse



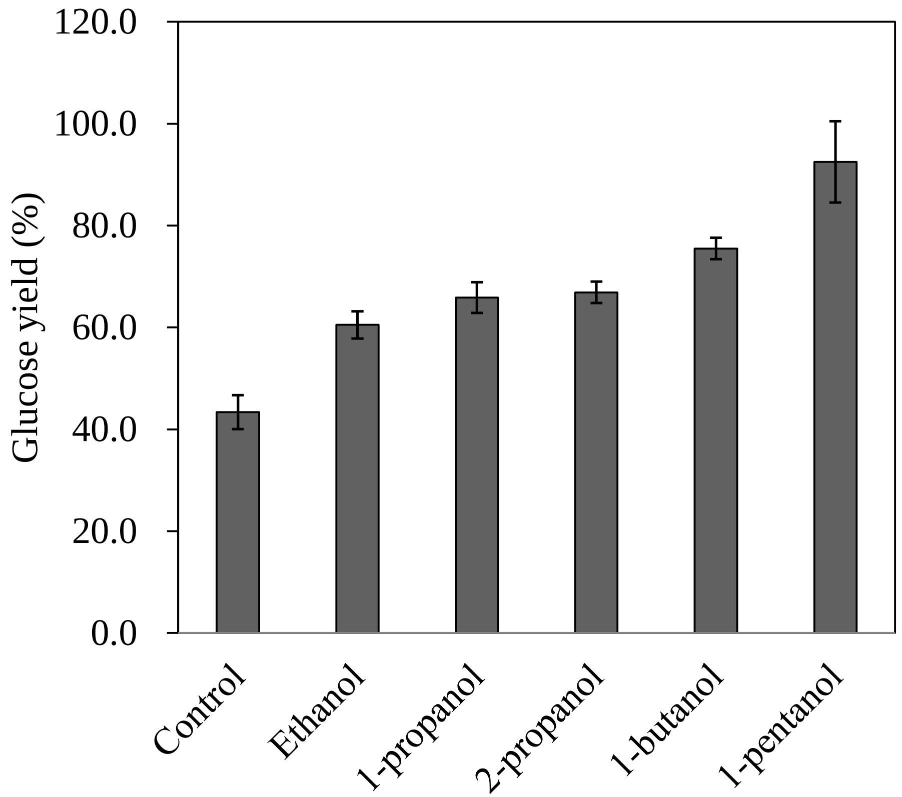
Three fractions (solid, liquid, and black liquor) were obtained with 1-butanol or 1-pentanol as the solvent.

Analysis of Cellulose-enriched solid fraction

Composition of solid fraction

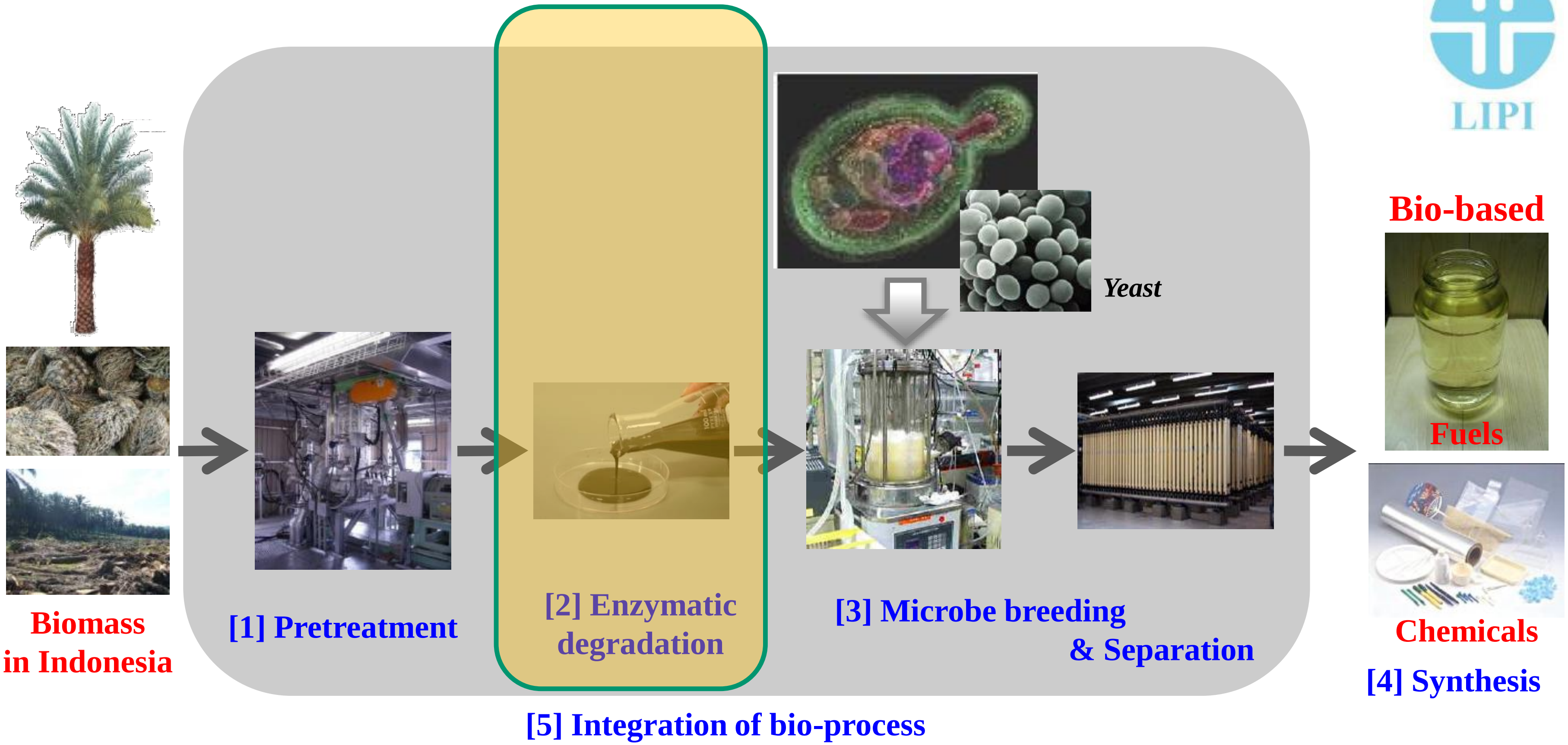


Enzymatic saccharification (6.6FPU/g biomass)



Lignin removal from solid fraction was higher when 1-butanol or 1-pentanol was used as the solvent. And, lignin removal enhance the enzymatic saccharification efficiency.

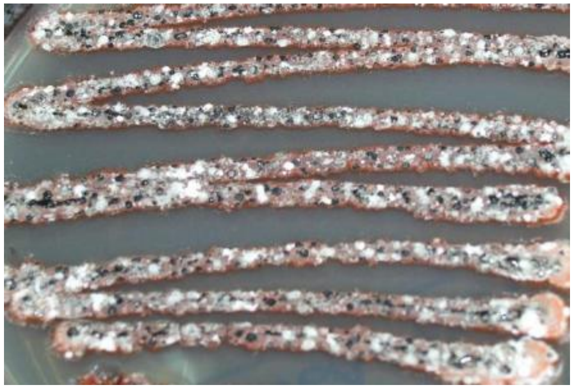
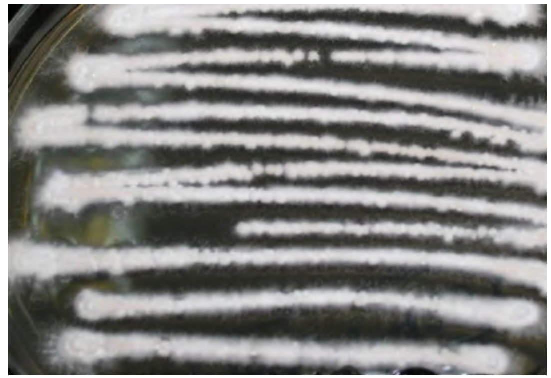
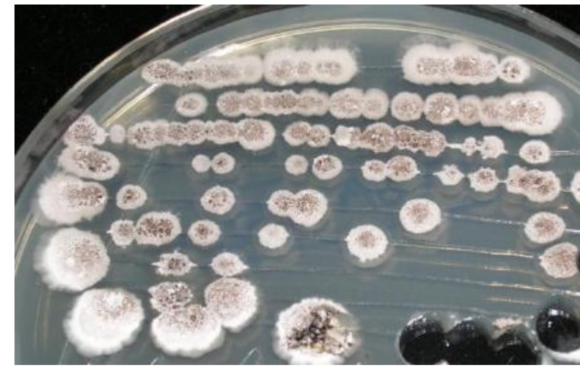
Five Key Technologies in SATREPS project



The sources of Actinomyces Isolates in Indonesia

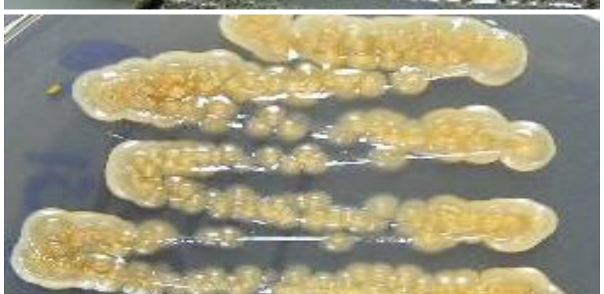
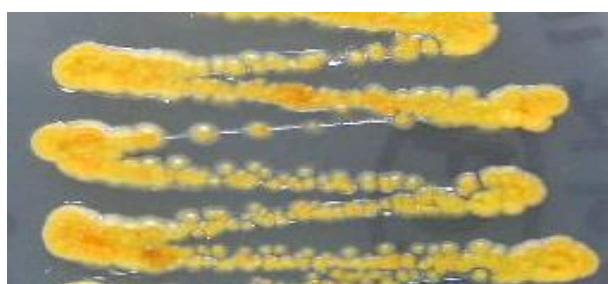
The kinds of Actinomyces Isolates in Indonesia

The genus *Streptomyces, Kitasatospora, Streptacidhiphilus*

The genus *Actinoplanes, Micromonospora, Nocardia, Gordonia, Dermatophilus*



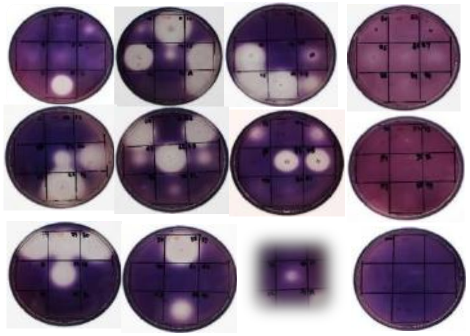




Screening of Indonesia Rare Actinomycetes Isolates based on Halo-formation and Congo Red Analysis

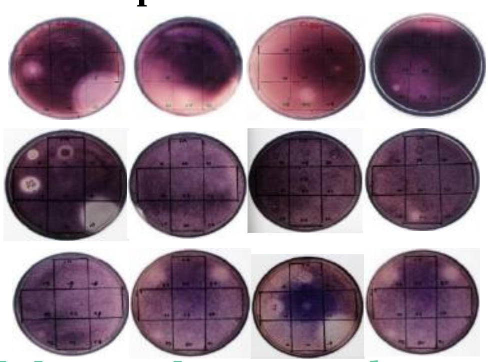
No	Isolate code	Name of isolates
1	ID.04-361	Streptomyces fumigatiscleroticus
2	ID.04-364	Streptomyces griseovariabilis
3	ID.04-372	Actinomadura citrea
4	ID.04-454	Streptomyces turgidiscabies
5	ID.04-455	Kitasatosporia putterlickiae
6	ID.04-487	Streptomyces albulus
7	ID.04-502	Streptomyce platensis
8	ID.04-509	Kitasatospora recifensis
9	ID.04-523	Streptomyces galbus
10	ID.04-532	
11	ID.04-539	Streptomyces lipmanii
12	ID.04-540	Kitasatospora kepongensis
13	ID.04-542	Streptomyces glaucescens
14	ID.04-544	Streptomyce galbus
15	ID.04-561	
16	ID.04-570	
17	ID.04-583	
18	ID.04-590	Streptomyces argillaceus
19	ID.04-651	Streptomyce maritimus
20	ID.04-663	Streptomyce capoamus
21	ID.04-668	Streptomyces roseoflavus
22	ID.04-674	
23	ID.04-677	Streptomyces peucetius
24	ID.04-681	Streptomyce capoamus
25	P1 CCA9	
26	P3 CCA5	
27	P3 CCA6	
28	P3 CCA13	
29	P5 CCA2	
30	P5 CCA5	
31	P5 CCA7	
32	P6 CCA5	
33	CESE 01 RCT 1	
34	CLI 04 RC 1B	Bacillus tequilensis
35	TKA 01 RCC 4	
36	TTA 01 SDS 6	Streptomyces luteoverticillatus strain 173699
37	TTA 01 SDS 15	Streptomyces seoulensis strain NBRC 16668
38	TTA 01 SDST 2	
39	TTA 02 SDST 6	Streptomyces spectabilis (99%)
40	TTA 02 SDST 13	Streptomyces mashuensis (99%)
41	TCA 01 SDS 20	
42	TSA 01 SDS 1	Streptomyces shandongensis (83%)
43	TSA 02 SDS 2	Kitasatospora putterlickiae strain F18-98
44	TSA 02 TC 4	Streptomyces hygroscopicus subsp. Hygroscopicus (99%)
45	TSA 02 SDST 4	Streptomyces fumigatiscleroticus strain S6SS3
46	TSA 03 SDST 7	Streptomyces anandii strain NRRL B-3590
47	TSA 04 SDS 12	
48	MAUNA 5	
49	MAUNA 6	
50	SA-15	
51	Cli04 RC-7	Streptomyces polychromogenes
52	Cli04 RC-2	Actinoplanes brasiliensis
53	CS 12 SDST-1	Streptomyces thermodiastaticus
54	Cwer03 E-2	Amycolatopsis saalfeldensis
55	TCA01 SDS-13	Streptomyces griseoverticillatus
56	TCA01 SDS-14	Streptomyces endus
57	TCA01 SDS-17	Nocardia arthritidis
58	TKA01 SDS-8	Streptomyces fradiae
59	TSA02 SDS-12	Streptomyces pulveraceus
60	TTA 01 SDST-6	Streptomyces sp
61	TTA02 SDS-9	Streptomyces puniciscabiei
62	TTA 02 SDS-13	Streptomyces hygroscopicus subsp. Jinggangensis
63	TTA 02 SDS-14	Streptomyces yeochonensis (84%)
64	TTA 02 SDST-2	Streptomyces thermocarboxydovorans strain AT52
65	TTA 02 SDST-18	Streptomyces mashuensis strain DSM 40221
66	GAL-1	
67	GAL-2	
68	GAL-3	
69	GAER-1	
70	GBL-4	
71	GCER-1	
72	GBSL-1	
73	GBSL-2	
74	GBSL-3	
75	GBSL-4	
76	GBSL-5	
77	GBSL-6	
78	GBSL-7	
79	GBSL-8	
80	GKRL-1	
81	GKRL-2	
82	GKRL-3	
83	GKRL-4	
84	GKRL-5	
85	GKRL-6	
86	GKRL-7	
87	GKRL-8	
88	GKRL-9	
89	GKRL-10	
90	GKRL-11	
91	GKRL-12	
92	GKRL-13	
93	ID.04-450	
94	ID.04-600	Streptomyces peruviensis
95	ID.04-686	Streptomyce peucetius
96	ID.04-687	Streptomyces virginiae
97	ID.04-691	Streptomyce somaliensis
98	ID.04-700	Streptomyces galilaeus
99	ID.04-766	Streptomyces lateritius
100	ID.04-783	

on CMC plate medium for cellulase

on Xylan plate medium for xylanase



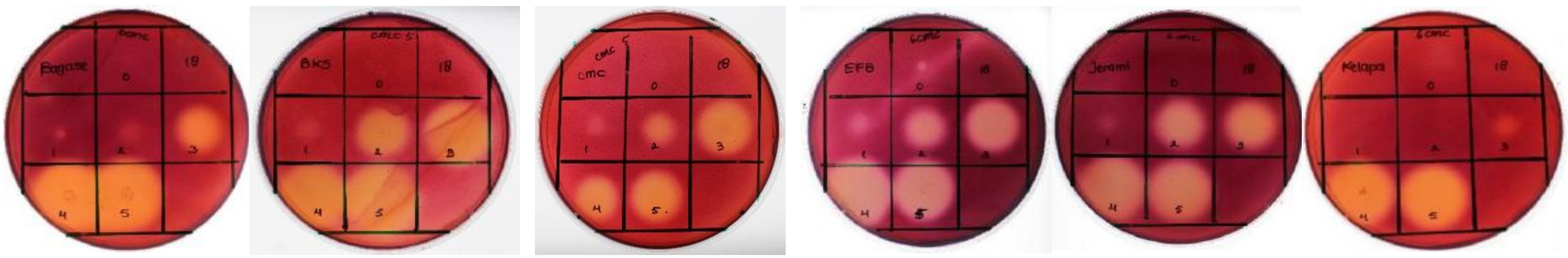
on LBG plate medium for mannase



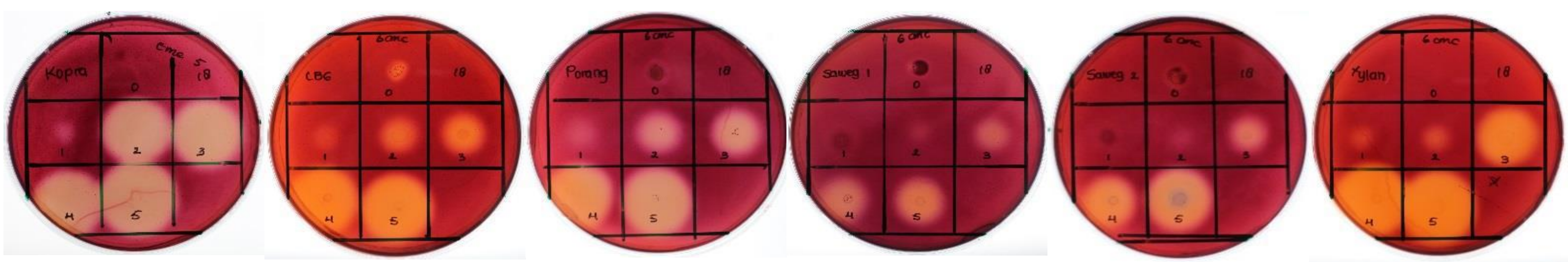
Many kinds of actinomycetes isolates show high activities of cellulase, xylanase and mannase

Production of Cellulase from Actinomycetes from many kinds of practical biomass

Sugar Cane Bagasse | Palm Kernel Cake | CMC | Oil Palm Empty Fruit Bunch | Rice Straw | Coconut

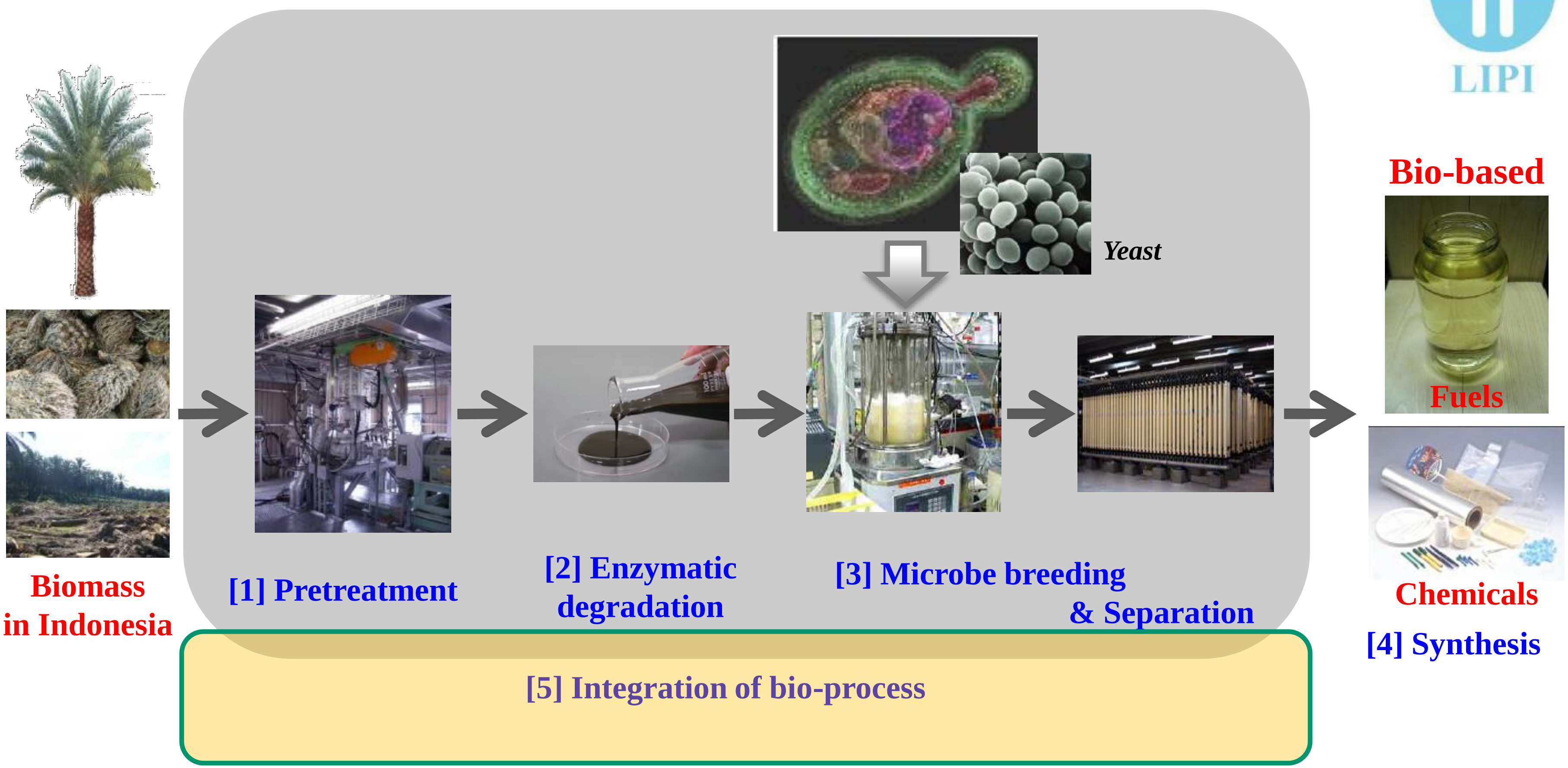


Kopra | LBG | Porang | Suweg 1 | Suweg 2 | Xylan

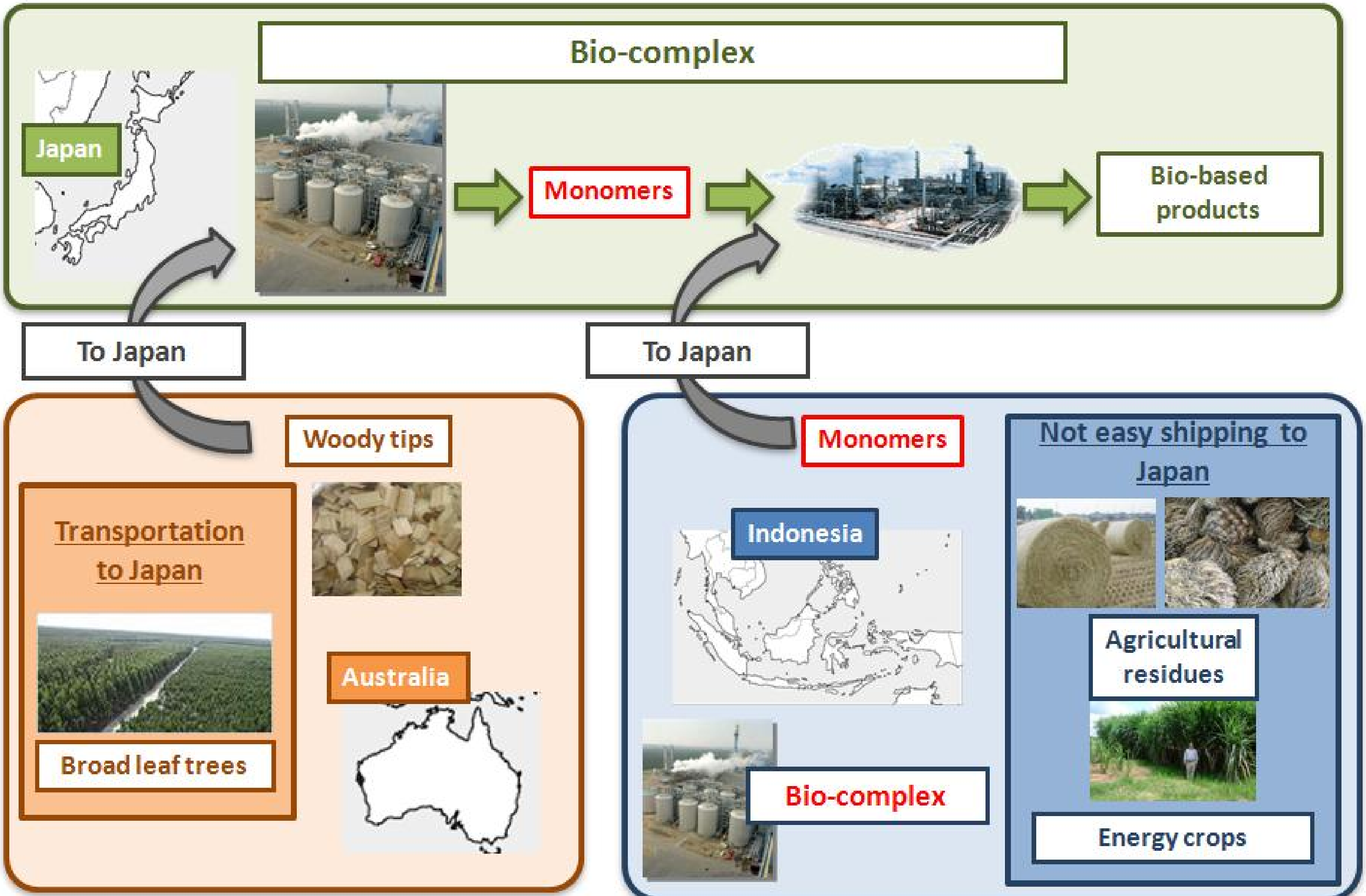


Isolate (No. 18) could produce Cellulase at high concentration and high enzyme activity from many kinds of practical biomass such as sugarcane bagasse, palm kernel cake, oilpalm empty fruit bunch, rice straw, etc, more better than that from CMC.

Five Key Technologies in SATREPS project



Establishment of Bio-Complex and biomass supply



White paper of biomass in Indonesia

ASSESSMENT OF PROSPECTS OF BIOMASS FOR BIOREFINERY INDUSTRI IN INDONESIA

EFB at an OP Milll

Bioethanol plant

By

Manaek Simamora
Syahrizal Maulana
Syafrizal Maludin
Aris Yaman
Sasa Sofyan Munawar

Business meeting between Japan and Indonesia

Process Development

Bench-scale plant in Kobe University

50 kg/h presser

100 kg/batch steamer

100 L liquefaction reactor

50 L fermentation reactor

30 L fermentation reactor (x3)

Cell recycling system

January 2017

Acknowledgement to SATREPS member

Biomass complex strategy for chemical production