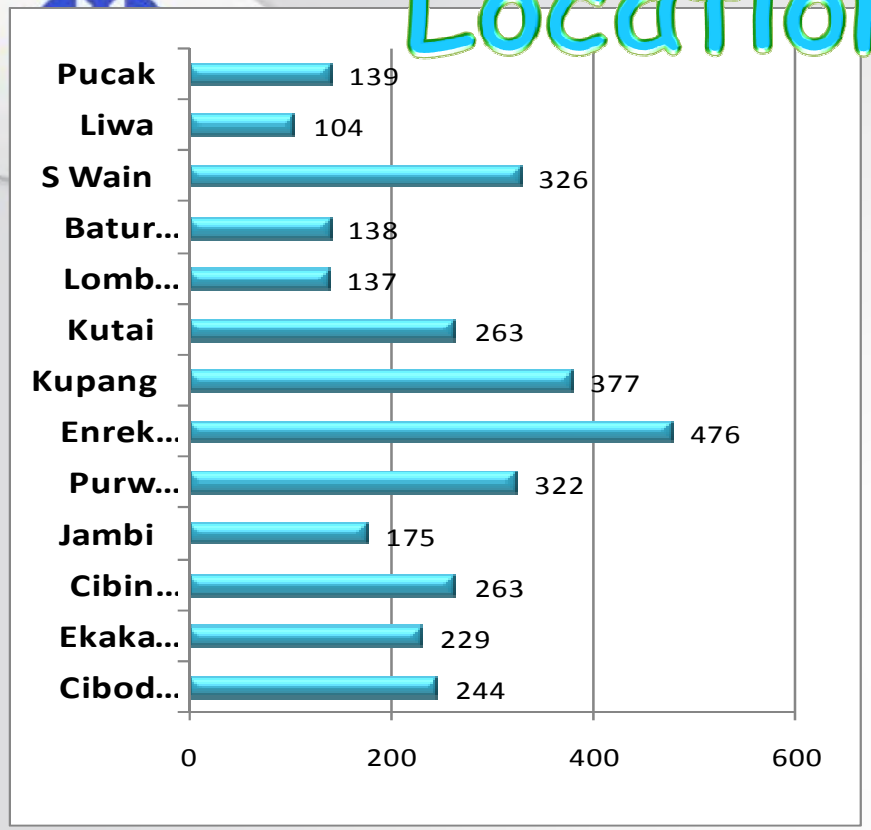
Actinobacteria:

Currently, order Actinomycetales consist of 13 suborders, 42 families, and 198 genera; while order Rubrobacterales consist of 5 families (Zhi et al., 2009).

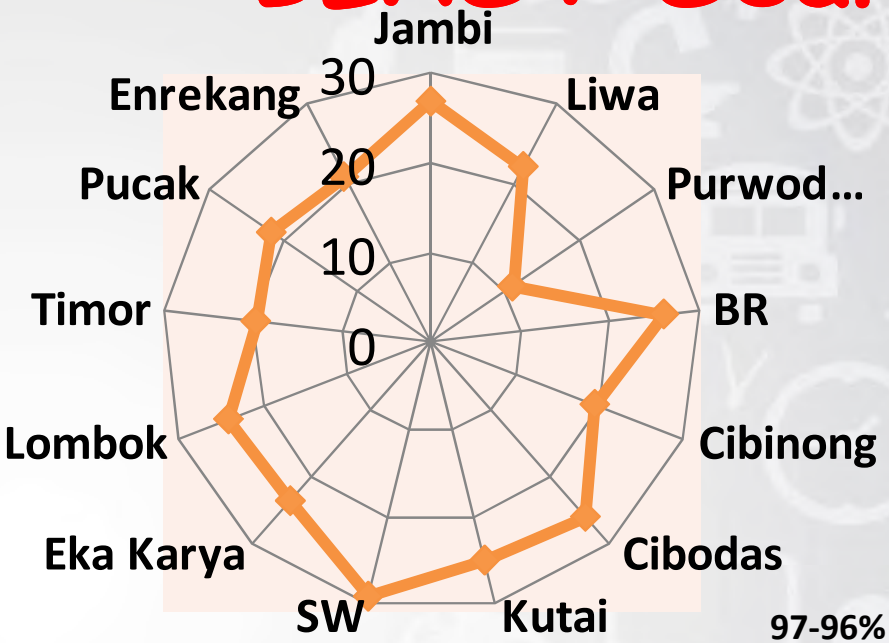
Indonesian Actinobacteria:

12 suborders, 27 families, and 65 genera for 3,193 isolates

Location



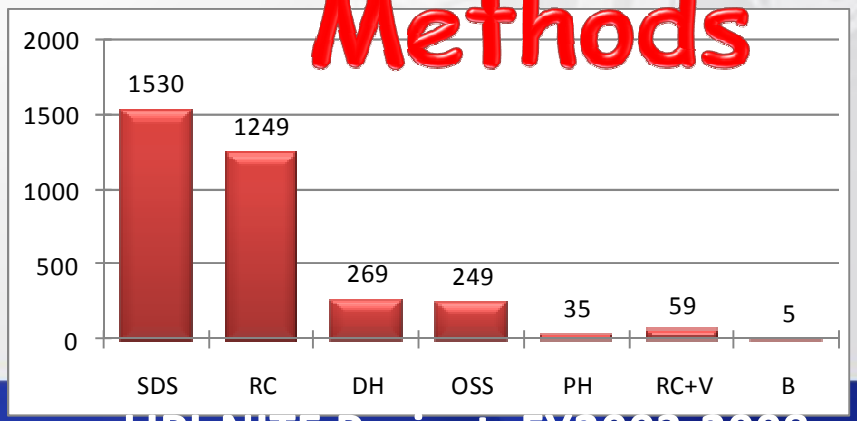
BLAST Search



97-96% sequence similarity

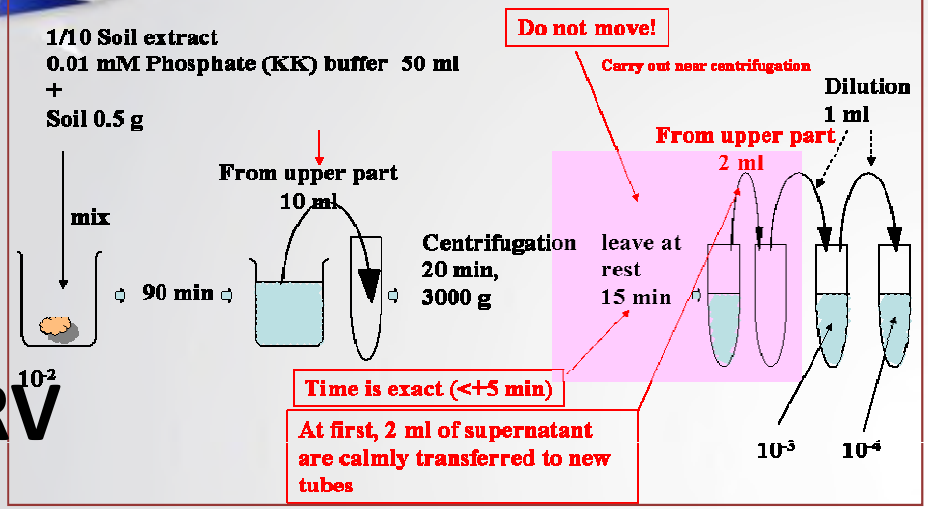
Source

Methods

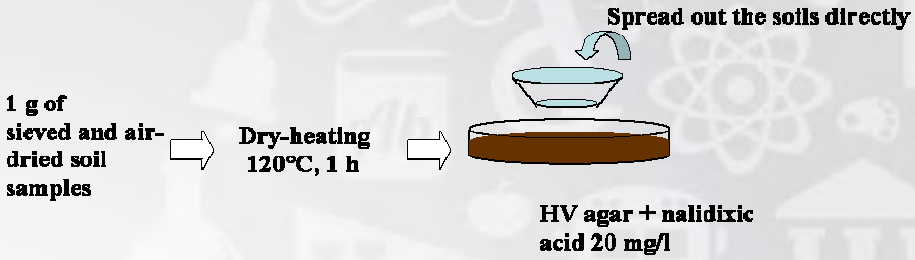


Isolation Methods

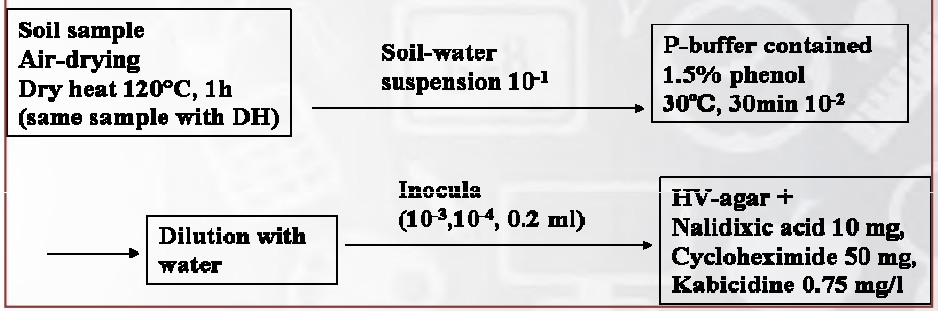
RC / RV — Rehydration and Centrifugation method



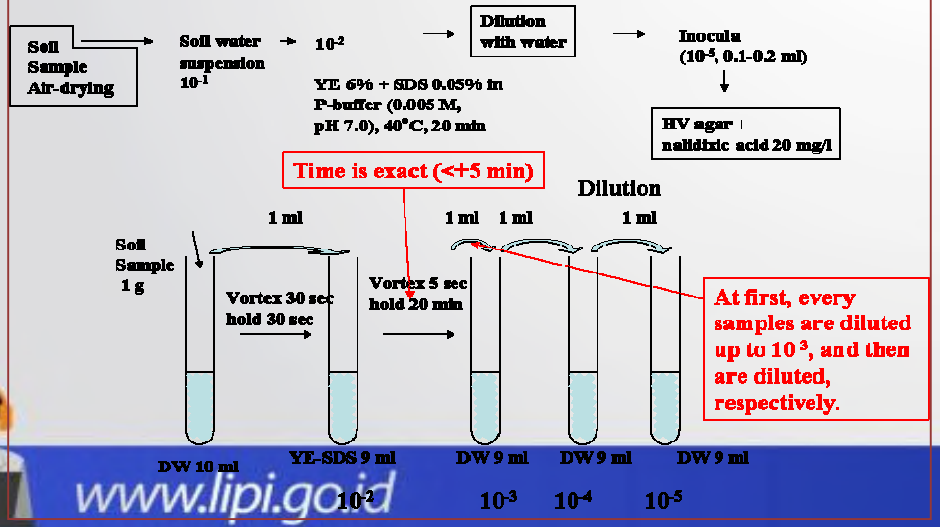
DH — Dry Heating (DH) method



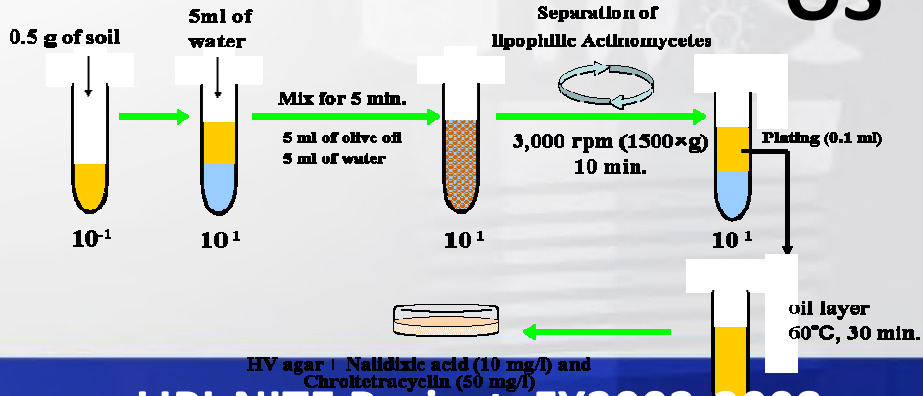
PH — Phenol method



SY — SDS-YE method



OS — Isolation method of lipophilic actinomycetes - Oil Separation (OS) method -



Diversity of Indonesian Actinobacteria

No.	Suborder	Litter	Soil	Total	%
Order Actinomycetales					
1	*Catenulisporineae*	0	2	2	0.06%
2	*Corynebacterineae*	1	105	106	3.32%
3	*Frankineae*	14	26	40	1.25%
4	*Glycomycineae*	1	0	1	0.03%
5	*Kineosporiineae*	83	9	92	2.88%
6	*Micrococcineae*	4	22	26	0.81%
7	*Micromonosporineae*	324	392	716	22.42%
8	*Propionibacterineae*	3	40	43	1.35%
9	*Pseudonocardineae*	24	49	73	2.29%
10	*Streptomycineae*	184	1702	1886	59.07%
11	*Streptosporangineae*	0	207	207	6.48%
Order Rubrobacterales					
12	*Patulibacteraceae*	1	0	1	0.03%
		638	2558	3193	100%

Description of New Taxa

1. Otoguro, M., Ratnakomala, S., Lestari, Y., Hastuti, R. D., Triana, E., Widyastuti, Y., & Ando, K. 2009. *Streptomyces baliensis* sp. nov., isolated from Balinese soil. Int. J. Syst. Evol. Microbiol., 59: 2158-2161
2. Yamamura, Y., Lisdiyanti, P., Ridwan, R., Ratnakomala, S., Sarawati, R., Lestari, Y., Triana, E., Kartina, G., Widyastuti, Y., & Ando, K. 2010. *Dietzia timorensis* sp. nov., isolated from soil. Int. J. Syst. Evol. Microbiol., 60: 451- 5 454
3. Lisdiyanti, P., Otoguro, M., Ratnakomala, S., Lestari, Y., Hastuti, R. D., Triana, E., Ando K., & Widyastuti, Y. 2010. *Actinokineospora baliensis* sp. nov., *Actinokineospora cibodasensis* sp. nov., and *Actinokineospora cianjurensis* sp. nov. isolated from Indonesia. Int. J. Syst. Evol. Microbiol., in press.
4. Otoguro, M., Yamamura, H., Tamura, T., Irzaldi, R., Ratnakomala, S., Ridwan, R., Kartina, G., Triana, E., Nurkanto, A., Lestari, Y., Lisdiyanti, P., Widyastuti, P., & Ando, K. 2011. *Actinophytocola timorensis* sp. nov. and *Actinophytocola corallina* sp. nov., isolated from soil in Indonesia

InaCC
(Indonesian Culture Collection)

InaCC Inauguration Ceremony
11 September 2014

LIPI

InaCC
Indonesian Culture Collection

Indonesian Culture Collection (InaCC)
Pusat Penelitian Biologi
Lembaga Ilmu Pengetahuan Indonesia

Document InaCC

InaCC Facilities

- **2 Storeys Laboratory Building, 2800 M²**

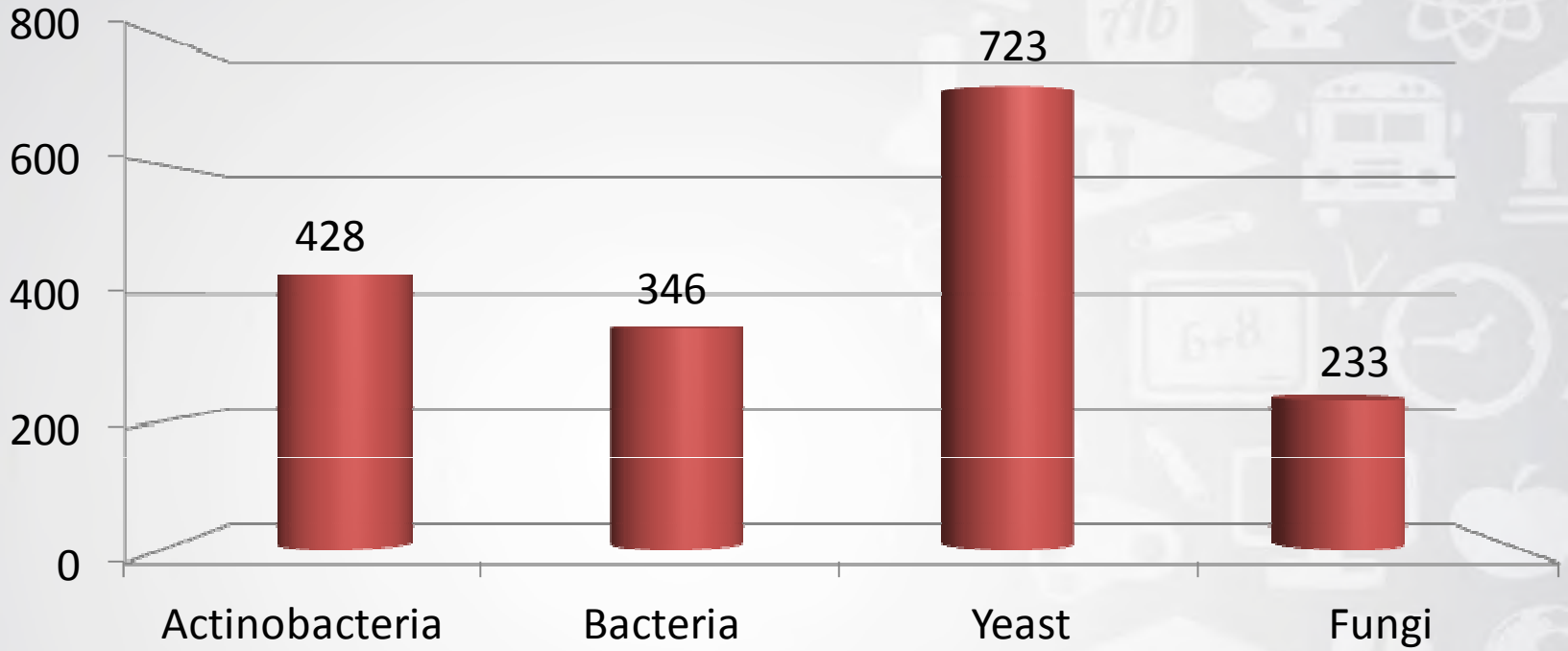
Multimode Microplate reader

L-Drying Apparatus

High Performance Liquid Chromatography

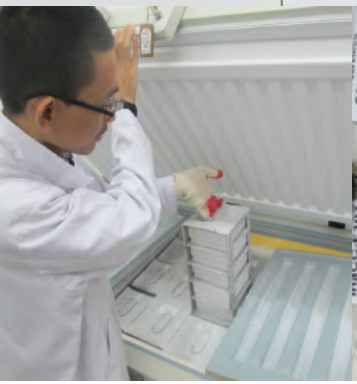
Matrix Assisted Laser Desorption/Ionizing Time Of Flight – Mass Spectrometry (MALDI TOF – MS)

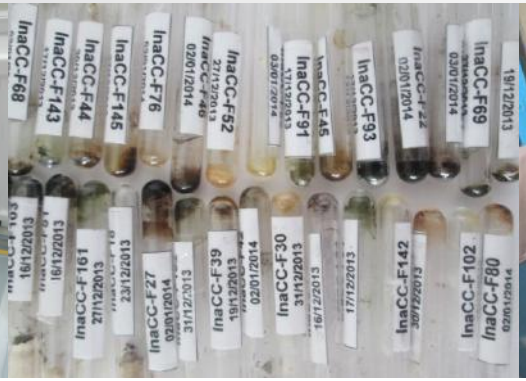
InaCC Holdings*



Total: 1730 Strains

(*) Online catalogue: , 2016
http://inacc.biologi.lipi.go.id/



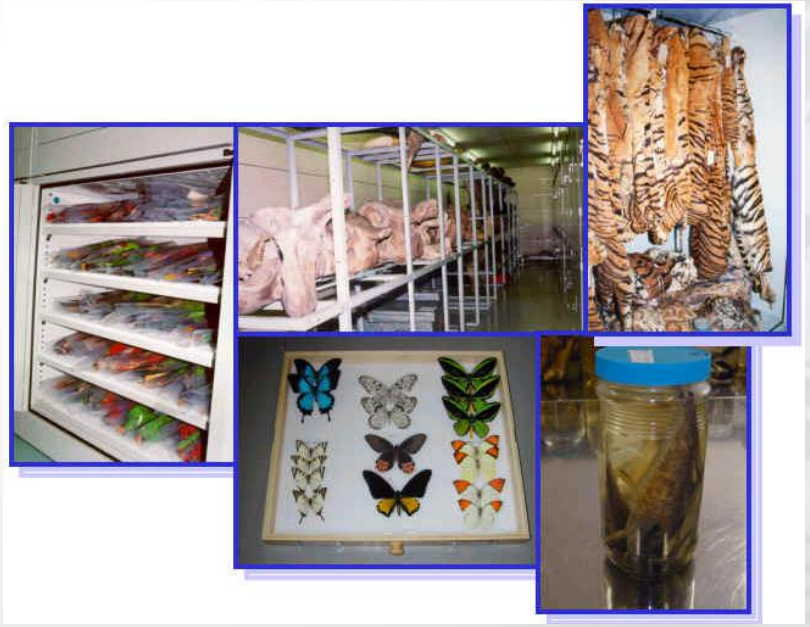


Herbarium Bogoriense

- **Botany Collection**
  - **> 2.000.000 specimens :**
  - o **Wet collections**
  - o **Dry Collections**
  - o **Karpologi**
  - o **Fossil**
  - o **Artefact Etnobotany**

Museum Zoologicum

Takson	Indonesia		Koleksi di MZB
	Minimum	Maksimun	
Mamalia	681	800	450 (66%)
Burung	1.540	1.600	1.200 (78%)
Reptilia	600	2.000	340 (57%)
Amphibia	1.000	1.500	150 (10%)
Ikan	7.000	8.500	1.200 (17%)
Mollusca	4.000	6.000	2.400 (60%)
Invertebrata lain	5.000	10.000	700 (14%)
Serangga	1.000.000	5.000.000	10.000 (1%)



4th JASTIP Symposium

"Biomass to Energy, Chemicals, and Functional Materials"

3rd and 4th July 2017 NSTDA, Thailand

JASTIP

SATREPS Project: Development of Internationally Standardized Microbial Resource Center to Promote Life Science Research and Biotechnology

Ken-ichiro Suzuki*, Hiroko Kawasaki *Biological Resource Center, National Institute of Technology and Evaluation (NBRC) and* **Witjaksono, Siti N. Projono and Bambang Sunarko** *Indonesian Institute of Sciences (LIPI)* **Present address: Tokyo Univ. Agriculture*

Purpose of Project

- **Development of Indonesian microbial resources** for human health and environmental restoration
- **An ex-situ conservation** of Indonesian microbial resources through impovement of Indonesian Microbial Collection at RCB-LIPI
- **Sustainable utilization** of Indonesian microbial resources for improving food and health
- **Creating global partnership** between culture collection center and stimulating development of bioindustry in Indonesia and Japan

Witjaksono, Siti Nuramaliati Prijono, Bambang Sunarko (LIPI)

Ken-ichiro Suzuki, Hiroko Kawasaki (NITE)

Output of Project

1. **InaCC**, Indonesian national microbial resource centers, was established in LIPI to collect and preserve microorganisms to promote further study and application.
2. **InaCC** will contribute to access and use of Indonesian microorganisms in compliance with CBD related laws and regulations.
3. Diversity and potential of Indonesian microorganisms were recognized.
4. More than 2000 strains of various microorganisms, including filamentous fungi, yeasts, microalgae, bacteria, archaea and bacteriophages were registered and preserved in **InaCC** with their taxonomic information.

Outlines of Project

Summary of Research for New Microbes

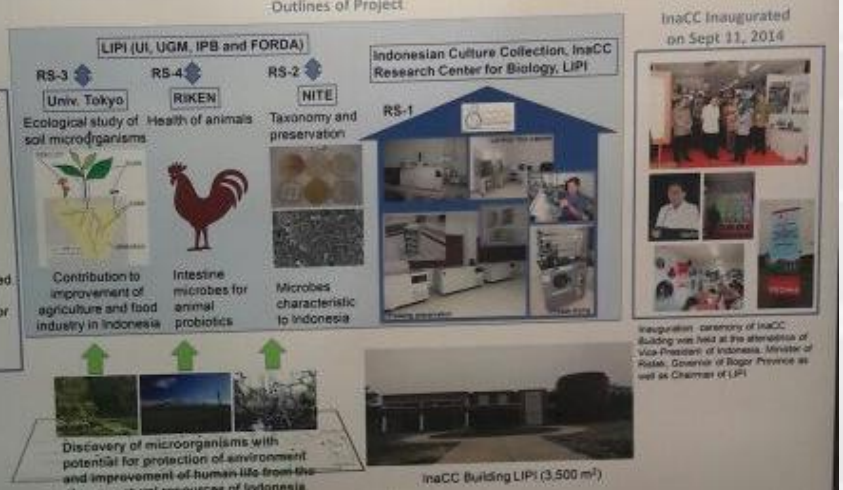
Yeasts accumulating lipid in the cells were isolated.

Yeasts utilizing xylose were isolated.

New actinomycete species were isolated and characterized.

Endophytic fungi in chinchonae were isolated.

Ectomycorrhizal fungi for Dipterocarps and Sumatra pine were isolated.



InaCC Inaugurated on Sept 11, 2014

Inauguration ceremony of InaCC Building was held at the attendance of Vice-President of Indonesia, Minister of Ristek, Governor of Bogor Province as well as Chairman of LIPI

InaCC Building LIPI (3,500 m²)

Establishment of InaCC

Technology was transferred for preservation, quality maintenance and management of microbial resource center.

Cooperative studies were achieved and microorganisms isolated from Indonesian environment were added in InaCC collection.

InaCC is supplying microbial strains to researchers and industries in compliance with Indonesian laws and regulations.

InaCC will support international corporation including biological material transfer.

InaCC was certified by ISO9001:2008 for Quality management.

Number of Strains Isolated and Registered in InaCC and NBRC

Research Subject	Microbes	Deposited in	
		InaCC	NBRC
RS2-A	Fungi	179	42
RS2-B	Yeasts	833	151
	Fungi	12	
	Microalgae	16	3
RS2-C	Actinomycetes	337	44
	Bacteria	12	
RS3-D	Bacteria	338	51
	Archaea	79	19
	Bacteriophages	9	3
RS2-E	Microalgae	60	38
RS2-A	Bacteria	349	61
RS1-B	Fungi	32	12
RS4-A	Bacteria	181	9
RS4-B	Bacteria	64	
	Actinomycetes	6	3
Total		2272	750

Acknowledgment

SATREPS Colleagues of NBRC / NITE and other Japanese members
SATREPS Colleagues of RCB-LIPI and other Indonesian members

This work was partly supported by the Science and Technology Research Partnership for Sustainable Development (SATREPS), which is a research program structured as a collaboration of the Japan Science and Technology Agency (JST) and the Japan International Cooperation Agency (JICA).

NBRC JICA JST

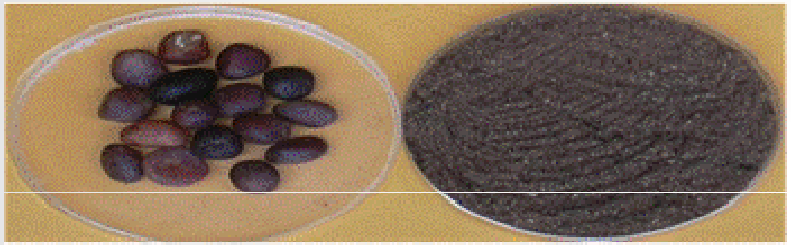
Linking SATREPS

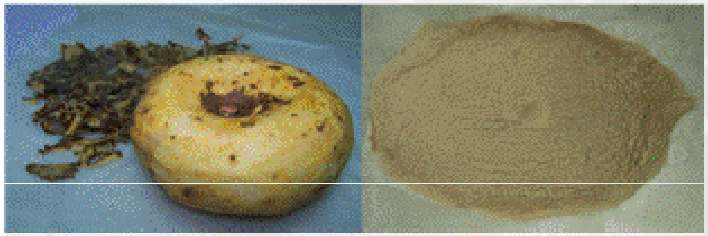
1. April 2011-March 2016 SATREPS PROJECT: Development of Internationally Standarized Microbial Culture Collection in Indonesia LIPI-JICA-JST-NBRC (NITE), Japan
2. April 2013-March 2018 SATREPS PROJECT: Innovative Bio-production in Indonesia (ibioI): Integrated Bio-refinery Strategy to Promote Biomass Utilization using Super-microbes for Fuels and Chemicals Production LIPI-JICA-JST-Kobe University
3. April 2014-March 2019 SATREPS PROJECT: Searching Lead Compounds of Anti-malarial and Anti-amebic Agents by Utilizing Diversity of Indonesian Bioresources BPPT-LIPI-JICA-JST-Tsukuba University
4. April 2015-March 2020 SATREPS PROJECT: Revegetation of alang-alang (Imperata cylindrica) field combined with sustainable production and utilization of biomass (for energy solution), LIPI-JICA-JST-Kyoto University

Screening & Cloning of Microbial Collection for Biorefinery Development (2011-present)

- Research Center for Biotechnology LIPI
- JSPS-LIPI Bilateral Project (FY2011-2013)
- Satreps Biorefinery (FY2013-2018)
- Center of Excelent, Ministry of Research, Technology, and Higher Education (December 2016)

Research on Utilization of Hetero-mannan biomass





Palm kernel cake : Galactomannan

Porang potato : Glucomannan

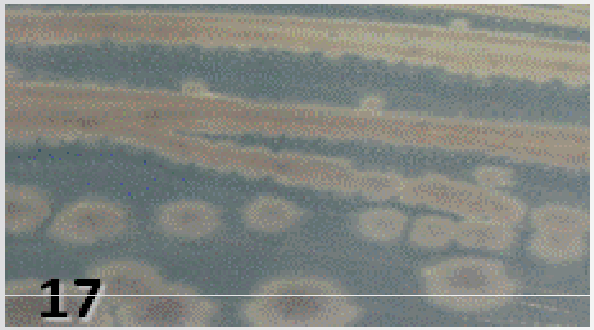
JSPS-LIPI Bilateral Project
(RC-Biotechnology - Kobe Univ.)

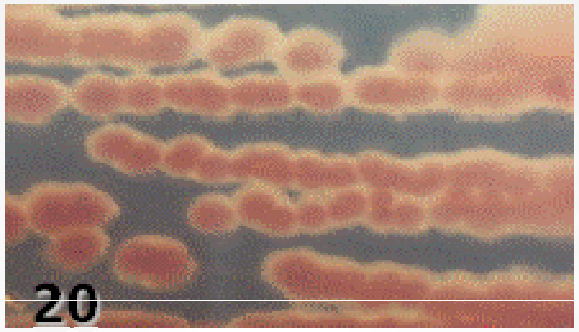
Competitive Project
(LIPI)

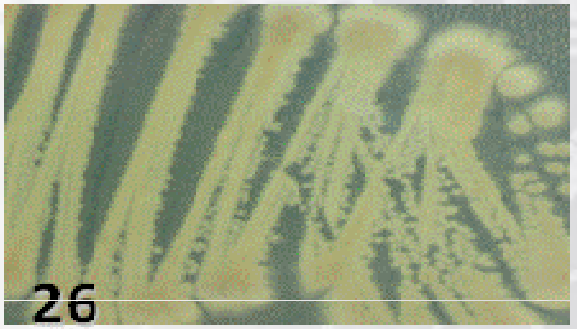
Main Acivity :

Utilization of Palm kernel cake to produce bioethanol and Porang potato to produce oligosaccharides enzimatically (using mannanase, mannosidase from actinobacteria)

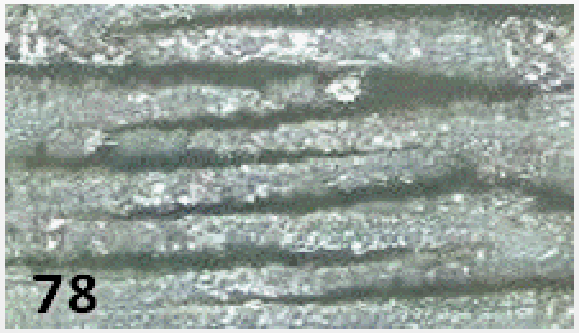
Several types of mannolytic microbes from Actinobacteria

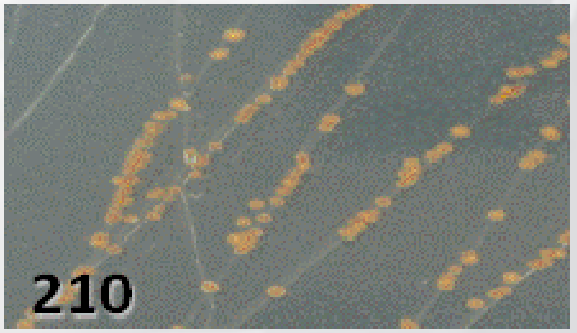






6 positive mannolytic bacteria, selected from 500 actinomycetes BTCC





Satreps Biorefinery Activities

Activity
2.1. Production of lignocellulose hydrolyzing enzymes
2.1.1. Screening and optimizing of cellulase and hemicellulase producing microbes from Indonesia Culture Collection (InaCC) and Biotechnology Culture Collection (BTCC)
2.1.2. Cloning of cellulase and hemicellulase genes from microbes in InaCC and BTCC
2.1.3. Construction of the expression system for enzyme production
2.1.4. Purification and characterization of recombinant enzymes
2.2. Evaluation of lignocellulose hydrolyzing enzymes
2.2.1. Lignocellulose degradation by produced enzymes

Strategy for Research

Actynomecete Indigenous Indonesia
(terestial/marine) from BTC

Empty Fruit Bunch Sugar Cane Bagasse

Sceening for ligncellulosic degrading enzyme

Isolate candidate for Saccharification

Enzyme Production

High concentration enzyme

Saccharification by using sugar cane bagasse and Ctex2

Crude enzyme from isolate candidat have the synergy effect with Ctex2

Genetic Engineering

Improved cellulase and hemicellulase performance

Pretreatment technology

Biomass after pretreatment

Consolidate Bioprocessing_CBP

Saccharification

Cellulose
Hemicellulose

Glukose
Xylose
Arabinose
Mannose
Galaktose

(Ctex2)

Fermentation

Saccharomyces cerevisiae

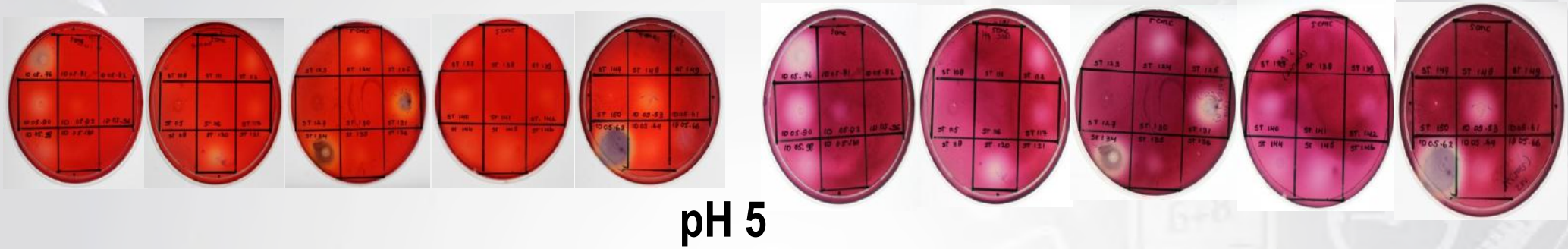
Bioethanol

Construction of Arming yeast displaying mannanase, xylanase and cellulase gene from *Streptomyces sp*

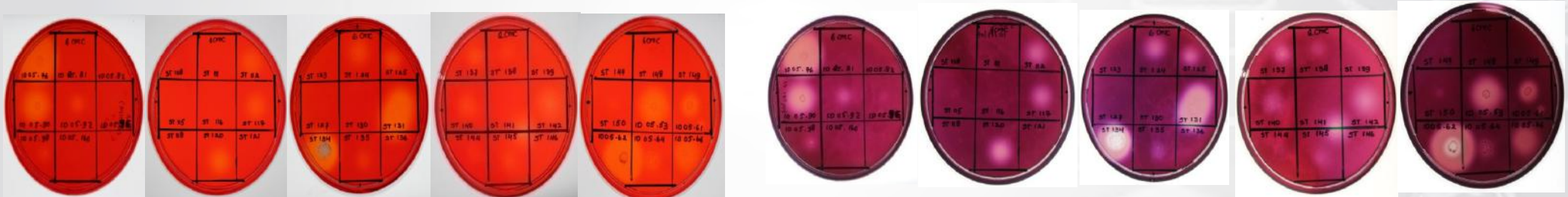
Concentrasi on

Gene for mannanase, xylanase & cellulase

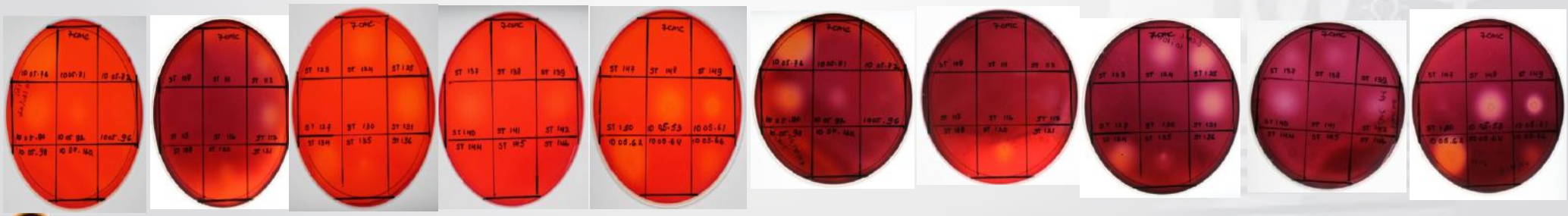
Result of Congo Red & Acetic acid Analysis of 44 isolates on CMC plate medium, pH 5, 6 and 7



pH 5



pH 6



pH 7

Isolate with diameter clear zone > 1.5 cm : isolates No. ID 05 76, S T131, ST134, ID05 53, ID 0562

Rahmani et al. AMB Expr (2017) 7:100
DOI 10.1186/s13568-017-0401-6

AMB Express

ORIGINAL ARTICLE Open Access

Mannan endo-1,4-β-mannosidase from *Kitasatospora* sp. isolated in Indonesia and its potential for production of mannooligosaccharides from mannan polymers

Nanik Rahmani[1], Norimasa Kashiwagi[2], JaeMin Lee[3], Satoko Niimi-Nakamura[3], Hana Matsumoto[3], Prihardi Kahar[3], Puspita Lisdiyanti[1], Yopi[1], Bambang Prasetya[1], Chiaki Ogino[3*] and Akihiko Kondo[2,4]

Abstract

Mannan endo-1,4-β-mannosidase (commonly known as β-mannanase) catalyzes a random cleavage of the β-D-1,4-mannopyranosyl linkage in mannan polymers. The enzyme has been utilized in biofuel production from lignocellulose biomass, as well as in production of mannooligosaccharides (MOS) for applications in feed and food industries. We aimed to obtain a β-mannanase, for such mannan polymer utilization, from actinomycetes strains isolated in Indonesia. Strains exhibiting high mannanase activity were screened, and one strain belonging to the genus *Kitasatospora* was selected. We obtained a β-mannanase from this strain, and an amino acid sequence of this *Kitasatospora* β-mannanase showed a 58–71% similarity with the amino acid sequences of *Streptomyces* β-mannanases. The *Kitasatospora* β-mannanase showed a significant level of activity (944 U/mg) against locust bean gum (0.5% w/v) and a potential for oligosaccharide production from various mannan polymers. The β-mannanase might be beneficial particularly in the enzymatic production of MOS for applications of mannan utilization.

Keywords: Mannan endo-1,4-β-mannosidase, Mannooligosaccharides (MOS), Screening, *Kitasatospora* sp., *Streptomyces lividans* 1326