BIOTEC

Microbial Utilization

Inaugural Meeting of ASEAN Network on Microbial Utilization
21 February 2014

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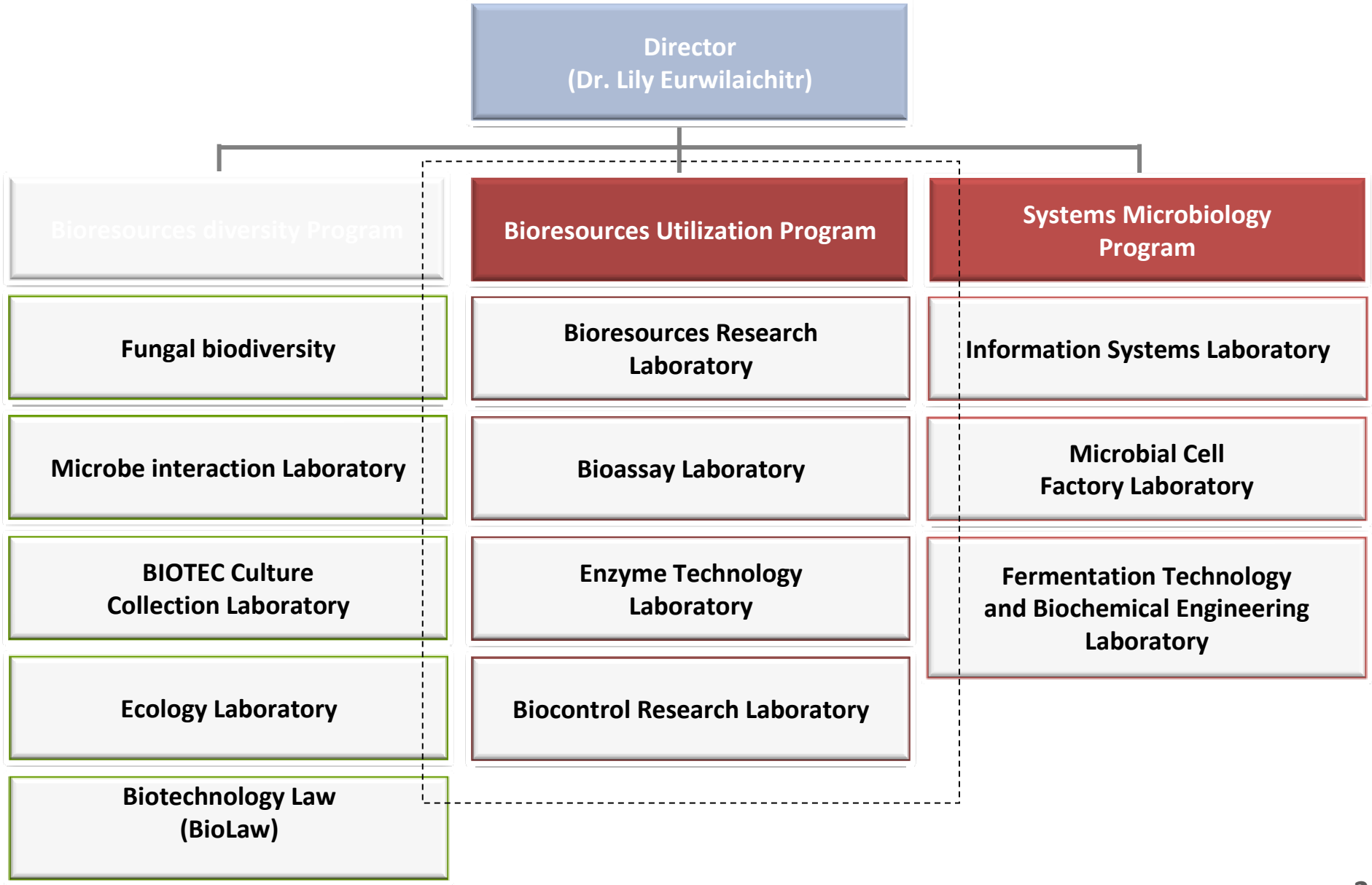
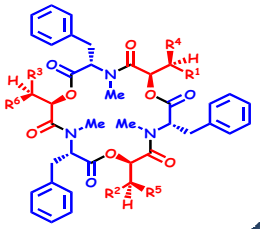
Bioresources Technology Unit

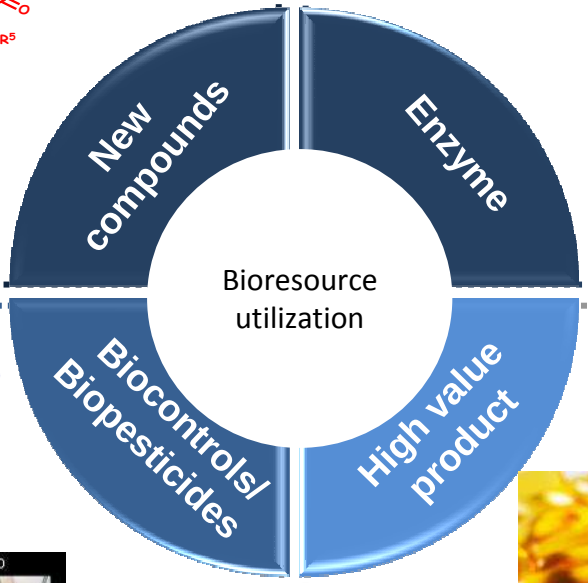


Research on the Utilization of Microorganisms

Natural product compound discovery

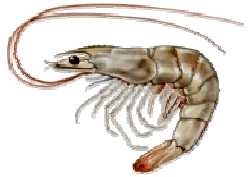


Discovery and development of industrial enzymes

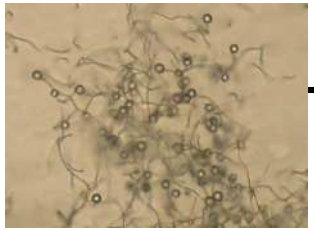


Biocontrols/biopesticides

High value products



Natural product compound identification



strain selection

BIOTEC Culture Collection

Fermentation → **Extract**

Biological assays
parasite, bacteria, fungi,
and mammalian cells

Chemical profile analysis

"Biological activity screening"

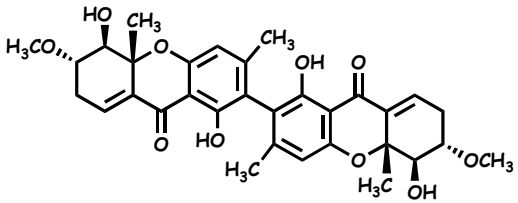
Selection based on chemical profiles and activities

HPLC profiling

"Chemical screening"

Search against compound library

large-scale cultivation

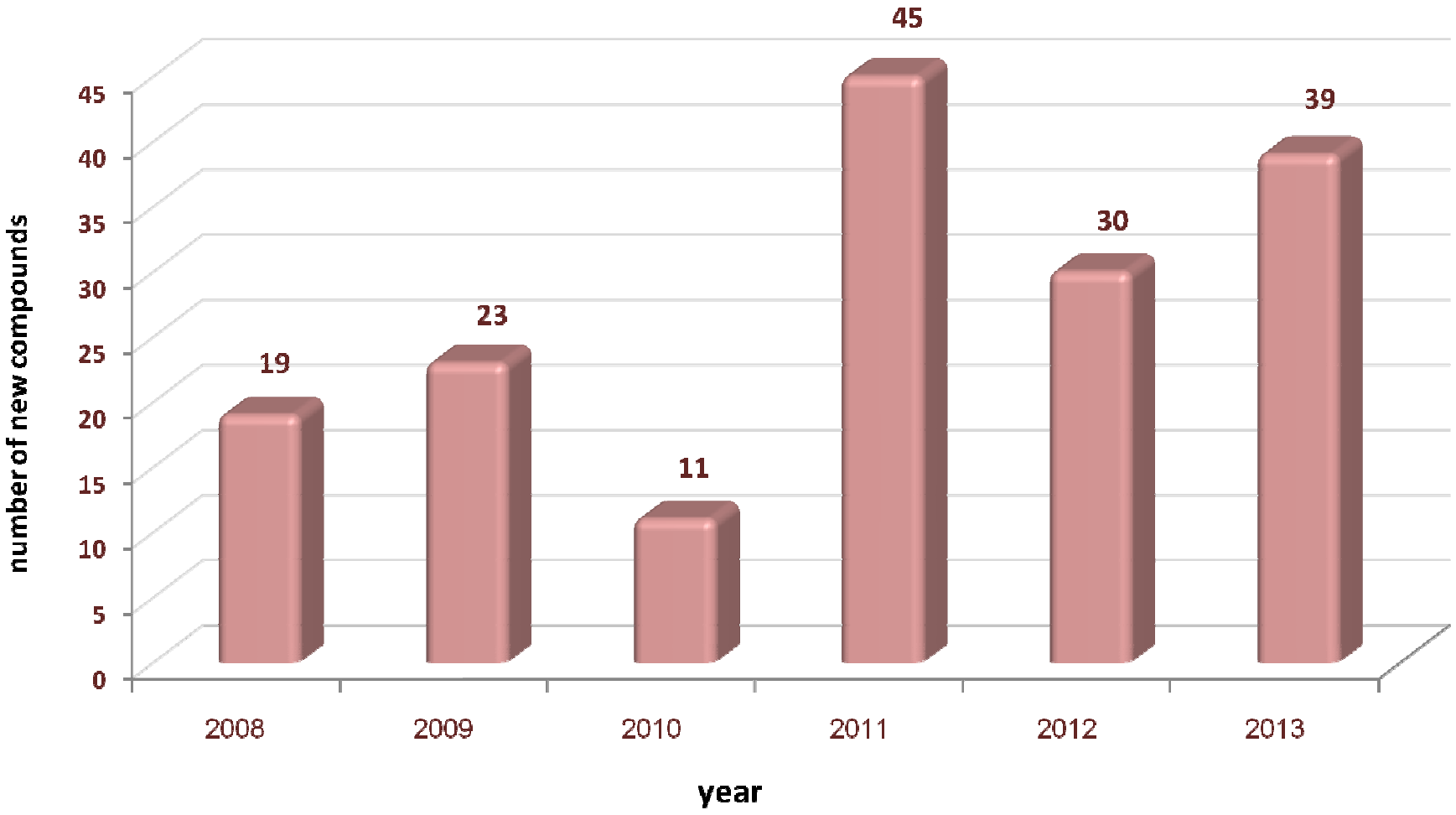


new lead compounds

Compound isolation & structure elucidation

NMR, UV, IR and mass spectroscopy

Fungal derived bioactive compounds



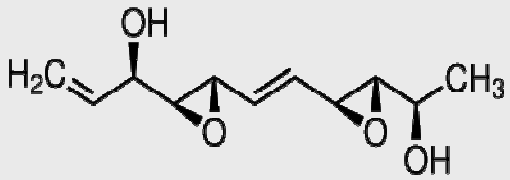
New bioactive compounds (2008-2013) 167 compounds

Compound licensing

BIOTEC
a member of NSTDA

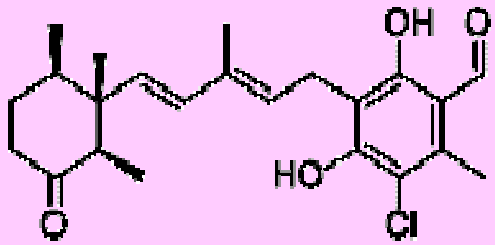
SIGMA-ALDRICH®

Xylaria sp. BCC1067



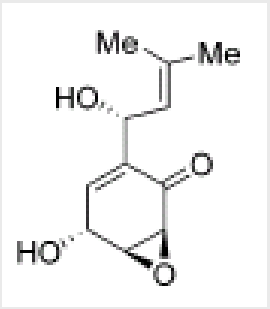
Depudecin
(Anticancer compounds)

Verticillium hemipterigenum BCC 2370



Ascochlorin
(Antiviral compounds)

Lentinus connatus



Panepoxydone
(Antimalarial compounds)

Development of Biocontrol Products

Beauveria bassiana
BCC2660

Single spore isolation

B. bassiana
BCC48145

Bacillus thuringiensis
From soil

Production

B. bassiana → Vegetative insecticidal protein (Vip)

Greenhouse test

Field test

Technology transfer

Government, private sectors and farmers

Highly effective & safe bio-product for insect pest control

BIOTEC

Beauveria bassiana-based bioinsecticide

B. bassiana is highly active against brown plant hopper, mealy bug, aphids

Field test

BIOTEC

Rice field at Phak Hai district, Ayutthaya

After field infected with brown planthopper

B. bassiana **is highly active against brown planthopper in rice field**

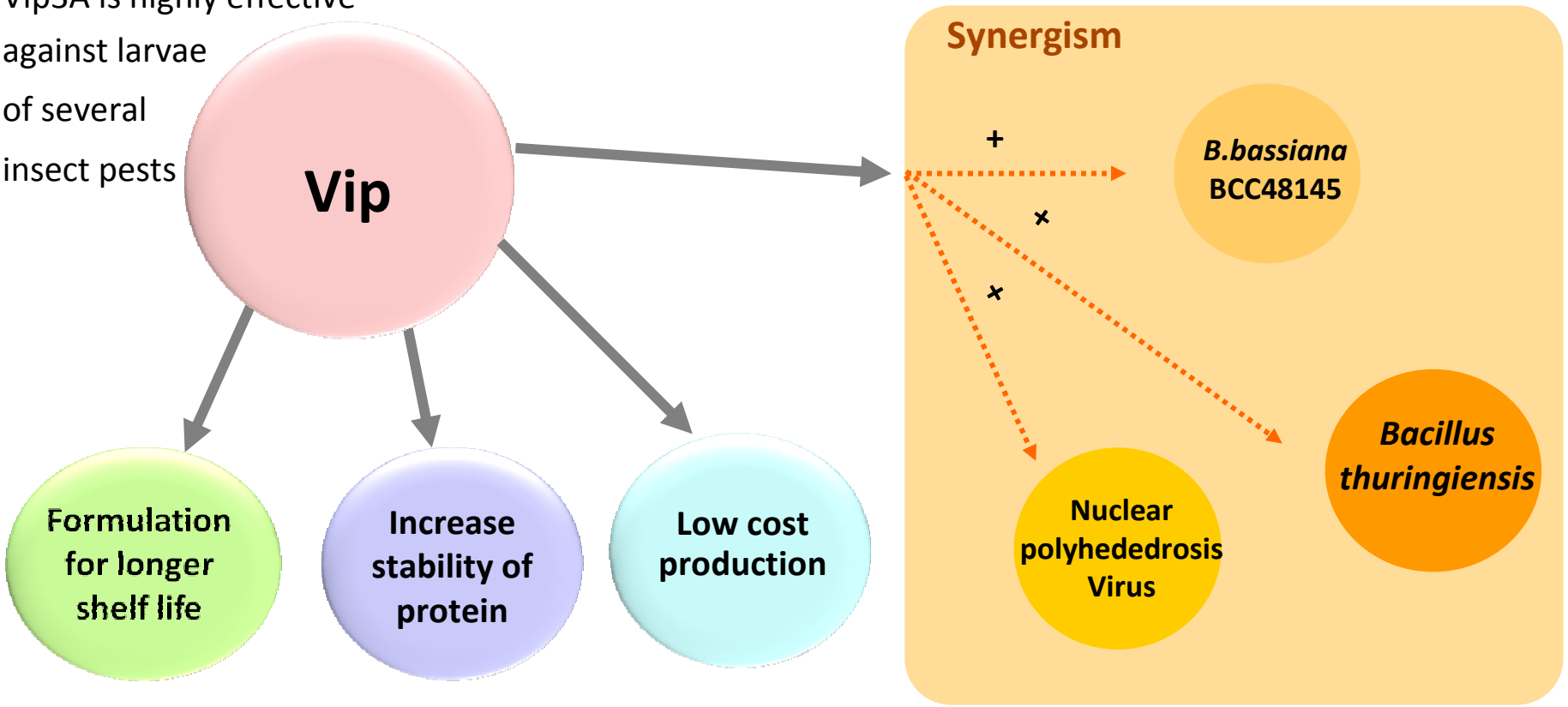
Cassava field at Sikhio district, Nakhon Ratchasima

After field infected with pink mealy bug

B. bassiana **is highly active against pink mealy bug in Cassava field**

Vegetative Insecticidal Proteins (Vips) from *B. thuringiensis*

Vip3A is highly effective against larvae of several insect pests



Greenhouse test

Highly active against larvae of Common cutworm (*Spodoptera litula)*

Control | Bt crystals | Vip3A

High value products: Polyunsaturated fatty acids (PUFAs)

Screening & Selection

Schizochytrium sp. BCC 25509: DHA producer
Mortierella sp. BCC 40632: ARA producer

Strain improvement

Fatty acid reconstitution in oleaginous fungus for DGLA production by heterolgous expression

Oleaginous strains
(Fungi, yeast & others)

Fermentation Technology
(Submerge / Solid-state)

Physiological study

High-value lipids
(e.g.DHA,ARA,EPA,DGLA,Hydroxy lipids)

SmF

DHA by pilot-scale (300 L) (DHA 15-24 g/L, 60-70% TFA/DW, 25-40% DHA/TFA)

ARA production in lab-scale (1.5 L) (25% ARA/TFA, 20-25% TFA/DW

SSF

Optimization of ARA & DHA production (Lab-scale)

- Alternative route of acytyl-CoA synthesis in oleaginous microbes
- PUFA biosynthetic pathway in Oomycetes
- Cataloging PUFA and lipid producing strains by profiling of fatty acids in PUFA producers

Feed additive

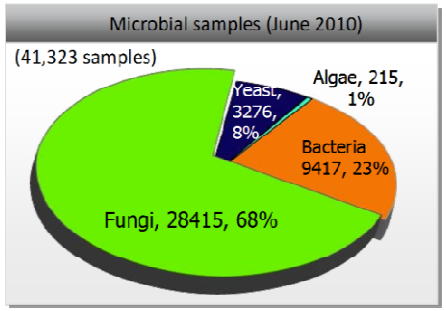


BIOTEC

Enzymes for Industry @ENZ

Gene library

Commercial enzymes



Metagenome collection

Enzyme library

novozymes

GENENCOR® A Danisco Division

Systematic formulation

- Heterologous expression
- Metabolic engineering

Fermentation & downstream processing

THE UNIVERSITY OF TOKYO

Food & Feed Industry

Biorefinery & Chemical Industry

CPF · ASAH · Sun Feed · SCG PAPER · THANAPAISAL · ptt Group · SCG CHEMICALS

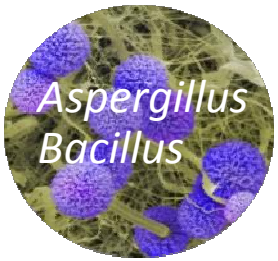
Enzyme for animal feeds

Screening of fiber digesting enzymes for increasing digestibility of animal feedstuff

- Optimal @40°C, pH 4-5
- Stable @80-90°C for 1-5 min

Sun Feed

http://www.reintechinc.com/biomassUtilization.php



DoE (SSF)
Cel/Xyl/Man

Pre-pilot SSF

Phytase gene

Rec *Pichia pastoris*

Pre-pilot SmF

Encapsulation & formulation

NANOTEC

***in-vitro* digestibility test:**

- fiber
- inhibitor
- nutrient

Commercialized enzyme product

Asia Star Animal Health Co., Ltd. (ASAH)

A-Zyme Feed Additive (Multi-enzyme preparation from fungi)

The technology, which includes the pentosanase-producing microorganism, *Aspergillus* sp., carefully screened from BIOTEC Culture Collection and the production process to achieve product in a powder form, was licensed to Asia Star Animal Health Co., Ltd. (ASAH) to manufacture and distribute pentosanase as feed additives.

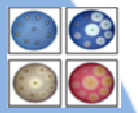
Economic and Social Impact in 2013
= US$ 2.30 million
- Profit to licensee
- Import substitution
- Benefit to farm operators

(better meat yield and healthier animals)

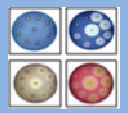
Enzyme for Green industry: Alkalophilic xylanase from metagenome for biobleaching

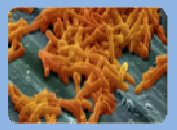
Environmental metagenomic gene library

Jae Sorn Hot Spring
Plasmid: 200 Mb
Thermophilic enzymes



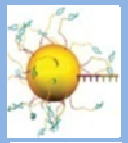
Termite gut
Fosmid: 2 Gb
Alkalophilic lignocellulolytic enzymes



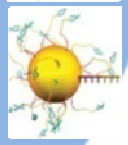


Microbial consortium
Fosmid: 4 Gb
Clostridial cellulosomes & secreted cellulases

Peat swamp forest
Fosmid: 2 Gb
Lignocellulolytic enzymes



Industrial bagasse collection site
Fosmid: 4 Gb
Accessory enzymes



Metatranscriptomics
Metaproteomics

Recombinant expression in *E. coli*

DoE Optimisation
HCD Fermentation

Downstream processing

Pilot-scale industrial process

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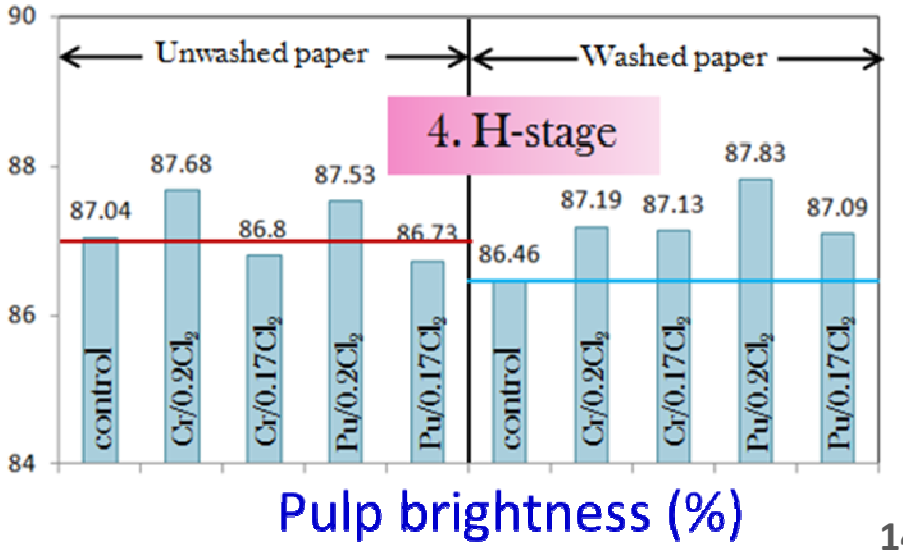
NZ bleach

Brightness
Chlorine



NSTDA Inventor day 2011
Gold Medal, INST 2012, Taiwan
NRCT award 2012, Thailand

Enzymes for Biorefinery & Chemical Industry

BIOTEC
a member of NSTDA

Enzymes

- Fungi
- Metagenomes
- Consortia

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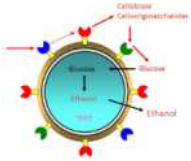

microbial cell engineering

users

Biomass

Sugars

Fuel
Ethanol; BTL

Chemicals
Building blocks
Aromatics

Lignin

Materials

Up-scaling

ptt Group

MITR PHOL

Process design and up-scaling

BEC BIOTEC
a member of NSTDA

Target

Sugar Platform Technology

Multi-displinary biorefinery

THANK YOU FOR YOUR ATTENTION

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