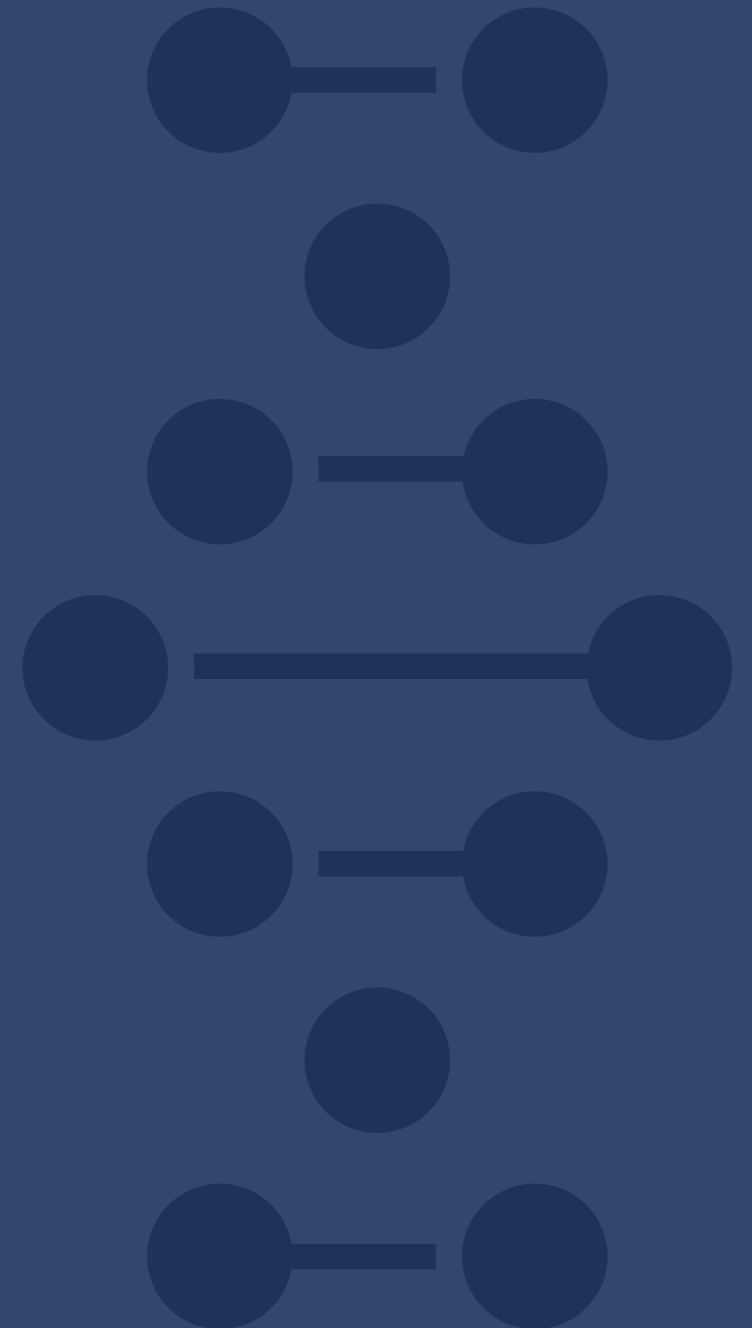


KRIBB ANNUAL REPORT 2016

K R I B B A N N U A L R E P O R T 2 0 1 6



KRIBB

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KRIBB



Future of Biotechnology Starts from KRIBB

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President's Message



Biotechnology plays an important role in human welfare, in the living environment and economic growth. Korea Research Institute of Bioscience & Biotechnology (KRIBB) was established in 1985 for the purpose of contributing to the national development of bioscience technology and industry and resolution of national and social issues by conducting research and development on bioscience technology and establishing and operating public infrastructure.

Now, the Korea Research Institute of Bioscience and Biotechnology makes a new leap forward to resolve national and social current affairs by producing research performances on globally critical technologies that lead the bio-economy era.

First, KRIBB will develop technologies to respond to high-risk and high-pathogenic infectious diseases, technologies to control diseases related to aging and core technologies to diagnose and treat incurable and chronic diseases including cancer for the purpose of resolving national and social issues and improving the quality of life for the public.

In addition, we will develop state-of-the-art BINT convergence technology to create new industries for the nation, corporate demand based technology and market leading technologies contributing to the development of bioindustry.

KRIBB will also improve the utilization of biological resources and information across the nation and strengthen the national capability in the bio sector by securing and managing domestic and overseas biological resources and information strategically and expanding research infrastructure focusing on our customers.

Henceforward, KRIBB will make our utmost effort for all Korean people to realize the dream of safe, happy and healthy lives.

Thank you.

President
Kyu-Tae Chang, Ph. D.

Biotechnology Policy in KOREA

Enacted 'Biotechnology
Promotion Law'

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Establishment of
KRIBB

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Chosen as one of
the '10 Next Generation
Growth Engines'

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Set up 'Biotech 2000'
(1994~2007)

20
03

Set up 'Phase 1 of
Bio-Vision 2016'
(2007~2016)

20
06

Set up 'Phase 2 of
Bio-Vision 2016'
(2012~2016)

20
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nature
immunology

Infection-specific phosphorylation of glutamyl-prolyl tRNA synthetase induces antiviral immunity [2016]

Cell

A Lactate-Induced Response to Hypoxia [2015]

Science

Regulatory T Cells generated early in life play a distinct role in maintaining self-tolerance [2015]

nature
cell biology

Amino-terminal arginylation targets endoplasmic reticulum chaperone BiP for autophagy through p62 binding [2015]

Genes
& Development

miR-431 promotes differentiation and regeneration of old skeletal muscle by targeting Smad4 [2015]

nature
structural &
molecular biology

Molecular basis for unidirectional scaffold switching of human Plk4 in centriole biogenesis [2014]

nature
commun

The structural basis for the negative regulation of thioredoxin by thioredoxin-interacting protein [2014]

Cell
metabolism

TXNIP Maintains the Hematopoietic Cell Pool by Switching the Function of p53 under Oxidative Stress [2013]

nature
biotechnology

Analysis of a genome-wide set of gene deletions in the fission yeast *Schizosaccharomyces pombe* [2010]

nature

Genome evolution and adaptation in a long-term experiment with *Escherichia coli* [2009]

nature
cell biology

Drosophila short neuropeptide F signalling regulates growth by ERK-mediated insulin signalling [2008]

Cancer
Cell

Block of T cell development in P53-deficient mice accelerates development of lymphomas with characteristic RAG-dependent cytogenetic alterations [2006]

nature
genetics

Comparative analysis of chimpanzee and human Y chromosomes unveils complex evolutionary pathway [2006]

nature
medicine

E2-EPF UCP targets pVHL for degradation and associates with tumor growth and metastasis [2006]

Mission & Vision

MISSION

- › To carry out R&D activities and related projects in the field of bioscience and biotechnology in joint effort with other research institutes, academia, and businesses at home and abroad
- › To disseminate the results of its scientific research and technological development

VISION

2018 Global best KRIBB

Global Research Institute Leading Bio-Innovation for the Humankind



| Convergence Technology | Personalized Bio-Medicine | Bio Green Technology | Bio-based National Agenda |

Bio Research Infrastructure

Biotech for
Economic Growth and
Better Living Standards

From fundamental research exploring basic facts about life to cutting-edging technologies, our work is aimed at creating new engines for economic growth and bringing concrete improvements in the quality of life.

Major Objective

01 CORE DIRECTIONS FOR RESEARCH & BUSINESS DEVELOPMENT

• **Biotechnology to Create New Economic Growth Engines**

- Development of BINT (BT, IT, NT) convergence technology
- Development of disease controlling technologies using stem cells and antibodies
- Identification of targets and development of candidate materials for the diagnosis and treatment of five major diseases
- Development of the platform technology for cell factories and biomaterials

• **Biotechnology to Address the National Agenda**

- Technology development for infection control
- Fostering R&D on cranial nerves and the aging society
- Development of biomass and bioenergy technology

• **National Infrastructure to Enhance National Biotechnology Competitiveness**

- Improvement of the infrastructure for compiling, managing and utilizing bio resources and data
- Consolidation of the infrastructure for biological assessment and GMO risk assessment

02 CORE DIRECTIONS FOR ORGANIZATIONAL MANAGEMENT

• **Improvement of the Framework to Facilitate R&D**

- Introduction of an open innovation system and acquisition of competitive human resources
- Strategical selection and concentration
- Expansion of global cooperation

• **Contributions to the Society and the Country**

- Improvement of the ability to respond to future biotechnology demands
- Promotion of demand-based R&D and commercialization of technologies
- Raising public awareness of biotechnology and public interest in science

• **Improvement of the Management Efficiency**

- Promotion of result and objective-oriented management
- Augmentation and efficient allocation of the R&D budget
- Maintenance of an up-to-date and facility infrastructure

General Information

FOUNDATION BASIS

Article 8, Act on the Establishment, Management and Promotion of Government-funded Research Institutions

KEY FUNCTION

- Develop and disseminate sophisticated core technology in bioengineering and bio-economy
- Innovative bioconvergence, creation of future growth engine, resolution of bio-based agenda
- Support public infrastructure for bioengineering research and development both at home and abroad
- Supporting establishment of public infrastructure, government-sponsored Think Tank, nurturing talented human resources, supporting commercialization of small/medium sized companies

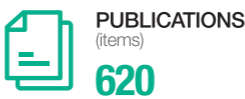
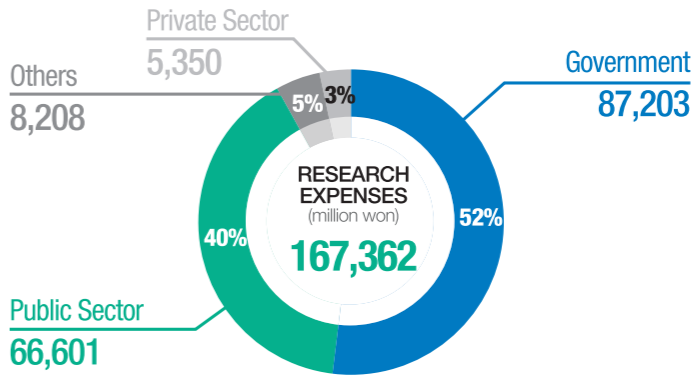
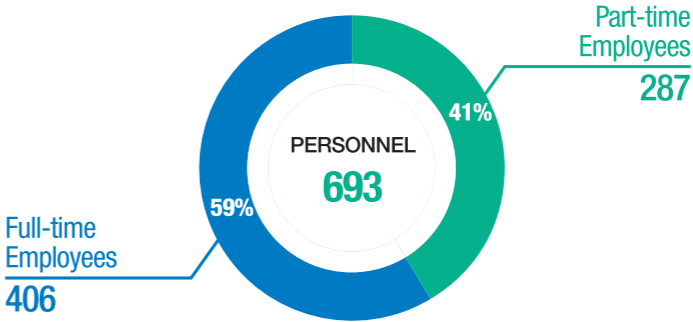
HISTORY

- Feb. 1985** Established as a Genetic Engineering Research Center (Seoul)
- Jul. 1990** Moved to Daejeon
- Mar. 1995** Changed its name to Korea Research Institute of Bioscience and Biotechnology (KRIBB)
- May. 1999** Became an independent legal entity under the Korea Research Council of Fundamental Science & Technology (KRCF)
- Sep. 2005** Established Ochang Branch Institute
- Nov. 2006** Established Jeonbuk Branch Institute

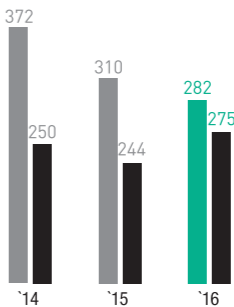
FACILITY

- Headquarter : 100,978 m²
 - Human Gene Bank, Plant Extract Bank
- Ochang Branch Institute : 212,258 m²
 - National Primate Research Center, Bio-Evaluation Center, Biotechnology Process Engineering Center
- Jeonbuk Branch Institute : 78,636 m²
 - Eco-friendly Bio Material R&D Hub Research Center, Microbial Evaluation Center

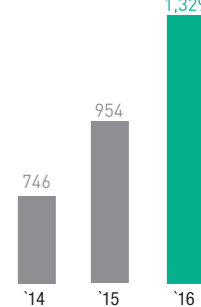
Yearly Progress



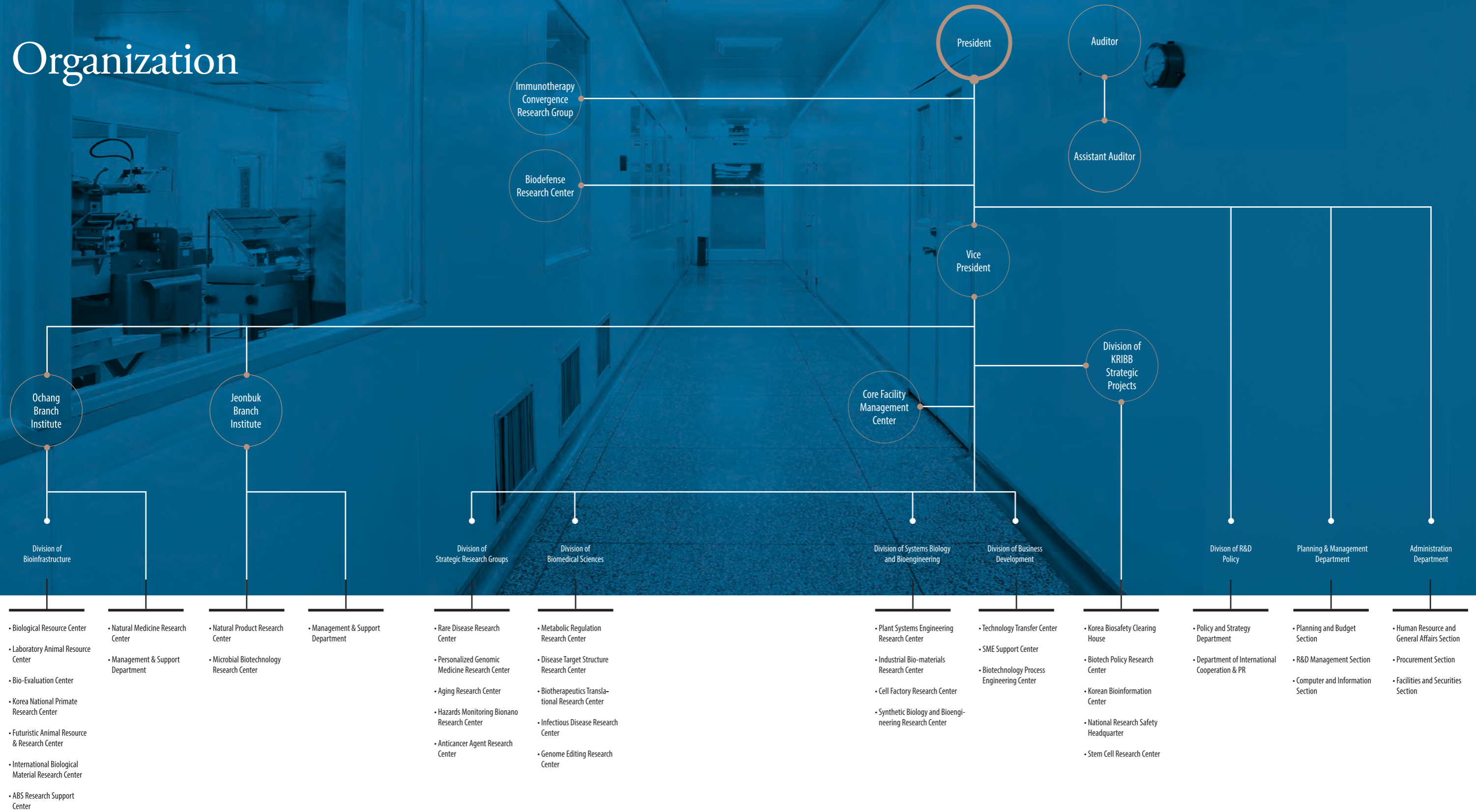
Domestic 94
Overseas 526



Application 282
Registration 275



Organization



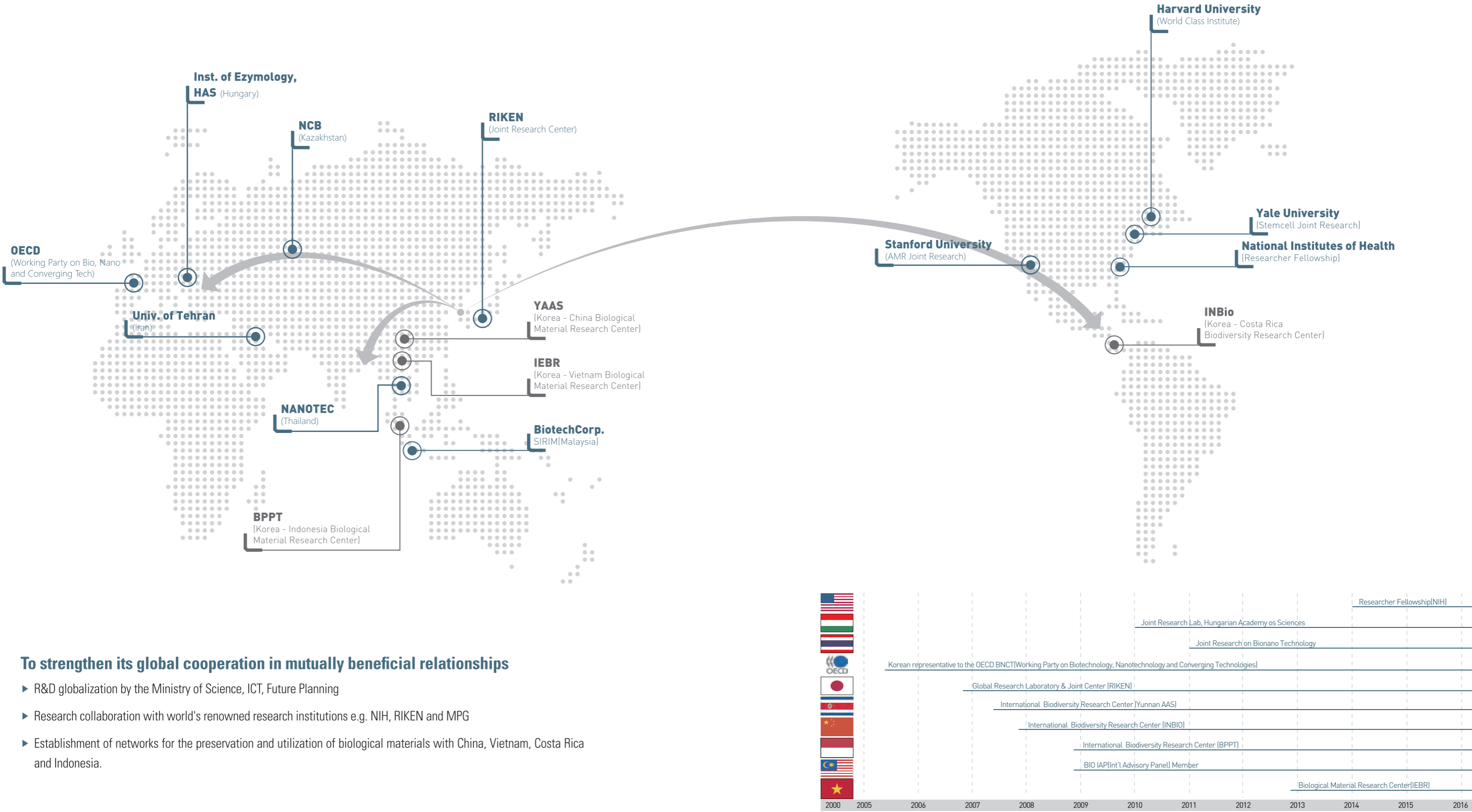
Research Infrastructure

1985 Biological Resource Center			2003 Human Gene Bank		
		2005 Korea National Primate Research Center			2006 Bio-Evaluation Center
2010 Korean Bioinformation Center				2012 Futuristic Animal Resource Research Center	
		2013 · Biotechnology Process Engineering Center · Eco-friendly Bio Material R&D Hub Research Center			2015 Microbial Evaluation Center

Research Direction



International Network



Cutting Edge Biotechnology Research and Creation of Bioindustry

At KRIBB, we conduct cutting-edge research of biotechnology for our society and economic growth in the field of medical healthcare, food and agriculture, and bioenergy. We are also fostering new bioindustry in Korea.



Division of Strategic Research Groups

- Rare Disease Research Center
- Personalized Genomic Medicine Research Center
- Aging Research Center
- Hazards Monitoring Bionano Research Center
- Anticancer Agent Research Center

We are making an effort to develop technologies to resolve national and social issues such as aging and rare/incurable diseases. We will take the lead in developing technologies to treat incurable diseases by advancing biotherapy.

Rare Disease Research Center

Our goal is to establish world-class genomics-based technology platforms and to apply them to biomedical research programs in order to achieve precision medicine for rare disease based on genome big-data. This will achieve production and analysis of large-scale NGS data for rare neuronal disease, high-throughput identification and global function analysis of the genes associated with rare neuronal disease, such as Hereditary spastic paraplegia (HSP), Ataxia, Malformations of Cortical Development (MCD) and Lennox-Gastaut Syndrome (LGS). We also perform discovery of gene therapy targets and biomarkers in order to develop precise diagnostics and therapeutics for rare neuronal disease.

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- Functional genomics of cancer
- Management of Korea Human Gene Bank (KHGB)
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- Functional analysis of synaptic molecules related with rare neuronal diseases
- Discovery of biomarkers for early diagnosis in neuro developmental disorders
- Kyung Sook Chung** kschung@kribb.re.kr
- Development of molecular diagnostics for rare neuronal disease
- Cancer therapies development
- Development of biomimetic 3D liver and toxicity analysis platform
- Eun-Wie Cho** ewcho@kribb.re.kr
- Cancer molecular cell biology and biochemistry
- Development of molecular diagnostics for rare neuronal disease
- Dae-Soo Kim** kds2465@kribb.re.kr
- Studies on genetic pathogenic variants of neurological disorder genes using exome sequencing
- Establishment of pathogenic variants reference map in the Korean neurological disorder population
- Da Yong Lee** daylee@kribb.re.kr
- Neuroscience
- Developmental neurobiology
- Hyun-Soo Cho** chohs@kribb.re.kr
- Cancer epigenomics (Histone methylation/ demethylation)
- Target validation for development of therapeutic target
- Jeong Ju Lee** snailee@kribb.re.kr
- Large-scale collection and distribution of human cDNA clones
- Operation of Korea Human Gene Bank (KHGB)
- Yong Jae Lee** tmx@kribb.re.kr
- Construction and operation of DB related to human gene clone

RESEARCH AREAS

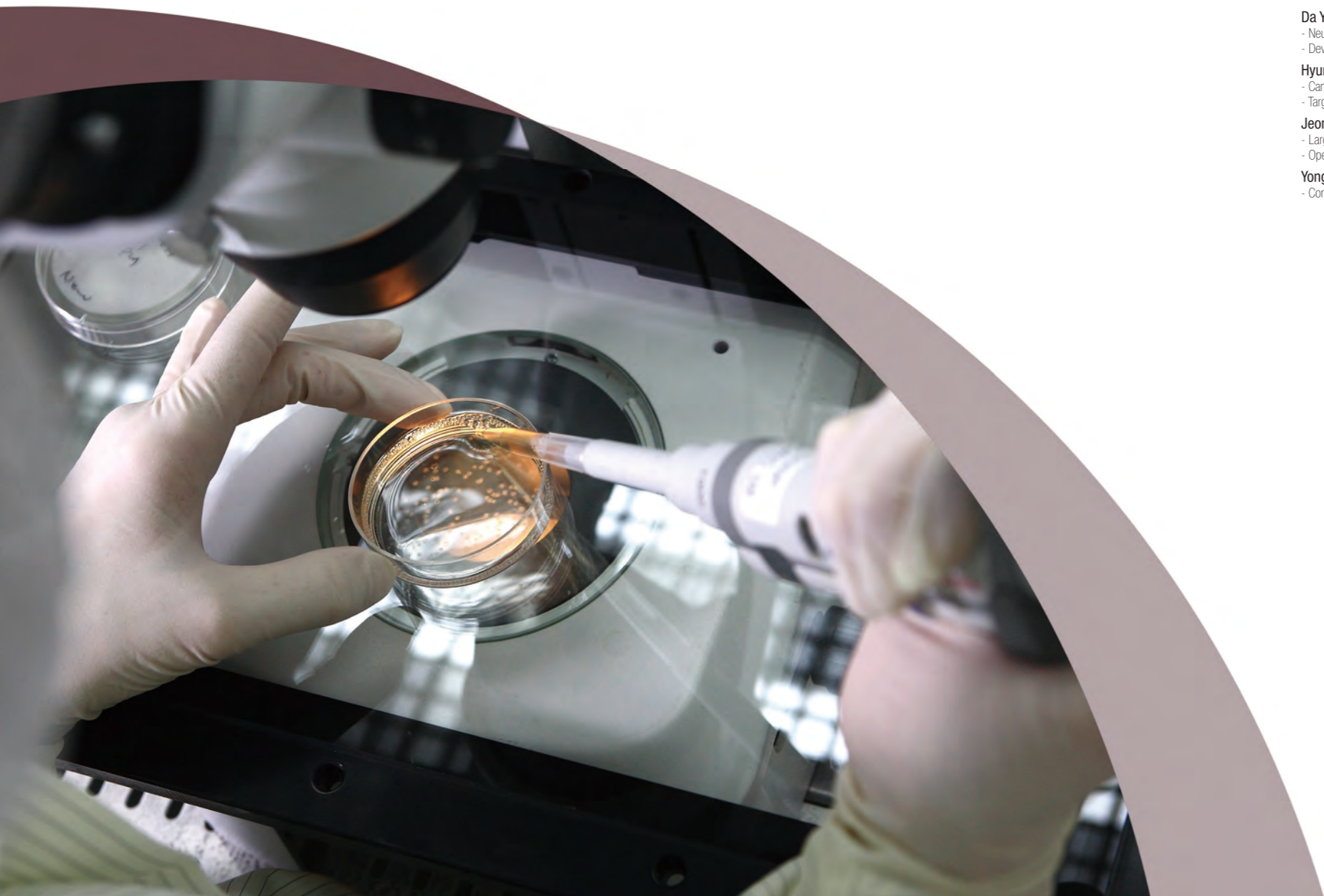
- Establishment of a genome research infrastructure and technology platforms for rare neuronal disease
- Construction of genetic variants map and integrated DB for Korean rare neuronal disease
- Large-scale screening and identification of genes related to rare neuronal disease
- Identification of biomarkers and development of gene panel for precise diagnostics of rare neuronal diseases
- Functional validation of candidate target genes for precise therapeutics development of rare neuronal disease
- Application of target genes onto gene therapy for precise therapeutics of rare neuronal disease

ACHIEVEMENTS

- Development of molecular diagnostics for Hereditary spastic paraplegia (HSP)**
- Construction of a draft genetic variants map of Korean HSP
 - Development of an in silico 113-gene panel for HSP consisting of five of X-linked genes, 21 of autosomal dominant genes and 54 of autosomal recessive genes.
 - Development of a digital PCR-based method for efficient and simple screening of large genomic deletion in the spastin gene (SPG4), main causative gene of HSP.
- Construction of analysis pipeline of large volume NGS genome data for rare disease**
- Development of the integrated system for handling, processing and analyzing large volume NGS genome data and multiple bio big data with different data structure
 - Identification of various SNV/INDEL candidates related to diseases using clinical sample and NGS data in Public DB
 - Establishment of technology for integrated analysis of genome information and information standardization
 - Construction of CNV map and DB related to diseases
- Modeling of rare neuronal diseases using animal & patient derived iPSC**
- Development of animal models for rare brain diseases including Hereditary Spastic Paraplegia (HSP), Tuberous Sclerosis Complex (TSC), and a rare multisystem genetic brain developmental disorder, a genetic brain disease with malfunction of cortical motor neurons.
 - Generation of iPSCs from the blood mononuclear cells of the patients with Duchenne Muscular Dystrophy (DMD), a severe type of muscular dystrophy and intellectual disability.
 - Finding out that various de novo mutations in nerve cell specific KIF1A motor domain cause intellectual developmental disorder, spastic paralysis, axon disorder and cerebellar atrophy

SELECTED PUBLICATIONS

Novel TRAIL sensitizer *Taraxacum officinale* F.H. Wigg enhances TRAIL-induced apoptosis in Huh7 cells.
Mol Carcinog. 55(4):387-96.
Nam-Soon Kim (Corresponding)



Personalized Genomic Medicine Research Center

The goal of the personalized genomic medicine research center is to develop of original technology for the customized treatment of cancer based on genome-wide screening as well as genome and epigenome analysis. We also deal with research on cellular differentiation using profiling technology and development of cellular differentiation control technology.

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RESEARCHERS

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- Genomics and data mining approach to understand human cancer (colorectal cancer, lung cancer and gastric cancer)
- Development of bioinformatics tools and databases

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- Bioinformatics analyses of genome, transcriptome and epigenome data

Kyung Chan Park kpark@kribb.re.kr
- Large-scale screening and identification of cancer related genes

Mi Sun Won misun@kribb.re.kr
- Identification and functional verificative of genes to develop carcinostatis substance
- Identification of mechanism of new carcinostatis substance and analysis and verification of genes to overcome resistance to therapeutics

Dong Cho Han dchan@kribb.re.kr
- Study of cancer cells' stress responses, migration, metastasis, stemness, and drug resistance using chemical biology

Mirang Kim mirang@kribb.re.kr
- Epigenomic study of stem cell differentiation and cancer development
- Genome-wide study of DNA methylation and microRNA

Bo Kyung Kim kimbk@kribb.re.kr
- Finding out the feasibility of cancer related gene expression control and treatment target

- Analysis and verification of gene to overcome resistance to therapeutics

Jung-Ae Kim jungaekim@kribb.re.kr
- Studies on histone modifications involved in gene expression and genome stability
- Studies on the crosstalks between metabolic regulation and chromatin regulators

Jeong-Hoon Kim jhoonkim@kribb.re.kr
- Studies on the regulatory mechanisms of chromatin modifiers

Seon-Kyu Kim seonkyu@kribb.re.kr
- Finding prognostic signatures based on cancer genomics/epigenomics and development of bionformatic analysis platforms

RESEARCH AREAS

- Development of bioinformatics tools and databases
- Genomic characterization of colorectal and gastric cancer for prognostic and predictive biomarker discovery
- Integrative analyses of NGS genome, transcriptome, and epigenome in a population scale data derived from various cancers
- Large-scale screening and identification of cancer related genes
- Functional validation of candidate target genes and biomarkers for therapeutics and diagnostics development
- Discovery and characterization of active compounds for anti-cancer, anti-metastasis, and anti-relapse therapy

ACHIEVEMENTS

Genomic characterization of gastric cancer with peritoneal metastasis

Genomic events during gastric cancer peritoneal metastasis were characterized by whole-exome sequencing of normal gastric tissues, primary tumors, and malignant ascites from gastric cancer patients. Recurrent mutations in COL4A6, INTS2, and PTPN13 were observed and several druggable genes including BRAF, ERBB4, PIK3CA, FYN, HDAC9, and ROCK1 were identified. Gene ontology analysis revealed the significant enrichment of mutations in the Rho-ROCK signaling pathway in malignant ascites.

Frequency and Spectrum of Actionable Pathogenic Secondary Findings in 196 Korean Exomes

One of the biggest challenges of exome and genome sequencing in the era of genomic medicine is the identification and reporting of secondary findings. In this study we investigated the frequency and spectrum of actionable pathogenic secondary findings in Korean exomes. Data from 196 Korean exomes were screened for variants from a list of 56 genes recommended by the American College of Medical Genetics and Genomics (ACMG) for return of secondary findings. Identified variants were classified according to the evidence-based guidelines reached by a joint consensus of the ACMG and the Association for Molecular Pathology. Among the 196 exomes, which were from 100 healthy controls and 96 patients with suspected genetic disorders, 11 variants in 13 individuals were found to be pathogenic or likely pathogenic. We estimated that the frequency of actionable pathogenic secondary findings was 7% for the control subjects (7/100) and 6% for the patients with disease (6/96). For one autosomal-recessive disease, four individuals exhibited either one pathogenic or one likely pathogenic variant of the MUTYH gene, leading to a carrier frequency of 2% (4/196). Secondary findings are not uncommon in Korean exomes.

Development of small molecular inhibitor of HSF1 and OCT4

HSF1 is the master transcription regulator of the stress responses. Knock-out of HSF1 protects mice from tumors initiation and progression. From the screening of HSF1 inhibitors using cell-based reporter assays, we identified KRIBB11, cantharidin, and Fisetin. Administration of KRIBB11, Cantharidin, or Fisetin effectively block tumor growth. In addition, we identified KRIBB3, an inhibitor of cancer cell migration/invasion/metastasis. OCT4 is a main transcription factor for stemness of stem cells and has reported to be involved in cancer stem cells.

SELECTED PUBLICATIONS

DNA damage induced apoptosis suppressor (DDI-AS) is upregulated via ERK5/MEF2B signaling and promotes β -catenin-mediated invasion.
Biochim Biophys Acta. 1859(11):1449-58.
Mi Sun Won (Corresponding)

DNA damage-induced apoptosis suppressor (DDI-AS), a novel target of NFATc1, is associated with cisplatin resistance in lung cancer.
Biochim Biophys Acta. 1863(1):40-9.
Mi Sun Won (Corresponding)

Identification of targets of the HIF-1 inhibitor IDF-11774 using alkyne-conjugated photoaffinity probes.
Bioconjug Chem. 27(8):1911-20.
Mi Sun Won (Co-corresponding)

Genetic alterations and their clinical implications in gastric cancer peritoneal carcinomatosis revealed by whole-exome sequencing of malignant ascites.
Oncotarget. 7(7):8055-66.
Seon-Young Kim (Co-corresponding)

Integrated epigenomic analyses of enhancer as well as promoter regions in gastric cancer.
Oncotarget. 7(18):25620-31.
Seon-Young Kim (Corresponding)

AKT-induced PKM2 phosphorylation signals for IGF-1-stimulated cancer cell growth.
Oncotarget. 7(30):48155-67.
Young Il Yeom and Kyung Chan Park (Co-corresponding)

Identification of candidate domestication regions in the radish genome based on high-depth resequencing analysis of 17 genotypes.
Theor Appl Genet. 129(9):1797-814.
Namshin Kim (Co-first)



Aging Research Center

We investigate the molecular mechanisms of aging process in the aspect of cellular changes and organ degeneration. We are going to develop the fundamental technologies in the prevention and therapeutics for healthy aging.

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RESEARCHERS

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- Systems biology of sarcopenia and age-related diseases
- Signal transduction related to muscle aging
- Yong-Kook Kang** ykkang@kribb.re.kr
- Epigenetic mechanism of muscle aging
- Dong Uk Kim** kimdongu@kribb.re.kr
- Systematic analysis of the cellular targets of bioactive molecules using the fission yeast genome-wide gene-deletion collection
- Mechanisms in degenerative brain disease and protein-misfolding diseases using yeast model
- Sung Sup Park** sspark@kribb.re.kr
- Understanding the pathogenesis of muscle dysfunction
- Molecular mechanisms in neuronal cell death
- Eun-Soo Kwon** eunsoo.kwon@kribb.re.kr
- Molecular biology and genome-wide studies on aging and aging-related diseases using *Caenorhabditis elegans*
- Inter-species regulation of longevity by gut microbe
- Seok Ho Kim** kims@kribb.re.kr
- Research on aging of muscle and immunity
- Molecular mechanism of age associated Tendinosis (rotator cuff tear)
- Kwang Pyo Lee** kplee@kribb.re.kr
- Molecular mechanisms of myoblast (satellite cell) differentiation, dysfunction and diseases (aging and sarcopenia)
- Yong Ryoul Yang** dearyang@kribb.re.kr
- Age-related diseases in mouse model
- Jung Sun Park** jspark@kribb.re.kr
- Production of transgenic model animal related to aging

RESEARCH AREAS

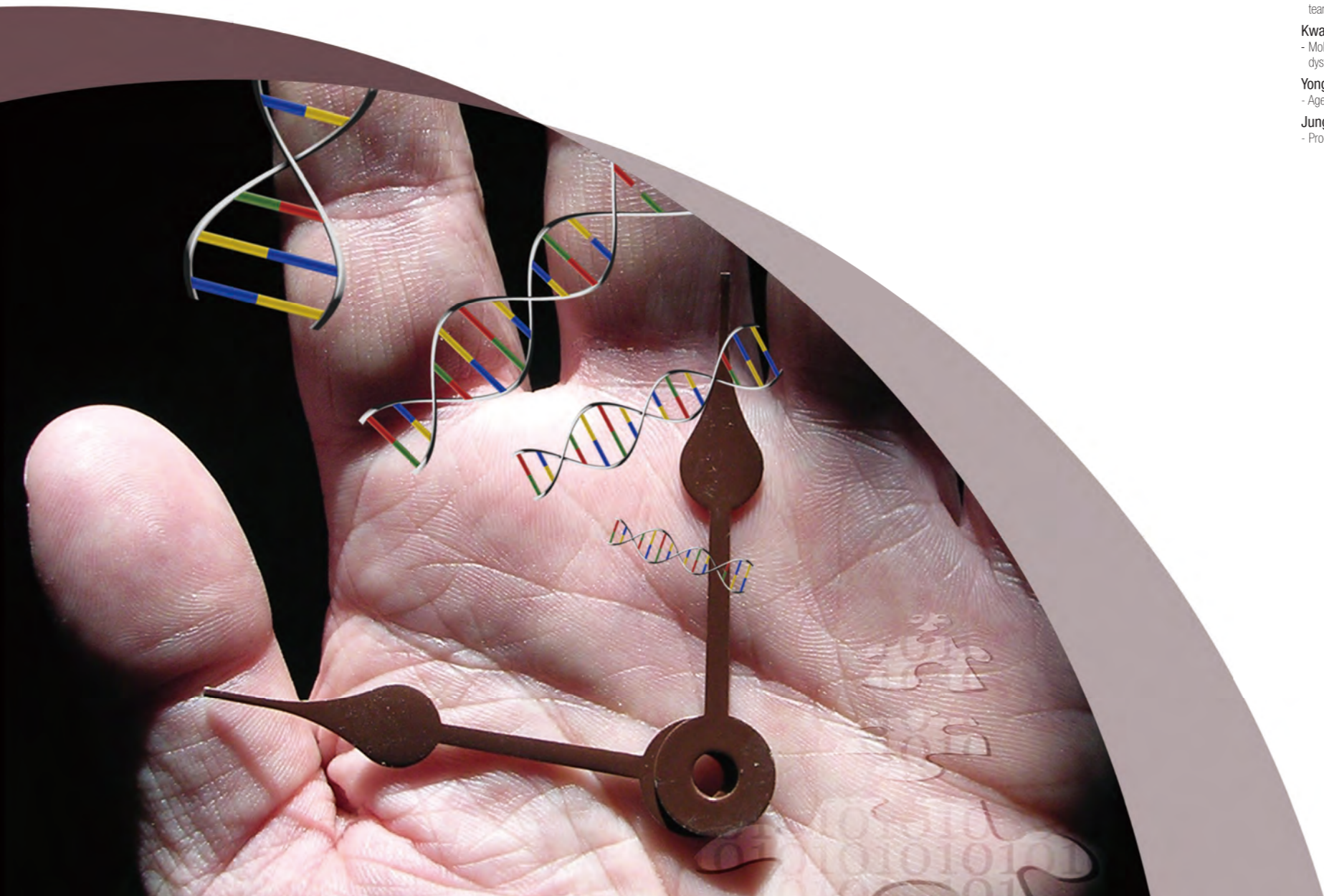
- Systems biology of sarcopenia and age-related diseases
- Discovery of new genes involved in the aging process and studies on signaling pathways therein
- Discovery of rejuvenating factors to reverse aging processes
- Functional identification of age-related genes using model worms, flies and mice
- Development of drug candidates and biologics for the control of age-associated diseases

ACHIEVEMENTS

- Identification of age-related genes in human muscles: We identified up-regulated genes which are involved in calcium signaling and lipid metabolism and discovered their roles in muscle dysfunction
- Identification of muscular age-associated miRNA: We are studying the function of down-regulated miRNAs in old muscles and their targets to improve muscular function in old animals
- Development of drug candidates to treat muscle wasting disease: We found chemical compounds that improve the regenerative capacity in old mice
- We are identifying the rejuvenating factors to reverse aging of old animals: proteomic analysis of blood factors, probiotic gut microbes to slow down the aging processes in old animals

SELECTED PUBLICATIONS

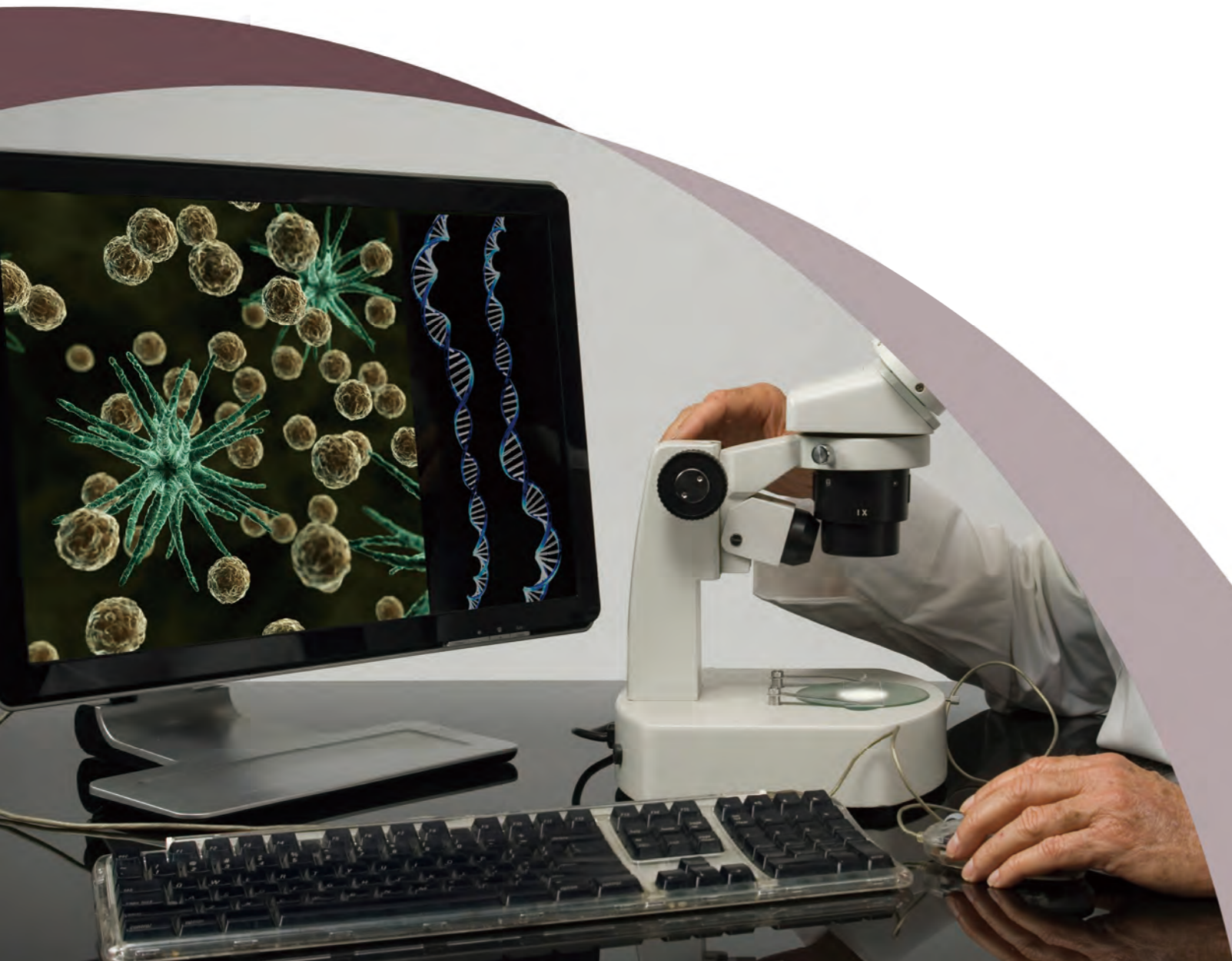
- Age-associated repression of type 1 inositol 1, 4, 5-triphosphate receptor impairs muscle regeneration.
Aging. 8(9):2062-80.
Ki-Sun Kwon (Corresponding)
- CTHRC1 promotes angiogenesis by recruiting Tie2-expressing monocytes to pancreatic tumors.
Exp Mol Med. 48(9):e261.
Seok Ho Kim (Co-corresponding)
- GPR171 expression enhances proliferation and metastasis of lung cancer cells.
Oncotarget. 7(7):7856-65.
Ki-Sun Kwon (Corresponding)
- Pancreatic adenocarcinoma up-regulated factor (PAUF) enhances the accumulation and functional activity of myeloid-derived suppressor cells (MD-SCs) in pancreatic cancer.
Oncotarget. 7(32):51840-53.
Seok Ho Kim (Co-corresponding)
- Differential matrix metalloprotease (MMP) expression profiles found in aged gingiva.
PLoS One. 11(7):e0158777.
Ki-Sun Kwon (Co-corresponding)



Hazards Monitoring Bionano Research Center

Our goal is to develop original technology to detect/analyze biological and chemical hazards based on the concept of nano-bio convergence. To accomplish this goal, we develop the new biocontents, bio-nano materials and integrated system thereof for highly sensitive detection and related technologies enabling continuous monitoring of hazards. Combined those efforts will contribute to creation of new businesses and realize our dream of pro-longing human life.

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RESEARCHERS

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- Development of a Drosophila model system for studying age-related diseases such as diabetes and neurodegenerative diseases

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RESEARCH AREAS

Bio contents technology to detect and analyze biological hazards (infectious germs and virus) and chemical hazards (toxicity, shellfish toxin, pesticide, heavy metals, etc.)

- Development of high-efficient bio materials (antibody, peptide, etc.) for detection/analysis of hazards
- Bio contents engineering to apply hazards detection and analysis system
- Establishment of bio contents library for hazards and effective analysis

New concept nano structure and bio contents interfacing technology to detect/analyze hazards

- New functional nano structure manufacturing technology to detect hazards
- Bio contents/nano structure highly efficient interfacing technology
- Highly sensitive hazard detection/analysis technology based on bio contents/nano structure

Integrated monitoring system technology to detect/analyze hazards

- Bio element and signal change technology to detect hazards
- Highly efficient bio interfacing technology for bio elements
- Bio sensing signal amplification technology to detect hazards sensitively
- Integrated hazards detection/analysis system for both bio contents and nano materials/elements

ACHIEVEMENTS

Development of nano original material for multi imaging

Development of new-concept multi bio imaging nano original materials that can be widely used in new drug development, disease diagnosis and understanding of life utilizing organic/inorganic nano material synthesis technology and bio material/nano material interfacing technology. It is a highly sensitive bio friendly nano material that can observe the movement of cells within a body with capability of monitoring movement of immune cells that can be used in cancer treatment and cancer cell treatment process with real-time in-body image.

Development of original technology for label-free micro RNA analysis

Development of array analytics utilizing structure specific RNA synthesis protein or nucleic acid derivatives as label-free micro RNA analysis method. Application on various solid surface is possible enabling the application on nano structure or devices like microfluidics.

Development of highly sensitive bio sensor

The highly sensitive label free bio sensor which does not need florescence or radioisotope label based on nano optics and nano electronic element technology is developed enabling the detection of very small amount of hazards (virus, toxicity).

SELECTED PUBLICATIONS

Human dopamine receptor-conjugated multidimensional conducting polymer nanofiber membrane for dopamine detection.

ACS Appl Mater Interf. 8:28897-903.
Oh Seok Kwon (Co-corresponding)

Dual-color emissive upconversion nanocapsules for differential cancer bioimaging *In vivo*.

ACS Nano. 10(1):1512-21.
Oh Seok Kwon (Co-first)

Covalent and oriented surface immobilization of antibody using photoactivatable antibody Fc-binding protein expressed in *Escherichia coli*.

Anal Chem. 88(19):9503-9.
Myung Kyu Lee (Corresponding)

Enzyme-coupled nanoplasmonic biosensing of cancer markers in human serum.

Biosens Bioelectron. 81:324-33.
Yong Beom Shin (Corresponding)

Simple, rapid detection of influenza A (H1N1) viruses using a highly sensitive peptide-based molecular beacon.

Chem Commun. 52(1):175-8.
Juyeon Jung (Co-corresponding)

A leucine zipper pair-based lipid vesicle for image-guided therapy in breast cancer.

Chem Commun. 52(13):2687-90.
Juyeon Jung (Corresponding)

Polo kinase phosphorylates miro to control ER-mitochondria contact sites and mitochondrial Ca²⁺ homeostasis in neural stem cell development.

Dev Cell. 37(2):174-89.
Kyu-Sun Lee (Co-first)

Harnessing low energy photons (635 nm) for the production of H₂O₂ using upconversion nanohybrid photocatalysts.

Energy Environ Sci. 9(3):1063-73.
Oh Seok Kwon (Co-first)

Raspberry-like poly(γ -glutamic acid) hydrogel particles for pH-dependent cell membrane passage and controlled cytosolic delivery of antitumor drugs.

Int J Nanomedicine. 11:5621-32.
Chang-Soo Lee (Co-corresponding)

Metal oxide semiconductor field-effect transistor (MOSFET)-based direct monitoring of p53 in spiked serum.

J Ind Eng Chem. 37:95-100.
Moonil Kim and Chang-Soo Lee (Co-corresponding)

Graphene-based nanoelectronic biosensors.

J Ind Eng Chem. 38:13-22.
Oh Seok Kwon (Co-corresponding)

Single nanowire on graphene (SNOG) as an efficient, reproducible, and stable SERS-active platform.

Nanoscale. 8(16):8878-86.
Taejoon Kang (Co-corresponding)

Preparation of pyrenyl-based multifunctional nanocomposites for biomedical applications.

Nat Protoc. 11(2):236-51.
Eun-Kyung Lim (First)

Precisely determining ultralow level UO₂²⁺ in natural water with plasmonic nanowire interstice sensor.

Sci Rep. 6:19646.
Taejoon Kang (Co-corresponding)

Nanoparticle-mediated physical exfoliation of aqueous-phase graphene for fabrication of three-dimensionally structured hybrid electrodes.

Sci Rep. 6:19761.
Oh Seok Kwon (Co-corresponding)

Structural effects of naphthalimide-based fluorescent sensor for hydrogen sulfide and imaging in live zebrafish.

Sci Rep. 6:26203.
Chang-Soo Lee and Tai Hwan Ha (Co-corresponding)

Carboxylic acid-functionalized conducting-polymer nanotubes as highly sensitive nerve-agent chemiresistors.

Sci Rep. 6:33724.
Chang-Soo Lee (Co-corresponding)

Anticancer Agent Research Center

The goals of center are discovering the new anticancer agents from microorganisms and chemical library, and identifying their cellular target for application to chemo-therapeutics development. Discovery of first-in anticancer drugs and novel cancer therapeutic targets will be based on the N-end rule pathway mediated protein degradation, PLK-linked cytokinesis and tumor cell specific metabolism.

To accomplish this goal, we adopt chemical biology techniques based on metabolomics, genomics, proteomics and cellulomics technology using bioactive microbial metabolites and synthetic chemicals to develop medicinal and bio-functional compounds.

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RESEARCHERS

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 - Microbiology and cell biology
 - Chemical biology

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 - Cancer Molecular Cell Biology
 - N-end rule pathway, protein degradation and autophagy

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 - Organic chemistry
 - Organic synthesis, Medicinal Chemistry

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 - Natural Product Biosynthesis and Engineering
 - Genome Mining for New Bioactive Molecule Discovery

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 - Microbial natural products chemistry
 - Marine natural products chemistry
 - Chemical biology

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 - Virology of oncogenic viruses
 - Drug discovery and validation

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 - Cancer Cell Biology
 - Cell Division, Anticancer drug discovery, osteoporosis

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 - Chemical biology
 - Target protein identification and target molecule interaction

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 - Molecular Cell Biology
 - N-end rule pathway, protein degradation and autophagy

Kyung Ho Lee leekh@kribb.re.kr
 - Cancer Cell Biology
 - Cell division, metastasis, ciliogenesis, spermatogenesis

In-Ja Ryoo ijryoo@kribb.re.kr
 - Natural product chemistry
 - Bio-assay system

RESEARCH AREAS

Anticancer agent screening
 - Screening new bioactive compounds regulating tumor cell proliferation and metastasis
 - Identifying their cellular targets.

Cancer target discovery and identification and functional mining of anticancer targets
 - Research on cancer cell division and its regulatory proteins, polo-like kinase (PLK) and mTOR
 - Identification of centrosomal protein Cep131, a key molecule for cancer cell division.
 - HEF1 mediated Wnt signaling for cell cycle and metastasis
 - Regulation of cilia formation in association with cancer

Research on the protein degradation based on N-end rule pathway
 - N-end rule pathway linked with cancer therapy
 - Redox modulated protein degradation in cancer cells
 - ER-stress and protein degradation in N-end rule pathway

Autophagy
 Development of bioactive compounds modulating authophagy and cellular microorganelle function

Tumor cell specific metabolism regulator
 Screening of bioactive compounds inhibiting indole 2,3-oxygenase (IDO) and MTH.

Virus-associated cancers
 - Epstein-Barr virus (EBV)-associated gastric cancer
 - Kaposi's sarcoma-associated herpesvirus (KSHV)

Construction of microbial secondary metabolites
 Discovering bioactive secondary metabolites and compiling a library of microbial secondary metabolites.

Combinatorial and Synthetic Biotechnology
 Generate structurally complex bioactive secondary metabolites and their analogues for drug development through deciphering and employing their biosynthetic mechanisms.

ACHIEVEMENTS

Technology transfer (30,000,000 won)

Discovery of anti-atopic compound

Discovery of compound against UV-induced inflammation and skin cancer

Discovering of bioactive secondary metabolites from microorganism

Structurally unique and diverse secondary metabolites from microorganisms have been an invaluable source of drug leads and molecular probes over decades. We have focused our attention on exploration of microorganisms from chemically less studied sites, which are potentially prolific sources of novel chemistry. Two novel cyclic depsipeptides, ulleungamides A and B , were isolated from cultures of terrestrial *Streptomyces* sp. KCB13F003. Ulleungamides were determined to be a new class of peptides bearing unprecedented units, such as 5-hydroxy-6-methyl-2,3-dehydropipecolic acid, 4,5-dihydroxy-6-methyl-2,3-dehydropipecolic acid, and amino-linked 2-isopropylsuccinic acid. Ulleungamide A displayed growth inhibitory activity against *Staphylococcus aureus* and *Salmonella typhimurium* without cytotoxicity.

Construction of artificial biosynthetic pathway of polyketides in *Escherichia coli*

Biological synthesis of plant-specific polyketides has attracted increasing attention due to their proven beneficial properties and health-promoting effects. Engineered *E. coli* containing artificial phenylpropanoid biosynthetic pathways were established for production of plant-specific metabolites. Our lab is interested in studying the biosynthesis of various pharmaceutically important natural products, including but not limited to plant-specific polyketides and bacterial type III polyketides.

Virus-associated cancers

We are exerting our efforts on the discovery of therapeutic candidates for efficient treatment of Epstein-Barr virus (EBV)-associated gastric cancers. To achieve this goal we successfully established a robust assay system quantitatively measuring lytic induction of EBV and utilized this system for screen of various synthetic chemical and natural resource libraries. Recently, we identified a *Euphorbia* extract from medicinal plant extracts as a strong lytic inducer of latent EBV and further revealed its active constituents.

SELECTED PUBLICATIONS

Modulation of SQSTM1/p62 activity by N-terminal arginylation of the endoplasmic reticulum chaperone HSPA5/GRP78/BiP.

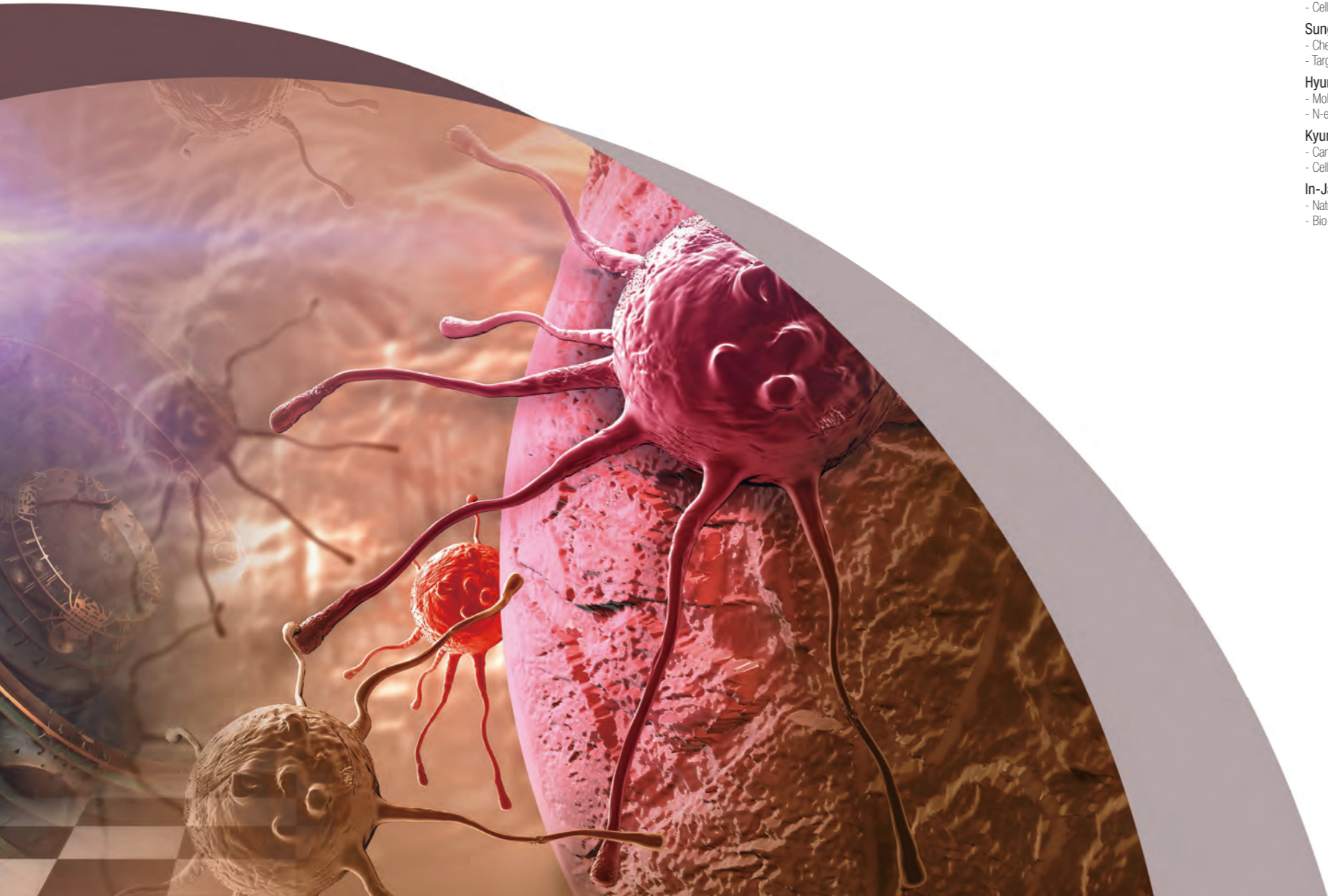
Autophagy. 12(2):426-8.
 Bo Yeon Kim (Co-corresponding)

A chemical with proven clinical safety rescues Down-syndrome-related phenotypes in through DYRK1A inhibition.

Dis Model Mech. 9(8):839-48.
 Sungchan Cho (Corresponding)

Stachybotrysin, an osteoclast differentiation inhibitor from the marine-derived fungus *Stachybotrys* sp. KCB13F013.

J Nat Prod. 79(10):2703-8.
 Jong Seog Ahn and Jae-Hyuk Jang (Co-corresponding)



Division of Biomedical Sciences

- Metabolic Regulation Research Center
- Disease Target Structure Research Center
- Biotherapeutics Translational Research Center
- Infectious Disease Research Center
- Genome Editing Research Center

We are making an effort to identify targets and develop structure-based control technologies to overcome incurable diseases. In addition, we aim to conduct clinical trial on control substances related to incurable diseases through clinical and translational studies. We will contribute to the generation of core technologies for metabolic diseases by playing the role as the hub of biotechnology and medical science in Korea.

Metabolic Regulation Research Center

The Metabolic Regulation Research Center (MRRC) is designed to conduct basic science and clinical relevant research to discover new knowledge about metabolic disease. The MRRC will support and promote multidisciplinary research to study mechanisms underlying metabolic diseases, including obesity and diabetes. We are also developing original technology for controlling protein and cellular function with the intention of regulating cell signaling, metabolism, and differentiation.

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RESEARCHERS

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 - Research on the regulation of adipocyte differentiation regulation and function
 - Research on trans-differentiation of adipocyte
 - Research on metabolic diseases

Kwang-Hee Bae khbae@kribb.re.kr
 - Identification of metabolic disease treatment target and functional research using proteomics
 - Identification of stem cell differentiation and de-differentiation related protein and functional research

Sang Chul Lee lesach@kribb.re.kr
 - Research on the mechanism of metabolism regulation related to stem cell differentiation
 - Identification of protein of metabolic disease based on omics and functions

Sang Jun Lee leesj@kribb.re.kr
 - Gut microorganism genetics, anaerobic metabolism, stress adaptation, genome evolution, and synthetic microbiology

Myung Hee Kim mhk8n@kribb.re.kr
 - Research on the mechanism and control of molecular pathology based on convergence technology

Byoung-Chan Kim bckim@kribb.re.kr
 - Research on the isolation and identification of anaerobic human microorganisms and their clinical application

Jungwon Hwang jwhwang@kribb.re.kr
 - Research on the pathogen-specific biochemical mechanism based on structural and cell biological approaches

Baek-Soo Han bshan@kribb.re.kr
 - Exploration of treatment for degenerative neural diseases, research on metabolic functions and identification of neural cell differentiation regulation factors

Hyun Seung Ban banhs@kribb.re.kr
 - Identification of new anticancer target molecule using chemical biology and development of function regulation materials

Young-Jun Park pyj71@kribb.re.kr
 - Research on metabolic control and control of infectious disease using macrophage which is involved in innate immunity

Kyung Jin Oh kjoh80@kribb.re.kr
 - Finding out the insulin signal delivery system and energy metabolism regarding type 2 diabetes and obesity and research on regulation

Eun-Woo Lee propadrum@kribb.re.kr
 - Research on control mechanism of metabolic diseases and cancer metabolism by protein ubiquitination
 - Research on control mechanism of apoptosis and necroptosis

RESEARCH AREAS

Research on the regulation of metabolic diseases
 - Identification of energy metabolic system in type 2 diabetes and obesity and research on regulation mechanism

- Identification of regulation material related to transition from white adipose tissue to brown adipose tissue and research on function

- Screening and functional research on metabolic disease regulation material based on low molecular compound or natural product

- Analysis on the functional change of major metabolic organs and signal delivery system under the metabolic abnormality and improvement condition using animal model

- Identification and functional research of network regulation factors among metabolic organs through omics analysis

Metabolic control research related to neurodegenerative diseases

- Research on metabolomics and animal model related to neuron function and neurodegenerative diseases

Research on the mechanism of deterring diabetes and macular degeneration by macrophage

- Research on the mechanism of controlling metabolism by macrophage

- Identification of mechanism for deterring infectious diseases and signaling control by macrophage

Research on the mechanism of cancer metabolism regulation

- Identification of target molecules related to cancer metabolism using compound and function regulation

Development of metabolic disease regulation technology utilizing microbiome analysis

- Development of treatment for obesity and diabetes utilizing intestinal microbiota

ACHIEVEMENTS

Research on the mechanism of differentiation control of white adipose tissue

- Finding out the mechanism of controlling differentiation by white adipose tissue using phosphates yeast

- Identification of factors that controls differentiation of white adipose tissue using analysis on proteome and finding out functions

- Identification of factors that controls differentiation of white adipose tissue by acetylation of protein and finding out functions

Research on brown adipose tissue and conversion from white adipose tissue to brown adipose tissue

- Finding out the role of phosphatase yeast in the generation of brown fat

- Identification of a new brown adipose tissue differentiation control target material and research on its function

- Finding out the mechanism of brown adipose tissue differentiation regulation through analysis on proteome

- Identification of protein that controls the conversion of white adipose tissue to brown adipose tissue and research on functions

Identification of new protein new drug target to treat neurodegenerative diseases

- Identification of new drug target protein for neurodegenerative by analyzing changes of phosphorylated protein during the destruction of neuron

Finding out mechanism of infectious disease control through the iNOS control

- Finding out mechanism of iNOS control by TXNIP

- Finding out the deterrent effect of inflammation by iNOS control

Research on the possibility of controlling obesity and diabetes by controlling TXNIP

- Finding out the role of TXNIP in obesity and diabetes

- Finding out the signaling system of TXNIP in obesity and diabetes

SELECTED PUBLICATIONS

c-Jun regulates adipocyte differentiation via the KLF15-mediated mode.

Biochem Biophys Res Commun. 469(3):552-8.
 Kwang-Hee Bae and Kyoung Jin Oh (Co-corresponding)

Development of a highly specific and sensitive cadmium and lead microbial biosensor using synthetic CadC-T7 genetic circuitry.

Biosens Bioelectron. 79:701-8.
 Sang Jun Lee (Co-corresponding)

Hypoxia-inducible factor (HIF) inhibitors: a patent survey (2011-2015).

Expert Opin Ther Pat. 26(3):309-22.
 Hyun Seung Ban (First)

Shiga toxins activate the NLRP3 inflammasome pathway to promote both production of the proinflammatory cytokine interleukin 1-β and apoptotic cell death.

Infect Immun. 84(1):172-86.
 Myung Hee Kim (Corresponding)

Molecular insights into toluene sensing in the TodS/TodT signal transduction system.

J Biol Chem. 291(16):8575-90.
 Myung Hee Kim and Ohsuk Kwon (Co-corresponding)

Set7/9, a methyltransferase, regulates the thermogenic program during brown adipocyte differentiation through the modulation of p53 acetylation.

Mol Cell Endocrinol. 431:46-53.
 Kwang-Hee Bae and Sang Chul Lee (Co-corresponding)

Infection-specific phosphorylation of glutamyl-prolyl tRNA synthetase induces antiviral immunity.

Nat Immunol. 17(11):1252-62.
 Myung Hee Kim (Co-corresponding)

Effect of BI-1 on insulin resistance through regulation of CYP2E1.

Sci Rep. 6:32229.
 Kyung Jin Oh (Co-first)



Disease Target Structure Research Center

Determination of three-dimensional structures of disease targets and development of platform technology for structure-based functional control of disease targets.

- Determination of structures and functions of disease target proteins
- Development of platform technology for structure-based functional control of disease targets
- Proteomics-based discovery and validation of disease targets
- Animal model-based research for treatment of degenerative diseases

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RESEARCHERS

Seung-Wook Chi swchi@kribb.re.kr

- Structural biology of apoptosis-regulating anticancer proteins, Structure-based drug development, Nanopore sensing technology development

Seung Jun Kim ksji@kribb.re.kr

- Structural studies on anti-oxidant proteins and protein tyrosine phosphatases

- Drug development using 3-D structural information

Jeong Hee Moon jhdal@kribb.re.kr

- Mass spectrometry, Proteomics, Protein Dynamics, Protein Quantification

Byoung Chul Park parkbc@kribb.re.kr

- Target mining and validation using proteomics, Signal transduction

- Translational research on immune diseases

Sung Goo Park sgpark@kribb.re.kr

- Mechanism and functions of apoptosis-related proteins, Protease degradomics

Eui-Jeon Woo ejwoo@kribb.re.kr

- Research on the structure and function of nucleic acid-binding proteins and Crispr system

- Development of functional control technology using structure-based protein engineering

Kweon Yu kweonyu@kribb.re.kr

- Molecular genetics research on metabolic and neurodegenerative diseases using drosophila model

Sunghyun Kang skang@kribb.re.kr

- Proteomics and mass spectrometry

Sunhong Kim sunhong@kribb.re.kr

- Cell Signal Transduction in cell and C. elegans model

- Drug Discovery

Tae-Sung Yoon yoonts@kribb.re.kr

- Neutron & X-ray crystallography, structural proteomics, astrobiology

Jeong-Soo Lee jeongsoo@kribb.re.kr

- Research on neurology, blood vessel development, and nanotoxicity using zebrafish

Bonsu Ku bku@kribb.re.kr

- Protein X-ray crystallography

- Structural studies on signaling-regulatory proteins

Ho-Chul Shin shinhc81@kribb.re.kr

- Protein X-ray crystallography

- 3D structural studies and antibody development of protein tyrosine phosphatases

Mi-Kyung Lee miki@kribb.re.kr

- Structural and dynamics studies using NMR spectroscopy

- Analysis of biomolecule using solid-state and protein nanopores

RESEARCH AREAS

Research on structures and functions of disease target proteins

- Elucidation of structures and functions of therapeutic proteins involved in apoptosis, cell division, and carcinogenesis using X-ray crystallography and NMR spectroscopy

- Structure-based drug development for controlling disease targets

Proteomics-based discovery and validation of disease target proteins

- Proteomics-based analysis of apoptosis interactome

- Identification and validation of biomarkers related to atopic skin disease, asthma, and rheumatoid arthritis

Animal model-based research for treatment of degenerative diseases

- Development of animal models (drosophila and zebrafish) for phenotypic screening of neurodegenerative diseases

- Animal model-based discovery and validation of new drug candidates for neurodegenerative disease

Drug discovery by cellular signalling research

- Research on cellular signaling mechanism in various pathways including GPCR, Wnt, mTOR

- Discovery of hits and leads using various activity evaluation assays

Development nanopore technology for sensing proteins and nucleic acids

- Development of novel drug screening and diagnosis platform technologies using nanopores

ACHIEVEMENTS

Elucidation of structures and functions of kinases and phosphatases

- Determination of three-dimensional structures and functional mechanisms of over 20 phosphatase involved in cellular signaling including apoptosis, cell division, and carcinogenesis.

Determination of structures of apoptosis-regulating proteins and development of structure-based drug repositioning strategy

- Determination of three-dimensional structures of apoptosis-regulating anticancer target proteins using NMR spectroscopy, Structure-based development of multi-targeting anti-cancer therapeutics

Elucidation of growth-regulating microRNA

- Discovery of growth-regulating microRNA9a by microRNA library screening

- Elucidation of growth-regulating role of microRNA9a as a new target of sNPER/NPYR

Research for treatment of Alzheimer's disease using photoactivated porphyrins

High-resolution real-time imaging analysis on the effect of graphene oxide nanoparticle on blood vessel development

Development of a novel screening technology for protein-protein interaction inhibiting drugs using nanopore

SELECTED PUBLICATIONS

Probing the small-molecule inhibition of an anti-cancer therapeutic protein-protein interaction using a solid-state nanopore.

Angew Chem Int Ed Engl. 55(19):5713-7.

Seung-Wook Chi (Co-corresponding)

Selective novel inverse agonists for human GPR43 augment GLP-1 secretion.

Eur J Pharmacol. 771:1-9.

Sunhong Kim (Co-corresponding)

Structural features of influenza A virus panhandle RNA enabling the activation of RIG-I independently of 5'-triphosphate.

Nucleic Acids Res. 44(17):8407-16.

Mi-Kyung Lee (Co-first)

Structural study of the HD-PTP Bro1 domain in a complex with the core region of STAM2, a subunit of ESCRT-0.

PLoS One. 11(2):e0149113.

Seung Jun Kim and Bonsu Ku (Co-corresponding)

Scaffold role of DUSP22 in ASK1-MKK7-JNK signaling pathway.

PLoS One. 11(10):e0164259.

Byoung Chul Park (Co-corresponding)

Structural insight into the critical role of the N-terminal region in the catalytic activity of dual-specificity phosphatase 26.

PLoS One. 11(9):e0162115.

Seung-Wook Chi and Seung Jun Kim (Co-corresponding)

High fat diet-induced TGF- β /Gbb signaling provokes insulin resistance through the tribbles expression.

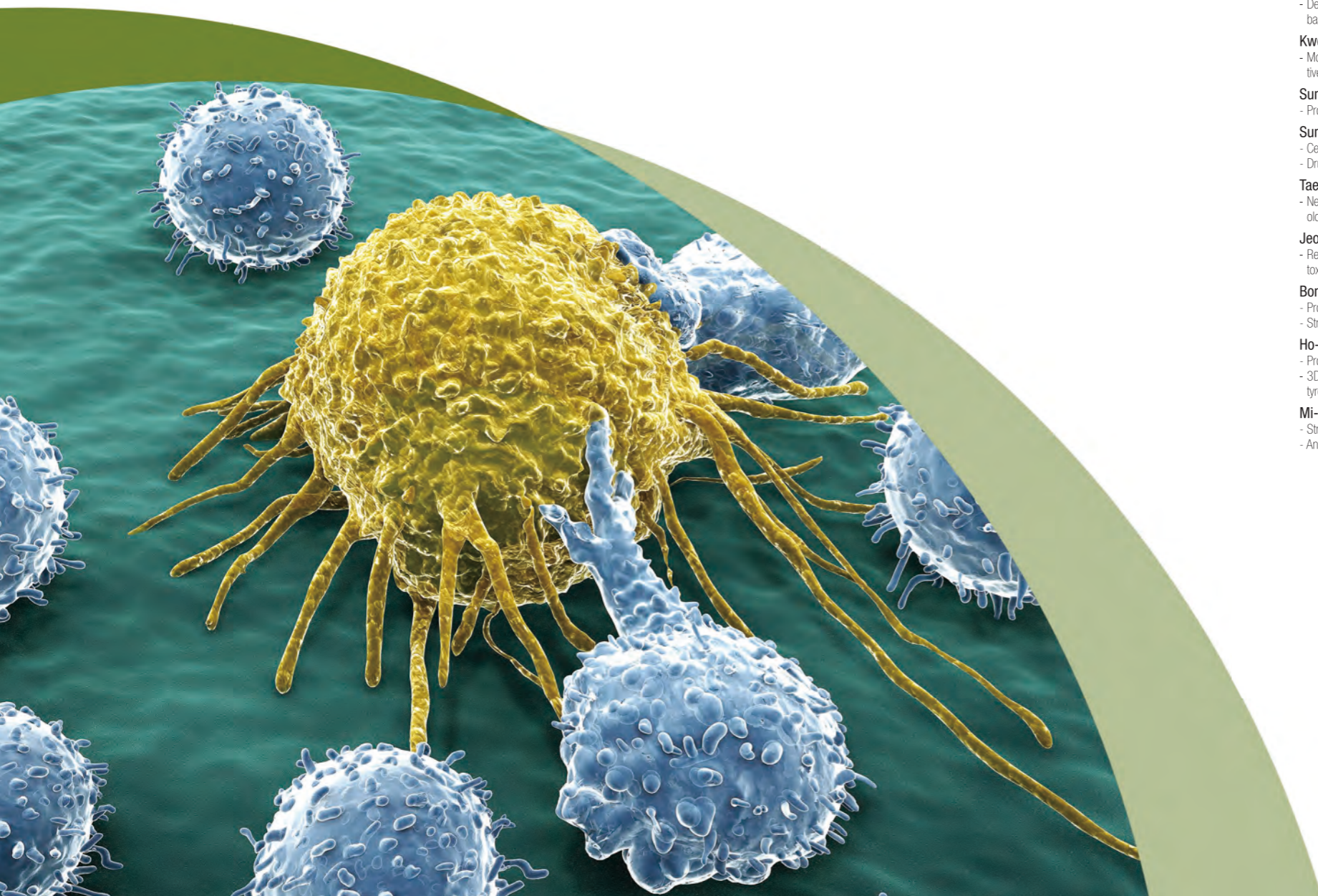
Sci Rep. 6:30265.

Kweon Yu and Kyu-Sun Lee (Co-corresponding)

Structural analysis of the phenol-responsive sensory domain of the transcription activator PoxR.

Structure. 24(4):624-30.

Eui-Jeon Woo (Corresponding)



Biotherapeutics Translational Research Center

Biotherapeutic Translational Research Center (BTRC) is focused on fostering personalized treatment of rare and incurable diseases through development and implementation of new therapeutic platform technology and translational research studies. The primary mission of the BTRC is to stimulate the high-quality clinical and translational research that seek to enhance the care of cancer, diabetes, and cardio-/neurodegenerative diseases. BTRC faculty are dedicated to several translational projects aimed to design, discovery, and development of tailored biotherapeutics in cancer, vascular, stem cell, and metabolic researches.

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- Studies on vascular development & inflammation, new anti-cancer drug targets, and stem cell differentiation

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- Cancer biology (metastasis research)

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- Production of knock-out clone pigs
- Functional genomics in disease model animals

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- Development of high therapeutic protein-producing mammalian cells
- Process development for therapeutic protein production in mammalian cells

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- Identification of cancer therapeutic targets
- Functional study of disease-related biomarkers

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- Validation and control technology of therapeutic targets by multifunctional protein antibody library based
- Translational research for development of cancer control technology
- To understand the role of microglia chemotaxis and activation in neuroinflammation

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- Validation of therapeutic targets for cardiovascular diseases
- Regulation of metabolic disorders

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- Development and application of therapeutic biomacromolecules-on-demand for patients
- Targeted macromolecule delivery system for disease theragnosis (diagnosis and therapy)

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- Identification and functional study of non-coding RNAs in cancer

RESEARCH AREAS

Identification of target that adjusts cancer/angiogenesis and blood vessel inflammation and development of control technology
- Identification of target based on multi-function antibody library system and development of antibody
- Regulating endothelium differentiation based on stem cell

Development of Biopharmaceuticals (antibody/AAV) for therapeutic angiogenesis & anti-cancer therapy

Mining of Diagnostic/therapeutic targets for vascular/metabolic diseases and cancer

Finding out the resistance to drug and metastasis regulation and development of control technology
- Development of a new drug through translational research between basic-clinical research

Identification of non-coding RNAs as biomarkers for diagnosis and prognosis of cancer

Development of treatment targeting cancer specific cell metabolism-signal and development of application technology
- Role of cancer cell metabolome lactic acid and research on mechanism
- Research on therapeutic technology through controlling of lactic acid signaling system

Targeted therapeutic biomacromolecules (antibody/protein/gene)
- Development of antibody-drug conjugates (Bibetter)
- Establishment of targeted drug delivery system

Identification of gene related to the production of immunodeficient pig
- Research on the mechanism of factors that cause immune rejection response

Genetic function research in disease animal models
- Establishment of effective gene editing system
- Development of mouse model targeted to specific genes

ACHIEVEMENTS

Providing cancer/blood vessel treatment technology through finding out the function of new protein that regulates angiogenesis and functions
- Technology that activates/controls angiogenesis based on antibody
- Cell treatment technology by establishing endothelium differentiation regulation platform

Identification of phosphatase enzyme that regulates blood vessel inflammation/permeability and finding out mechanism for new inflammation regulation

Finding out the new function of lactate in tumor cell metabolism
- Finding out the new signaling mechanism in hypoxic tumor microenvironment
- Finding out the major factors that regulate the function of lactate, which is cancer specific metabolic product

Finding out the factors that regulate resistance to drug and metastasis, development of control technology and establishment of basic-clinical translational research

Development of EC-specific receptor agonistic antibodies, tumor-specific antibody-protein conjugate for therapeutic angiogenesis & anti-cancer therapy
- Development of antibodies to surface proteins and for isolation of pluripotent stem cells
- Mining of Diagnostic/therapeutic targets for biliary tract cancer, insulin resistance and steatosis

Development of biocompatible drug delivery system that can address an adverse drug reaction and achieve targeted therapeutic success

Production of pig T-cell, B-cell immune deficient cell line

Establishment of the genetically modified cell line for the production of mini cloned pig for heterograft transplant

Development of disease mouse models

SELECTED PUBLICATIONS

Graphene oxide induces apoptotic cell death in endothelial cells by activating autophagy via calcium-dependent phosphorylation of c-Jun N-terminal kinases.
Acta Biomater. 46:191-203.
Jeong Ki Min, Kwang-Hee Bae and Jang-Seong Kim (Co-corresponding)

DUSP1 induces paclitaxel resistance through the regulation of p-glycoprotein expression in human ovarian cancer cells.
Biochem Biophys Res Commun. 478(1):403-9.
Jang-Seong Kim (Corresponding)

Regulation of integrin α 6 recycling by calcium-independent phospholipase A2 (iPLA2) to promote microglia chemotaxis on laminin.
J Biol Chem. 291(45):23645-53.
Sang-Hyun Lee (First)

Homeobox A9 directly targeted by miR-196b regulates aggressiveness through nuclear factor-kappa B activity in non-small cell lung cancer cells.
Mol Carcinog. 55(12):1915-26.
Dong Chul Lee (Co-first)

Construction of a dual-fluorescence reporter system to monitor the dynamic progression of pluripotent cell differentiation.
Stem Cells Int. 2016:1390284.
Jeong-Woong Lee (Co-corresponding)



Infectious Disease Research Center

Infection has become a serious medical and social problem in recent days. Bacteria resistant to major antibiotics are evolving into untreatable 'superbacteria' and acute viral diseases such as influenza and MERS are threatening public health with high morbidity and mortality. Therefore, it is necessary to formulate plans to counter current and future infectious diseases. Being motivated by new insights gained from small RNA, induced resistance, genomic library and novel antibacterial lead compounds, we are actively engaged in identifying novel antibacterial targets and innovative antibacterial leads. We are also investigating microbe-host interactions to better understand and manage bacterial pathogenesis. For the prophylactic measure against viral diseases, we are developing new vaccine and adjuvant technologies and antiviral strategies based on virology, immunology, and structural biology.

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RESEARCHERS

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- Bacteria-bacteria communication, Bacteria-plant interactions, plant immunity

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- Structure-based development of recombinant viral protein vaccines
- Proteomic analysis of virus-host interaction

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- High-throughput sequencing and analysis of microbial genomes

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- Development of vaccine adjuvants and study of their immune mechanism
- Development of a cervical cancer vaccine using lactobacillus as a vehicle

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- Molecular microbial physiology and antimicrobial genomics

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- Functional genomic study on *Bacillus* spp. and peptide antibiotics

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- Genetics and genomics of Gram-positive bacteria

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- Discovery and development of new antibacterials
- Microbial natural product chemistry/biosynthetic engineering

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- Molecular cell biology based-characterization of virulence factors in infected host
- Pathogenesis of microbial toxins in infectious diseases

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- Pathogenesis and genetic characterization of influenza viruses
- Development of influenza vaccine technologies using the reverse genetics system

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- DNA vaccines to viral infectious diseases
- Mechanisms of action of immunomodulatory vaccine adjuvants

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- Viral infectious diseases in animals
- Identification and characterization of novel viruses

Ji Hyung Kim kzh81@kribb.re.kr
- Aquatic animal medicine & genetics
- Biocontrol of antibiotic resistant bacteria using bacteriophage

Sung-Kyun Park skpark@kribb.re.kr
- Stage-specific control of B cell development and function
- Development of therapeutic antibody for viral infectious diseases

RESEARCH AREAS

- Antibacterials discovery and target identification with genomic library
- Microbial genome analysis and recombineering for enhanced antibiotics production
- Small RNA biology and induced resistance related to the pathogenic bacteria
- Bacterial display of enzymes and antigens: directed evolution
- Bacterial acetylproteomes
- Bacteria-host interactions
- Development of new vaccines against infectious diseases including influenza and MERS
- Development of novel vaccine adjuvants and the investigation of their immunomodulatory mechanisms
- Basic research on pandemic influenza, including surveillance and genetic characterization
- Researches on Emerging and re-emerging viral infectious diseases

ACHIEVEMENTS

- Dissecting probiotic *Paenibacillus*-plant interactions and their genome analysis
- Understanding and applying *Paenibacillus* elicited plant growth promotion and induced resistance.
- Engineering of NRPS gene clusters from *Paenibacillus polymyxa* and over-producing strains of peptide antibiotics
- High expression of polymyxin and fusaricidin biosynthetic gene clusters and engineering to generate novel derivatives.
- Discovery of new anti-Gram negative compounds with new mode of action from a microbial library
- Generation of new analogues by biosynthetic engineering of *Streptomyces* gene clusters
- Construction of libraries for monitoring functions of small RNAs
- Vector-based library construction for analyzing the function of small RNAs and related proteins in metabolic pathways of bacteria.
- Role of volatile organic compounds on bacterial communications
- Understanding the mechanistic basis of bacterial interactions by volatile organic compounds in developing drug resistance.
- Spore display system for enzymes and vaccines
- Developing novel display systems for enzymes and antigens in *Bacillus* spores.
- Bacterial acetylproteomes
- Systematic identification of post-translationally acetylated proteins in bacteria.
- Genome engineering of *Bacillus subtilis*
- Developing a new method for scarless genome engineering in *Bacillus subtilis* using a synthetic gene circuit.
- Development and technology transfer of a novel avian influenza vaccine
- Investigation on the immunomodulatory and antiviral functions of bacterial outer membrane vesicles

- Isolation and characterization of influenza viruses from domestic wild birds, dogs, horses, and human patients.
- Development and clinical studies of a cervical cancer vaccine

SELECTED PUBLICATIONS

Root-mediated signal transmission of systemic acquired resistance against above-ground and below-ground pathogens.

Ann Bot. 118:821-31.
Choong-Min Ryu (Corresponding)

Are bacterial volatile compounds poisonous odors to a fungal pathogen *Botrytis cinerea*, alarm signals to *Arabidopsis* seedlings for eliciting induced resistance, or both?

Front Microbiol. 7:196.
Choong-Min Ryu (Corresponding)

Daphnane diterpenes from *Daphne genkwa* activate Nurr1 and have a neuroprotective effect in an animal model of Parkinson's disease.

J Nat Prod. 79(6):1604-9.
Won-Gon Kim (Corresponding)

Isolation of coralmycins A and B, potent anti-Gram negative compounds from the myxobacteria *Corallococcus coralloides*.

J Nat Prod. 79(9):2223-8.
Won-Gon Kim (Corresponding)

Plant perceptions of extracellular DNA and RNA.

Mol Plant. 9(7):956-8.

Choong-Min Ryu (Corresponding)

Bacterial RNAs activate innate immunity in *Arabidopsis*.

New Phytol. 209(2):785-97.
Choong-Min Ryu (Corresponding)

Sweet scents from good bacteria: case studies on bacterial volatile compounds for plant growth and immunity.

Plant Mol Biol. 90(6):677-87.
Choong-Min Ryu (Corresponding)

Combination therapy with polymyxin B and netropsin against clinical isolates of multidrug-resistant *Acinetobacter baumannii*.

Sci Rep. 6:28168.
Choong-Min Ryu (Corresponding)

Shiga toxins as multi-functional proteins: induction of host cellular stress responses, role in pathogenesis and therapeutic applications.

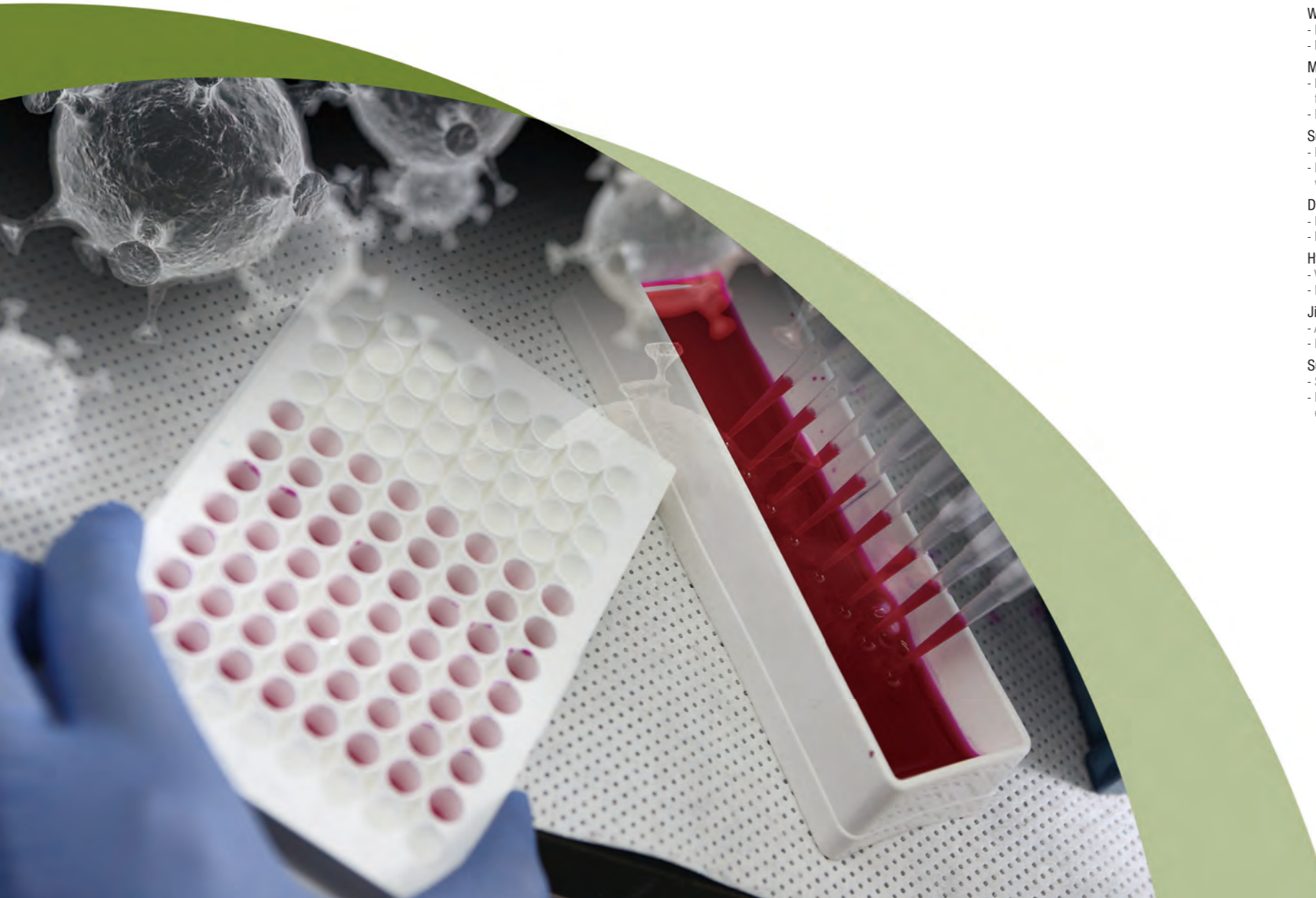
Toxins. 8(3):e77.
Moo-Seung Lee (Co-corresponding)

Detection of severe acute respiratory syndrome-like, Middle East respiratory syndrome-like bat coronaviruses and group H rotavirus in faeces of Korean bats.

Transbound Emerg Dis. 63(4):365-72.
Dae Gwin Jeong (Co-corresponding)

Attenuation of the virulence of a recombinant influenza virus expressing the naturally truncated NS gene from an H3N8 equine influenza virus in mice.

Vet Res. 47(1):115.
Sun Woo Yoon (Co-first)



Genome Editing Research Center

Genome editing is a type of genetic engineering in which DNA is inserted, deleted or corrected in the genome of a living organism using engineered nucleases, or "molecular scissors." These nucleases create site-specific double-strand breaks (DSBs) at desired locations in the genome, and the induced double-strand breaks are repaired through nonhomologous end-joining or homologous recombination, resulting in targeted mutations. Three distinct types of engineered nucleases are being used; meganucleases, zinc finger nucleases (ZFNs), transcription activator-like effector-based nucleases (TALEN), and the CRISPR-Cas system. The developments of alternative genome engineering tools are also being attempted. These genome-engineering tools are used for genetic functional study, generation of model organisms and gene therapy. The related techniques can be applied to various research and development fields including gene delivery, stem cells, nanotechnology, and cell therapy.

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RESEARCHERS

Yong-Sam Kim omsys1@kribb.re.kr
 - Development of a new gene editing technology
 - Research on the advancement of a gene editing technology

Yong Sung Kim yongsung@kribb.re.kr
 - Exploration of epigenetic target gene related to cancer and stem cell differentiation
 - Development of epigenetic gene editing technology of a target gene

Byoung-Mog Kwon kwonbm@kribb.re.kr
 - Exploration of gene related to diseases utilizing biochemical and chemical genomics and identification of the function utilizing a gene editing technology

Jeong-Heon Ko jhko@kribb.re.kr
 - Research on the function of glucide genes and development of glucide gene editing technologies

Dae-Yeul Yu dyyu10@kribb.re.kr
 - Production of transformation mouse model and research on its function

Kyou Hoon Han khhan600@kribb.re.kr
 - Intrinsically disordered protein, NMR structure biology, anti-cancer nano new drugs

Yoonkyung Kim ykim@kribb.re.kr
 - Biocompatible polymer, dendrimer, nano-medicine (diagnosis, drug delivery), organic/supramolecular/medicinal chemistry

Jeong-Gu Kang kang@kribb.re.kr
 - Development of method to regulate epigenetic target gene utilizing a gene editing technology

RESEARCH AREAS

Research on the advancement of gene editing technologies
 - Research on the increase of efficiency of CRISPR/Cas9 and CRISPR/cpf1 gene editing technologies
 - Establishment of target regulation system of genes related to stem cell, disease and aging

Development of human mimicking mouse model utilizing glucide gene editing technology
 - Selection of glucide gene that causes differences in glucide between human and mouse and development of a mouse model editing the selected gene.
 - Verification of non-clinical appropriateness of human mimicking mouse model

Development of new gene editing technologies
 - Development and effect verification of the 4th gene editing technology

Development of disease model mouse utilizing animal transformation technology

Research on the mechanism of antioxidant enzyme in the process of cancer development

Identification of biological activation mechanism of intrinsically disordered protein and mechanism of causing diseases

Design, compounding and application of new organic/polymer/nano compounds for diagnosis and treatment for incurable diseases

ACHIEVEMENTS

Leading selective expression of a target gene using a gene editing technology
 - Development of gene expression regulation system based on TALEN targeting promoter of E-cadherin

Development of epigenetic regulation method for a target gene
 - Development and verification of technology that induces change of epigenetic gene in a certain chromatin body

Development of disease model mouse for a number of diseases including liver cancer and lung cancer

Invention and spread of the activated part of pre-structured motif of intrinsically disordered protein for the first time in the world

Development of new nano compounds for diagnosis of cancer and retina disease

SELECTED PUBLICATIONS

Identification and evaluation of age-correlated DNA methylation markers for forensic use.
Forensic Sci Int Genet. 23:64-70.
 Yong Sung Kim (Corresponding)

PPAR γ agonists induce adipocyte differentiation by modulating the expression of Lipin-1, which acts as a PPAR γ phosphatase.
Int J Biochem Cell Biol. 81(A):57-66.
 Byoung-Mog Kwon (Corresponding)

High-performance dendritic contrast agents for X-ray computed tomography imaging using potent tetraiodobenzene derivatives.
J Control Release. 226:258-67.
 Yoonkyung Kim (Corresponding)

Peroxiredoxin II promotes hepatic tumorigenesis through cooperation with Ras/Forkhead box M1 signaling pathway.
Oncogene. 35(27):3503-13.
 Dae Yeul Yu (Corresponding)

IL-32 θ inhibits stemness and epithelial-mesenchymal transition of cancer stem cells via the STAT3 pathway in colon cancer.
Oncotarget. 7(6):7307-17.
 Dae Yeul Yu (Co-corresponding)

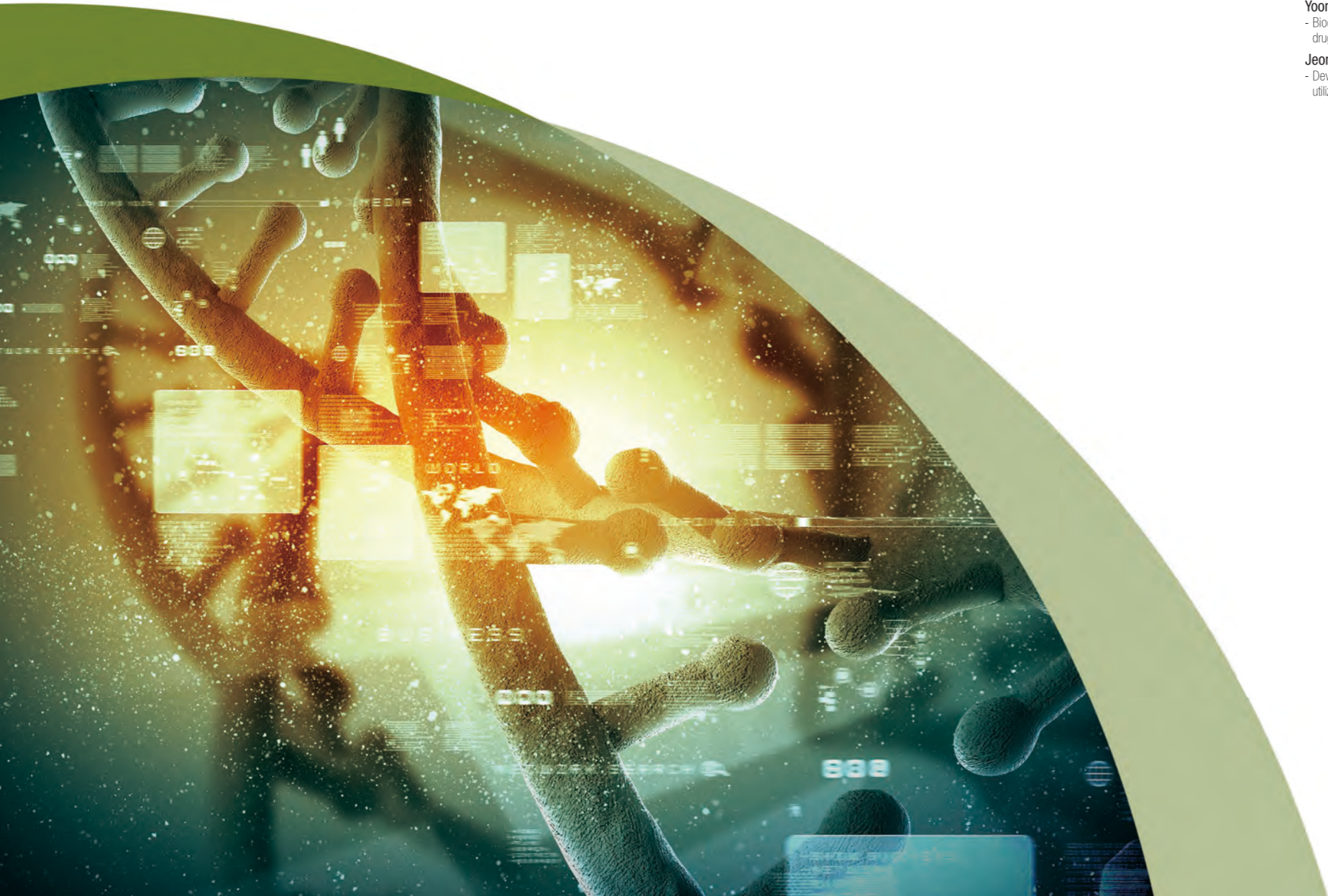
Genome-wide DNA methylation profiles altered by *Helicobacter pylori* in gastric mucosa and blood leukocyte DNA.
Oncotarget. 7(24):37132-44.
 Yong Sung Kim (Co-corresponding)

IGF-II induced by hepatitis B virus X protein regulates EMT via SUMO mediated loss of E-cadherin in mice.
Oncotarget. 7(35):56944-57.
 Dae Yeul Yu and Bo Yeon Kim (Co-corresponding)

Complex behavior of ALDH1A1 and IGFBP1 in liver metastasis from a colorectal cancer.
PLoS One. 11(5):e0155160.
 Yong Sung Kim (Co-corresponding)

Application of cancer-associated glycoforms and glycan-binding probes to an *In vitro* diagnostic multivariate index assay for precise diagnoses of cancer.
Proteomics. 16(24):3062-72.
 Yong Sam Kim and Jeong Heon Ko (Co-corresponding)

Peroxiredoxin II is essential for maintaining stemness by redox regulation in liver cancer cells.
Stem Cells. 34(5):1188-97.
 Dae Yeul Yu (Co-corresponding)



Division of Systems Biology and Bioengineering

- Plant Systems Engineering Research Center
- Industrial Bio-materials Research Center
- Cell Factory Research Center
- Synthetic Biology and Bioengineering Research Center

We are making an effort to develop technologies for the production and utilization of high-functional food, pharmaceutical and industrial materials. In addition, we are aiming to realize the industrialization of a cell factory based on synthetic biology. We are committed to opening the era of global bioindustry in the 21st century which is led by plant biotechnology.

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Plant Systems Engineering Research Center

We focus on the development of important platform technology for plant biotechnology and industrial transgenic plants. These include studies on plant genome and transcriptome, finding functionally important genes, development of transgenic plants and analysis of their characteristics. Furthermore, we generate industrial transgenic plants with enhanced tolerance to environment stresses on marginal lands to develop plant-based global green technology and establishment of global cooperation network. We also currently focus on the development of In-Plant cell biotechnology for invaluable bio-pharmaceuticals and bio-materials. Our endeavour is to research on these organisms and associated processes, and develop sustainable technologies/ products from these resources.

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RESEARCHERS

Hyun Soon Kim hyuns@kribb.re.kr

- Establishment of plant-based expression system for sustainable production of invaluable bio-materials

Sang-Soo Kwak sskwak@kribb.re.kr

- Transgenic plants (sweetpotato, alfalfa, poplar etc.) with enhanced tolerance to multiple stresses on global marginal lands

HyeRan Kim kimhr@kribb.re.kr

- Genetics and Genomics for crop improvement
- Development of crop molecular markers for genomics assisted breeding

Sung Ran Min srmin@kribb.re.kr

- Development of stress and functional crops through nuclear and chloroplast transformation
- Establishment of optimal culture system for in vitro large scale production of medicinal plants

Stephen Beungtae Ryu sbryu@kribb.re.kr

- Enhancement of multi-resistances of plants using natural lipids
- Green biotechnology for natural rubber

Haeng-Soon Lee hslee@kribb.re.kr

- Molecular breeding of sweetpotato by metabolic engineering of pigment antioxidants

Suk Yoon Kwon sykwon@kribb.re.kr

- Structural and functional genomics of plants
- Transformation of crop plants for enhancing agricultural traits

Jae Sun Moon jsmoon@kribb.re.kr

- Molecular plant-microbe interactions
- Development of oligo chips for the pathogen diagnosis

Jeong Mee Park jmpark@kribb.re.kr

- Molecular mechanisms of pathogen - induced cell death
- Plant immunity to viruses

Hye Sun Cho hscho@kribb.re.kr

- Identification and application of useful genes improving biomass in major crops
- Studies on roles and fine-tuning mechanism of post-translational regulation (PPlase) during plant abiotic stresses

Won-Joong Jeong wonjoong@kribb.re.kr

- Regulation of gene expression for improvement of algal biomass

Jae Heung Jeon jeonjh@kribb.re.kr

- Development of optimal mass production system of the seeds or seedling of useful vegetative-propagation crops

Jeongyeo Lee leeje@kribb.re.kr

- Functional characterization of the genes associated with the content of bioactive compounds and plant nutrients using molecular genetics approaches

RESEARCH AREAS

- Studies on structural and functional genomics of plant

- Studies on transcriptome in response to oxidative stress in plants

- Studies on plant-microbe interaction and its utilizable technology

- Studies on metabolic engineering of carotenoids in plants

- The cooperative study of plant-based global green technology with China, Kazakhstan, etc.

- Establishment of sustainable Biomass

- Development of high-efficiency production system

- Biomaterials research

ACHIEVEMENTS

Development of transgenic plants with enhanced tolerant to multiple environmental stresses and investigation of their characteristics

- We characterized the tolerance to drought, high salt and oxidative stress using transgenic sweetpotato, alfalfa and poplar which are harboring over-expression of *lbMYB1*, *lbOrange*, *AtYUCCA6* etc under the control of an oxidative stress-inducible *SWPA2* promoter.

Development of transgenic sweetpotato with increased pigment antioxidants contents

- We developed transgenic sweetpotato plants with increased β -carotene contents by the down-regulation of β -carotene hydroxylase (CHY-B). We also developed transgenic sweetpotato plants that accumulate both carotenoids and anthocyanin in single storage roots by introducing *lbOrange* gene involving in carotenoid accumulation into purple-fleshed sweetpotato.

Development of chloroplast transformation technology

- We have developed chloroplast transgenic tobacco plants enhanced photosynthetic efficiency and biomass by introducing a cyanobacterial *FBP/SSBPase*.

Investigating the cell death mechanism of plants related to disease resistance

- Isolation of novel leaf-inhabiting endophytic bacteria that showed antagonistic activities against phytopathogens.
- We have been characterized genes related to cell death mechanism of plants which were involved in resistance to bacterial and viral-disease using virus induced gene silencing technology.

Development of genomics assisted breeding tools

- Commercialization the backcross selection markers for cabbage breeding program
- Development of cabbage F1 purity test marker set
- Establishment of classification and genetic diversity assesment systems for strawberry cultivars

Increased lipid productivity in microalgae for bio-fuel production

- Three prong strategy for achieving high lipid productivity with enhanced growth.
- Collection of strains from Korean wilderness with high lipid productivity
- Ecosystem engineering of algal production systems using beneficial bacteria
- Genetic engineering of algal metabolic and signaling pathways

Construction of omics information and genetic network

- The whole genome of two novel microalgae have been sequenced. Genomic information will provide valuable clues to drive commercialization of microalgae for the maximum production of lipid and carotenoids through genetic modification.

Establishment of transcriptome database in *Jerusalem artichoke*

- We took advantage of RNA-Seq technology from the Illumina platform to investigate the metabolic pathways and tissue-specific functional genomics in a non-model plant species. The assembled transcriptome sequences and additional data make a substantial contribution to the existing genomic resources for *Jerusalem artichoke* and will serve to enable research on differentially-expressed genes and functional genomics in *Jerusalem artichoke*. Further, our work supports a global view and provides resources for future research on the *Jerusalem artichoke* species.

SELECTED PUBLICATIONS

Cross-talk in viral defense signaling in plants.

Front Microbiol. 7:2068.
Jeong Mee Park (Co-corresponding)

Identification of flowering-related genes responsible for differences in bolting time between two radish inbred lines.

Front Plant Sci. 7:1844.
Hye Sun Cho (Co-corresponding)

Highly efficient plant regeneration and *Agrobacterium*-mediated transformation of *Helianthus tuberosus* L.

Ind Crop Prod. 83:670-9.
Hyun Soon Kim and Jae Heung Jeon (Co-corresponding)

Overexpression of *OsCYP19-4* increases tolerance to cold stress and enhances grain yield in rice (*Oryza sativa*).

J Exp Bot. 67(1):69-82.
Hye Sun Cho (Co-corresponding)

Development of a new vector using *Soybean yellow common mosaic virus* for gene function study or heterologous protein expression in soybeans.

J Virol Methods. 228:1-9.
Jae Sun Moon (Corresponding)

Endoplasmic reticulum stress responses function in the HRT-mediated hypersensitive response in *Nicotiana benthamiana*.

Mol Plant Pathol. 17(9):1382-97.
Jeong Mee Park (Corresponding)

Heterologous expression of chloroplast-localized geranylgeranyl pyrophosphate synthase confers fast plant growth, early flowering and increased seed yield.

Plant Biotechnol J. 14(1):29-39.
Stephen Beungtae Ryu (Corresponding)

Intracellular Ca^{2+} and K^{+} concentration in *Brassica oleracea* leaf induces differential expression of transporter and stress-related genes

BMC Genomics. 17:211.
HyeRan Kim (corresponding)

Molecular characterization of tocopherol biosynthetic genes in sweetpotato that respond to stress and activate the tocopherol production in tobacco.

Plant Physiol Biochem. 106:118-28.
Sang Soo Kwak (Corresponding)

CRISPR/Cas9-induced knockout and knock-in mutations in *Chlamydomonas reinhardtii*.

Sci Rep. 6:27810.
Won-Joong Jeong (Co-corresponding)

Orange protein has a role in phytoene synthase stabilization in sweetpotato.

Sci Rep. 6:33563.
Sang Soo Kwak (Corresponding)

Industrial Bio-materials Research Center

Based on the bio-diversity of insects, microorganisms, plants and marine organisms, this team is trying to figure out and build-up a new platform technology that can support new biomaterials, diverse enzymes (including feed enzymes and saccharification enzymes), nutraceuticals, cosmeceuticals and biopesticides.

- Microbial enzymes from insect symbiotic environment
- Nutraceuticals and cosmeceuticals from natural products
- Biopesticide ingredients from natural sources
- Microbial (Bacteria, Actinomycetes, Fungy and Yeast) library
- Business build-up from biodiversity information

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RESEARCHERS

Kwang-Hee Son sonkh@kribb.re.kr

- Enzymes for industrial uses from biodiversity.
- Microbial genomics and bioinformatics.
- Plant natural products for skin whitening agents.

Tae-Sook Jeong tsjeong@kribb.re.kr

- Screening, in vivo efficacy test, and mechanism study of bioactive materials and substances for prevention and treatment of metabolic syndrome (including obesity, diabetes, hyperlipidemia, atherosclerosis, and inflammation) and using them for the development of functional foods and nutraceuticals

Ho-Yong Park hypark@kribb.re.kr

- Highly active enzymes and bio-materials from invertebrates & microbes for industrial application
- Development of bio-insecticides for the control of agricultural insects by insect pathogens

Sung Uk Kim kimsu@kribb.re.kr

- Search and development of bio-materials for agriculture including biological control agents, fungicides, and signaling modulators from natural resources

Do Young Kim kdy119@kribb.re.kr

- Development of industrially valuable biocatalysts, bioactive compounds, and biopolyesters
- Metagenomic analysis of the invertebrate gut microbiome

Chang-Jin Kim changjin@kribb.re.kr

- Exploitation of microbial resources (Actinomycetes)
- Screening of secondary metabolites and development of useful biomaterials

Kee-Sun Shin ksshin@kribb.re.kr

- Studies on the value evaluation of microbial resources for industrial applications
- Identification and phylogeny of yeasts

RESEARCH AREAS

Development of bio-materials based on biodiversity and FT (fusion technology)

- Unique enzymes from insect and related (symbiotic for example) microorganisms.
- Bio-catalysts to resolve bio-recalcitrance of biomass.
- Environment-friendly bio-pesticides using entomopathogenic microorganisms.

Development of anti-virus drugs to cure virus originated hepatitis B

- Isolation of 3 new materials from plant natural products in Korea (Alleviate drug resistance caused by mutation).

Development of nutraceuticals for metabolic syndrome control

- Development and mechanism study of health functional foods, nutraceuticals or active components from natural and edible sources for preventing and treating metabolic syndrome

Search and development of bio-materials inhibiting microbial functions from natural resources

- Search and development of signaling modulators from natural resources
- Improvement of antagonistic microorganism to enhance the productivity of biological control agents
- Search and development of biopesticides from microbial metabolites

Construction of mass utilization system of value created microbial resources for industrial applications

- Investigation of the production of useful microbial enzymes, antimicrobial activities and Plant growth-promoting activities, etc
- Production of microbial broths, extracts, and proteomes
- Generation of LC/MS profiles for microbial metabolomes
- Construction of DB for the information of microbial characterization and products

ACHIEVEMENTS

Protein degrading enzyme, Arazyme

- From the gut-bacteria pool of Korean blackwidow spider, salt tolerant and cold tolerant enzyme, Arazyme was developed. Core technology with the protein producing strain were transferred to bio-special company and resulted in various industrial materials, biocosmetics and feed enzymes.

NSP(non starch polysaccharides) degrading enzymes

- Although wooden part (including cellulose, hemicellulose and lignin) is known to major biomass on earth, its usage is limited because of its recalcitrance. As a biocatalyst to cut and degrade the NSP, our team developed xylanase system and its related products to get share in feed market.

Discovery of signaling modulators using the wild-type and a calcineurin mutant of *Cryptococcus neoformans*

- Using specific signal mutants of *C. neoformans* for Hog1 MAPK and calcineurin, a screening system for signaling modulators was established targeting the two-component system of *C. neoformans*, based on the counter-regulatory action of these pathways. Three compounds from plant extracts were isolated and their structures and biological activities were determined.

Development of functional materials from soy leaf extracts for prevention and treatment of obesity and diabetes, and Investigation of their molecular mechanism

- Extracts of soy (*Glycine max* (L.) Merr.) leaves (ESL) are enriched in flavone glycosides and pterocarpans. ESL exhibits anti-obesity effects via inhibition of lipid accumulation and stimulation of fat oxidation, and ESL also enhances insulin sensitivity and pancreatic β -cell proliferation in disease mouse models. We first demonstrated the anti-obesity and anti-diabetic effects of ESL in clinical study with overweight and prediabetes individuals. ESL has potential as a safe and effective supplement against obesity and type 2 diabetes.

Technology transfer of *Aspergillus niger* F22 and its applications for biological control of *Meloidogyne incognita*

- Plant-parasitic nematode infections is a major problem in crop production. In the course of screening of nematode biological control agent, we isolated a fungal strain, *A. niger* F22, exhibiting strong nematocidal activity on *M. incognita* and devised a suitable formulation for the industrial application and handling of the bio-agent with increased efficacy.

SELECTED PUBLICATIONS

Genetic and functional characterization of an extracellular modular GH6 endo- β -1,4-glucanase from an earthworm symbiont, *Cellulosimicrobium funkei* HY-13.

Antonie Van Leeuwenhoek. 109(1):1-12.

Ho Yong Park and Kwang-Hee Son (Co-corresponding)

Inhibition of the calcineurin pathway by two flavonoids isolated from *Milvusa sinensis* Finet & Gagnep.

J Microbial Biotechnol. 26(10):1696-700.

Sung Uk Kim (Corresponding)



Cell Factory Research Center

The world market is embracing ecofriend, healthcare, and sustainability, in its truest sense. Slowly but surely, bioproducts with a sustainable life cycle, are being preferred. Hence, this center identifies and develops cell-factory system which could produce bioresources for host of industries including energy, environment, nutraceuticals, pharmaceuticals and cosmetics. We currently focus on the production these products from yeast and microalgae using process, genetic and ecological engineering. Our endeavour is to research on these organisms and associated processes, and develop novel and high-efficient technologies/products from these resources.

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RESEARCHERS

Hee-Sik Kim hkim@kribb.re.kr

- Algal biology, metabolism and ecology
- Research on microalgal biofuels and other bioproducts
- Algal-bacterial interactions and their impending applications

Hee-Mock Oh heemock@kribb.re.kr

- Ecophysiological, genomic research of microalgae and cyanobacteria for cyanobacterial bloom control and algal biofuel production

Jung-Hoon Sohn sohn4090@kribb.re.kr

- Yeast secretory production of recombinant proteins
- Yeast-based platform technology for bioenergy and biochemicals
- Lipase engineering for eco-friendly production of biodiesel

Jae-Wha Kim wjkim@kribb.re.kr

- Establishment of external factors that are involved in bio regulation and immunity activation related to disease and securing candidate materials

Chi-Yong Ahn cyahn@kribb.re.kr

- Ecophysiology of microalgae and cyanobacteria (control of algal bloom)
- Optimization of mass cultivation of microalgae using wastewater

Bong Hyun Sung bhsung@kribb.re.kr

- Microbial genome engineering, enzyme engineering, and artificial photosynthesis

Jung-Hoon Bae hoon@kribb.re.kr

- Yeast metabolic engineering
- Recombinant protein production

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- Microbial taxonomy and genetic engineering of microalgae
- Omics studies for phylogenetic identification and adaptive evolution of microalgae and bacteria

RESEARCH AREAS

Development of functional-oil-producing microalgal cell factory

- Testing both genetic and ecological engineering for strain improvement
- Omics studies on metabolism, signaling and regulation
- Development of high-efficiency production system based on exploring novel engineered systems for cultivation and harvesting of microalgae

Microalgae biofuel/biomaterial research

- Economic and efficient production of biodiesel and high-value materials from microalgae, based on physiological, genetic, and omics research.
- Screening of novel pharmaceutical, cosmetic and nutraceutical compounds from microalgae

Algal bloom research

Ecophysiological and metagenomic study on the mechanisms of algal bloom in freshwater (green tide) and seawater (red tide): advanced monitoring of bloom and production of algal toxins, mal-odor compounds, and their interaction with aquatic microorganisms.

Yeast cell and protein factory

- Novel expression systems with yeast and bacteria to produce pharmaceutical proteins, antimicrobial peptides and industrial enzymes
- Microbial cell engineering and synthetic biology for sustainable biochemicals including biopolymers and bioplastics

Discovery and engineering of enzymes for industrial biocatalyst

- Lipase engineering for eco-friendly production of biodiesel
- Carbohydrate-related enzymes for high-value polysaccharides
- Enzyme engineering for artificial photosynthesis

ACHIEVEMENTS

Increased lipid productivity in microalgae for industrial application.

- Three- pronged strategy for achieving high lipid productivity with enhanced growth.
- Collection of strains from Korean wilderness with high lipid productivity
- Ecosystem engineering of algal production systems using beneficial bacteria
- Genetic engineering of algal metabolic and signaling pathways

Construction of omics information and genetic network

The whole genomes of two novel microalgae have been sequenced. Genomic information will provide valuable clues to drive commercialization of microalgae for the maximum production of lipid and carotenoids through genetic modification.

Mechanism of algal bloom and its control

Genetic diversity of microalgae and their interactions with other microorganisms are being studied, using metagenomic and ecoinformatics tools, to understand detailed biological mechanisms of bloom formation. Environment-friendly methods are being developed to control algal bloom, based on ecological principles.

Construction of a yeast protein factory for the efficient production of recombinant proteins for therapeutics and bio-based industry

Genome-wide screening of the TFP library and efficient secretion of difficult-to-express proteins and enzymes.

Development of bio-refinery processes

Enzymatic production of biodiesel and consolidated bioprocessing for bio-based chemical production from various feedstocks

SELECTED PUBLICATIONS

Improved mixing efficiency and biomass productivity of *Ettlia* sp. in co-cultivation system with loaches.

Algal Res. 17(7):300-7.
Hee-Mock Oh (Corresponding)

A novel fusion partner for enhanced secretion of recombinant proteins in *Saccharomyces cerevisiae*.

Appl Microbiol Biotechnol. 100(24):10453-61.
Jung-Hoon Sohn (Corresponding)

Two-phase photoperiodic cultivation of algal-bacterial consortia for high biomass production and efficient nutrient removal from municipal wastewater.

Bioresour Technol. 200:867-75.
Chi-Yong Ahn (Corresponding)

Influence of limiting factors on biomass and lipid productivities of axenic *Chlorella vulgaris* in photobioreactor under chemostat cultivation.

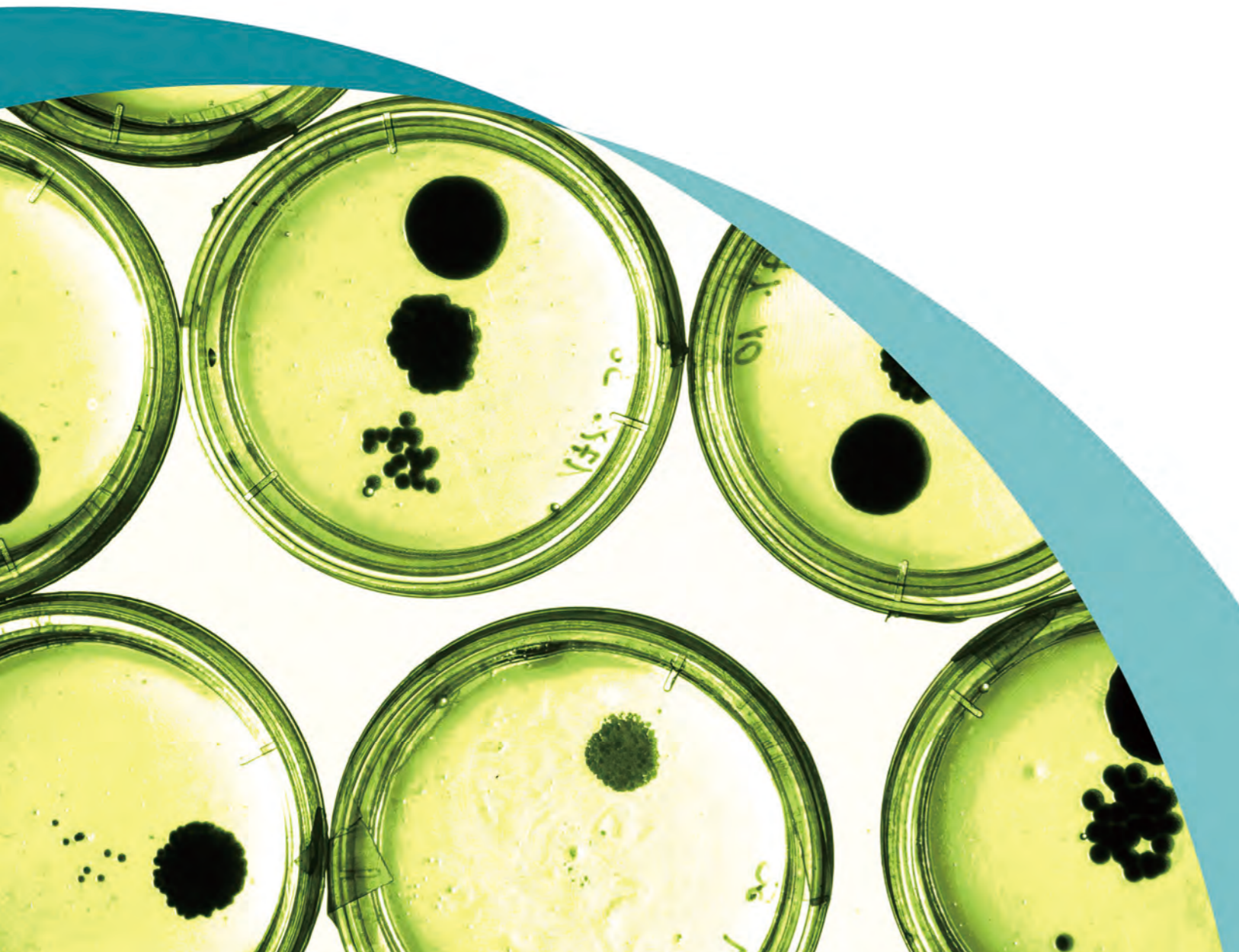
Bioresour Technol. 211:367-73.
Hee-Sik Kim (Corresponding)

Algae-bacteria interactions: evolution, ecology and emerging applications.

Biotechnol Adv. 34(1):14-29.
Hee-Sik Kim (Corresponding)

PLAG (1-palmitoyl-2-linoleoyl-3-acetyl-rac-glycerol) augments the therapeutic effect of pegfilgrastim on gemcitabine-induced neutropenia.

Cancer Lett. 377(1):25-31.
Jae-Wha Kim (Co-corresponding)



Synthetic Biology and Bioengineering Research Center

Synthetic Biology and Bioengineering Research Center (SBBRC) is to develop and advance novel biological systems and make them into a practical and useful engineering discipline. The key is the development of diagnosis/sensing devices using synthetic bio-parts, designed genetic circuits, and CRISPR/dCas9 technology. The range of potential applications is encompassing but not limited to: diagnostics, therapeutics, sensors, biofuel/chemical production.

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RESEARCHERS

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Doo-Byoung Oh dhoh@kribb.re.kr
- Protein therapeutics, Glycan analysis and remodeling

Sang Jick Kim sjick@kribb.re.kr
- Phage-antibody library building, Production of protein medicine

Dae-Hee Lee dhlee@kribb.re.kr
- Synthetic Biology, Metabolic engineering, Genome evolution and application

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- Systems biology, Genetic circuit design

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- Protein/enzyme engineering, Synthetic Biology

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- Bioimaging, Biosensors and Biochips

RESEARCH AREAS

Synthetic biology
- Development of synthetic genetic circuits for high-throughput screening and evolution of enzymes
- Development of microbial cell factories through CRISPR interference-based intelligent control of cellular networks

Systems biology
- In silico modeling and simulation of biological networks

Bioengineering
- Design and synthesis of customized proteins
- Synthetic biology-based production of high-value natural compounds

ACHIEVEMENTS

Development of platform technologies of intelligent genetic circuits
- Intelligent genetic circuit-based high-throughput screening of enzymes and microbes
- Characterization of biosynthetic pathways of novel enzymes to produce natural compounds

Development of intelligent metabolic control devices
- CRISPR interference-based metabolic control of microbial cells to produce natural compounds

Development of novel antibiotics-free protein expression system
- Development of antibiotics-free protein expression system for long-term stable and tightly controlled production

SELECTED PUBLICATIONS

A cell-cell communication-based screening system for novel microbes with target enzyme activities.
ACS Synth Biol. 5(11):1231-8.
Haseong Kim(First), Seung-Goo Lee (Corresponding)

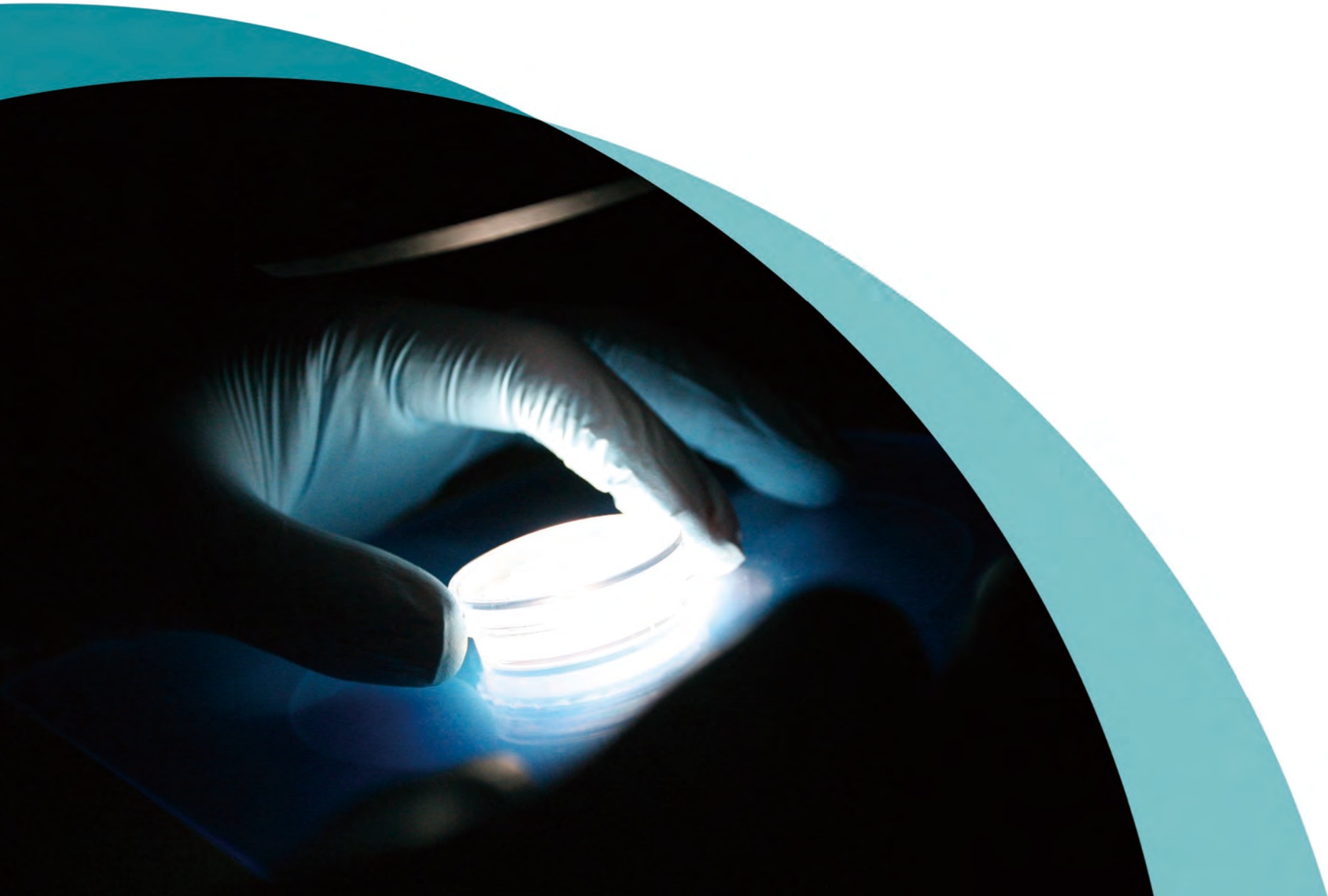
CRISPR interference-guided balancing of a biosynthetic mevalonate pathway increases terpenoid production.
Metab Eng. 38:228-40.
Seung-Goo Lee and Dae-Hee Lee (Co-corresponding)

Minicircle microporation-based non-viral gene delivery improved the targeting of mesenchymal stem cells to an injury site.
Biomaterials. 101:310-20.
Doo-Byoung Oh (Co-corresponding)

Encoded hydrogel microparticles for sensitive and multiplex microRNA detection directly from raw cell lysates.
Anal Chem. 88(6):3075-81.
Hyewon Lee (First)

Long-term stable and tightly controlled expression of recombinant proteins in antibiotics-free conditions.
PLoS One. 11(12):e0166890.
Soo-Jin Yeom(First), Seung-Goo Lee (Corresponding)

Fermentative production and direct extraction of (-)- α -bisabolol in metabolically engineered *Escherichia coli*.
Microb Cell Fact. 15:185.
Dae-Hee Lee and Seung-Goo Lee(Co-corresponding)



Division of Business Development

- Technology Transfer Center
- SME Support Center
- Biotechnology Process Engineering Center

Korea Research Institute of Bioscience and Biotechnology(KRIBB) has made efforts to realize a creative economy as one of new growth strategies by creating a new industry and market which combine creative idea, imagination and science & technology and by strengthening existing industries and to fully support R&BD for small-to-medium enterprises (SMEs) and technology projects.

Technology Transfer Center

Bridging the Gap between Bioscience Innovation and Industrial Applications. Business development, based on scientific findings of KRIBB, has been established by our Technology Transfer office (TLO), whose role is also involved in intellectual property (IP) management.

The ideas from KRIBB research teams that have potential to become know-hows or patents are reviewed and examined by our in-house technology evaluation committee run by TLO. Those selected IPs are in turn accessed to industry for creating new bio enterprises or licensed by global or domestic bio companies.

KRIBB TLO also has role in establishing joint ventures with partner companies that provided with highly valued technology from KRIBB.

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MAIN FUNCTIONS

Intellectual Property Management : Building a strong patent portfolio

- Consulting of intellectual property filling / office action / maintenance
- Screening of excellent idea / know-how / technology
- Scientific affairs to internal and / or external collaboration

Technology Transfer

- Technology valuation / marketing / negotiation for transfer
- Technology licensing-out

Business Incubation

- Joint ventures (Institute Enterprise)
- Arranging fund investment for spin-off KRIBB companies

ACHIEVEMENTS

Creating/Securing Superior Technology

- Number of patent Applications and Registrations from 2012 to 2016

Year	Application	Registration
2012	369	202
2013	301	166
2014	372	250
2015	310	244
2016	282	275

- Number of Registered Patents (accumulated, 2012~2016)

Year	Domestic	Overseas	Total
2016	1,017	463	1,480

Technology Transfer Commercialization

- 315 intellectual properties are transfers to industry until 2016
 - ▷ Established an in-house venture, 'Mico Biomed' in June 2009 as a joint venture between KRIBB and Komico Inc.
 - ▷ Established an industry-academia partnership company, 'Inji Bio' in September 2012 as a joint venture between KRIBB, GIST, and Infoplia Inc.
 - ▷ Established an in-house venture, 'Nano Biotech' in November 2015 as a joint venture between KRIBB and Natural F&P Inc. and Next BT Inc.
 - ▷ Established an in-house venture, 'DK Bio' in May 2016 as a joint venture between KRIBB and DAMY Chemical Inc.

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SME Support Center

The Biotech Startups and small-to-medium enterprises (SMEs) compete fairly with large companies, make inroads into global market, and are at the forefront of efforts to drive the nation's economic growth and high-quality job creation. However, Biotech SMEs have to overcome various barriers at every stage of growth.

The primary goals of SME Support Center (Small and Medium Enterprise Support Center) are to establish Biotech Business Ecosystems for mutual growth of participating large and small-to-medium sized biotech enterprises, to support Biotech SMEs to consolidate their technological and developmental competence, and to incubate Biotech Startups. To achieve these goals, SME Support Center develops and implements various strategies, programs, and networks, based on manpower, infrastructure, and funds of KRIBB.

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MAIN FUNCTIONS

Establishment of Biotech Business Ecosystems

- Building a Biotech Business Ecosystems focusing on Eco-friendly biomaterials, Bio-medicine, and Bio-convergence
- Exchange of technology and business information, generation of common agendas, and development of B2B business models among participants
- Building a KRIBB Bio-Mentoring System with technical mentor group (60 Ph.D.), investment mentor group (27 VC investment specialists) and Business growth mentor group (25 business management specialists)

Operation of Growth Stage Specific Support Programs

- (to foster 50 global future leader biotech companies)
- 5 Global hidden champion with annual sales of 50B KRW
- 15 Pre-global hidden champion with annual sales of 10B KRW
- 30 Techn-Biz companies with annual sales of 2B KRW

Operation of demands-based support programs for Biotech SMEs

- Demands-Based KRIBB-Biotech Cooperative R&BD Program to accelerate technology commercialization by Biotech SMEs
- KRIBB Research Center - Biotech SME Partnership Program to strengthen technology competitiveness of Biotech SMEs
- KRIBB Biotechnology Mentoring Program to provide solution for technology difficulties of Biotech SMEs

Acceleration of Biotech Startups

- Customized Researcher Startup Support Program including entrepreneurship education, business plan preparation, inauguration, and business incubation
- Operation of Bio-Venture Center to accelerate inauguration of Biotech Startups and their success (designated space and Startup Incubation Programs for Technology Business Incubator, Technology Innovation Center, and KRIBB Cooperation Company)

ACHIEVEMENTS

Operation of Biotech business ecosystems

- Eco-friendly biomaterials in Jeollabuk-do, Bio-medicine in Chungcheongbuk-do, and Bio-convergence in Daejeon with 220 Biotech SMEs
- Generation of common agendas and development of B2B business models
- Operation of KRIBB Bio-Mentoring System (Technology innovation and problem solving [25 case] / Investment attraction and financing [24 case] / Business management [6 case])

Operation of Growth Stage Specific Support Programs

- Global Hidden Champion program (2 projects)
- Pre-global hidden champion program (4 projects)
- Techn-Biz program (10 projects)

Operation of demands-based support programs for Biotech SMEs

- Demands-Based KRIBB-Biotech Cooperative R&BD Program (13 projects)
- KRIBB Research Center-Biotech SME Partnership Program (73 companies with 24 KRIBB research centers / 19 technology problem solving projects)

Acceleration of Biotech Startups

- Bio-Venture Center (3-story building with total 2,970 m² and 35 business incubation units)
- 58 Biotech Startups graduated since 2000 (9 listed on the KOSDAQ)
- 18 Biotech Startups in Bio-Venture Center achieved total annual sales of 20.1B KRW in 2016

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Biotechnology Process Engineering Center

Main activity of center is to develop an industrial platform technology for biological products. In particular, we intensively carry out a process scale-up towards the optimization and commercialization for the production of biomaterials and biopharmaceuticals using pilot-plant facilities in order to expand research outcomes and to stimulate commercialization. Additionally, we systematically support the business activities of the bioindustry and cultivate human resources through academic-industrial collaborations.

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RESEARCH AREAS

Microbial fermentation and scale-up research for biomaterials production

- Development of novel expression system for biomaterials.
- Development of industrial strain for biomaterials.
- Process development and scale-up research for biomaterials.

Mammalian cell culture for biopharmaceuticals production

- Development of stable cell line producing biopharmaceuticals.
- High-cell density culture for mammalian cells.
- Process design for quality control.

Separation and purification technology

- Optimization of chromatography and membrane processes.
- Protein/Organic acid purification.
- Scale-up in separation and purification process.

ACHIEVEMENTS

Development of a novel Pichia expression system

Two strong methanol-free promoters in *P. pastoris* : translation elongation factor 1a promoter (PTEF1) with high growth-associated expression characteristics and phosphateresponsive promoter (PPH089) of a sodium phosphate symporter were developed. Also, a cost-effective and simple PTEF1- and PPH089-based fermentation process was developed for industrial applications. Furthermore, we established an easy-to-use multicopy system in *P. pastoris* using autonomous replication sequences (ARS) and an episomal plasmid to maintain multiple genes of interest in *P. pastoris* and enhance heterologous expression compared with a single copy integration in *P. pastoris*.

Development of biological process for the production of caprolactam

Caprolactam is a valuable organic compound which is widely used as a precursor to Nylon-6. The present commercial methods of preparing caprolactam is based on the chemical reaction consisting of catalytic oxidation and conversion (Beckmann rearrangement) using sulfuric acid as a catalyst. However, this method presents environmental and safety concerns because it requires petroleum-based fuel and toxic catalysts. So, we are currently developing the transformed microorganism producing 6-amino caproic acid which was used as a precursor to caprolactam by introducing 6-amino caproic acid biosynthetic pathway-related genes.

Development of microbial fermentation process for isoprene from renewable sources

Isoprene is a commodity chemical widely used in rubber industry. Microbial isoprene production was recently attempted by using recombinant *E. coli* containing codon-optimized ispS originated from *P. trichocarpa*. Despite the successful development of a microbial strain producing isoprene, it is difficult to measure isoprene level during processing due to its high volatility, and therefore, optimization is difficult to achieve. In this study, on-line monitoring system of isoprene process was developed by using on-line gas chromatography. Thereafter, various culture conditions were investigated to enhance the isoprene production in fermentation process. Taken together, we successfully adapt gas chromatography system to fermentation to measure isoprene level on-line, and overall 31.8 g/L of isoprene titer was achieved.

Development of recombinant vaccines for Haemophilus parasuis

Haemophilus parasuis causes contagious porcine Glässer's disease leading to severe losses in the swine industry. We established an integrated system for the expression of novel subunit antigen candidates for protection against *H. parasuis* infection from the annotated genome by reverse vaccinology strategy. Use of an *E. coli* -derived pelB leader sequence made it possible to produce subunit antigen candidates as the soluble forms without an additional refolding process. Additionally, the effects of subunit antigen candidates on immunological response and the ability to provide protective immunity were evaluated in a guinea pig and mouse model, respectively.

New cell line development for antibody-producing CHO cells

Chinese hamster ovary (CHO) cells are one of the most widely used host cells for therapeutic protein production. For large number of analytes from clonal variation, it is necessary to develop an efficient high-throughput cell screening system. Currently, we developed an efficient screening method based on reconstitution of split GFP to select high antibodyproducing CHO cells using a FACS analysis. On the basis of correlation between antibody production and fluorescence intensity by reconstituting GFP, the fragment complementation system for split GFP could be a powerful tool for antibody production in CHO cells.

Process development of mammalian cells for biopharmaceuticals production

Mammalian cell culture has become the dominant system for biopharmaceuticals production including therapeutic proteins and live virus vaccines. We are currently developing a cell line adapted in serum-free suspension culture, the serum-free medium with hydrolysates, and the feeding strategies for fed-batch culture in a number of mammalian cell lines such as CHO cells, baby hamster kidney (BHK) cells, and human embryonic kidney (HEK)-293 cells. Furthermore, we have developed chromatographic purification technologies and highthroughput precision analysis based on design of experiment (DOE) analysis.

SELECTED PUBLICATIONS

Genome-scale metabolic modeling and *in silico* analysis of lipid accumulating yeast *Candida tropicalis* for dicarboxylic acid production.

Biotechnol Bioeng. 113(9):1993-2004.
Jung-Oh Ahn (Co-corresponding)

A novel regulatory element (E77) isolated from CHO-K1 genomic DNA enhances stable gene expression in Chinese hamster ovary cells.

Biotechnol J. 11(5):633-41.
Eun-Gyo Lee (Corresponding)

Isoprene production by *Escherichia coli* through the exogenous mevalonate pathway with reduced formation of fermentation byproducts.

Microb Cell Fact. 15(1):214.
Eui-Sung Choi (Co-corresponding)

Protective efficacy of *Streptococcus iniae* derived enolase against *Streptococcal* infection in a zebrafish model.

Vet Immunol Immunopathol. 170:25-9.
Jung-Oh Ahn (Co-corresponding)



Division of KRIBB Strategic Projects

- Korea Biosafety Clearing House
- Biotech Policy Research Center
- Korean Bioinformation Center
- National Research Safety Headquarter
- Stem Cell Research Center

Division of KRIBB Strategy Projects, responsible for national agenda programs, conducts important researches at the national level, which include researches on viral infectious disease and stem cell. The Division also extends policy support for biotechnology by providing biosafety information and undertaking biotechnology policy research.

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Korea Biosafety Clearing House

The Korea Biosafety Clearing House (KBCH) is dedicated to promoting public awareness and exchange of information, and undertaking survey and research, international cooperation on issues regarding Living Modified Organisms (LMOs), while implementing the legal duties on LMO related information as per the “Cartagena Protocol on Biosafety” and the “Act on Transboundary Movements, etc. of LMOs”.

The KBCH is also functioning as a Korean national focal point of the Biosafety Clearing-House installed under the “Cartagena Protocol on Biosafety” and now expanding its overseas activities especially to promote subregional cooperation on biosafety.

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- Establishment of KBCH strategies and monitoring of Living Modified Organisms, Biosafety and related topics

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- Collection of information regarding LMOs related industry especially focusing on White(or Industrial) biotechnology, Publishing “Trends in White Biotech”

RESEARCH AREAS

Implementation of the Biosafety Protocol & LMO Act

- Performance of information-related duties such as collection and dissemination
- Implementation of administrative matters (preparation of Country Reports, analysis of major issues in COP-MOP, management of Expert Forum for discussion of major issues, etc)
- Supporting developing countries' capacity-building efforts
- Implementation of the LMO Act (operation of Biosafety Committee, support for implementation of LMO Act to attain purpose and achieve further improvements)
- Industrial LMO safety management (operation of Industrial LMO Risk Assessment Committee, as consigned by The Ministry of Trade, Industry & Energy according to the government guideline).

Improvement of Public Awareness & Communication

- Management of Biosafety Portal and family sites
- Publications such as the 'Biosafety Whitepaper'(biennial), 'Biosafety' Journal(semiannual), etc
- Hosting of communication activities (LMO forums, international seminars, debate competitions, KBCH reporters, etc)

Survey & Research

- Survey of public perceptions
- Establishment of database for holding LMOs and BIO related statistics
- LMOs and bioindustry trend analysis
- Analysis of the industrial impact of the ABS Protocol

ACHIEVEMENTS

Compliance with the LMO Act and the Biosafety Protocol

Although its actual work in the management of LMO information and issues was launched a decade or more years back ago, KBCH as a role player of an official organization began to work in January 2008 when the LMO law and the Biosafety Protocol took effective in Korea. KBCH's primary mission is to undertake duties mandated by the LMO Act and the Biosafety Protocol, which involve information management regarding transfer, handling and use of LMOs.

Its mission involves the collection and distribution of accurate information on LMOs, the promotion of public awareness on LMOs, and participation in various related activities.

At the COP-MOP8 held-in Dec. 2016 in Cancun Mexico, Dr. Jang, the director of KBCH, pointed out the importance of regional collaboration among BCH focal points in an effort to achieve the higher level of compliance with the Biosafety Protocol in their countries.

He really suggested that such regional collaborative efforts should be put into relevant decisions; the operation and activities of BCH, Public Awareness and Participation, Capacity Building, and he also stressed the urgent need to increase the financial support for them.

All those suggestions were successfully reflected in the final decision papers.

Promotion of Public Awareness and Participation

To promote awareness and participation, especially with the public, KBCH does its best playing an indispensable role in order to ensure biosafety, as stipulated in the Protocol. Above all, KBCH conveys both positive and negative aspects of LMOs to the public, helping public discussion concerning LMOs to be made based on facts.

To this end, it operates the Korean “Biosafety Portal”, participates in discussions on high-profile Internet sites, and distributes printed materials published by the KBCH, such as semiannual “Biosafety”, a biennial “White Paper on Biosafety”, and various booklets and pamphlets. Its other activities include opening seminars(LMO forum, etc.), which anyone can attend to share their opinions, and holding “Biosafety Debate Competition” for high school students, which attracts hundreds of applicants nationwide every year.

Implementation of the Korea Biosafety capacity-building Initiative

At COP-MOP7 in 2014, Korea had proposed the Korea Biosafety Capacity Building Initiative with a view to contribute to helping capacity building with developing country Parties and the Parties with economies in transition.

Two main programs are taken to be implemented by KBCH, under the Initiative. One area is about assisting Parties in Asia to build capacities for their national BCH operation to their full compliance with the Protocol.

For this purpose, KBCH held an Asia Regional BCH Workshop in partnership with UNEP in Nanjing China in 2015 in which participants developed a roadmap to 2020, a milestone of Asian countries' step by step efforts for their faithful adherence to the Protocol with a sense of community of so called Asia BCH Family(ABF).

In 2016, KBCH led the follow-up process by hosting several ICC(Informal Consultative Committee) meetings. Based on such preparatory activities, KBCH could successfully open a special side event to the COP-MOP8 in Cancun Mexico to introduce all about the ABF.

With regard to the other area, LMO safety management, KBCH had a collaborative seminar on Biosafety with the Government of Malaysia.



Biotech Policy Research Center

Nominated and established by the Ministry of Science and Technology in 2004, the Biotech Policy Research Center is a non-profit organization devoted to research and development of biotech policy and policy alternatives.

Our mission is mainly threefold

- ① To provide government officers with accurate, relevant, and timely information on biotech trend.
- ② As a think tank, to develop biotech R&D strategy to help government officers.
- ③ To build network with opinion leaders as a idea platform.

We also runs a portal site(BIOIN, www.bioin.or.kr) to enhance the public understanding of biotechnology and biotechnology policies.

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- BT Policy Planning & tech trends Research
- BT R&D Project Planning
- Korea BT White Book project

RESEARCH AREAS

Policy Planning

To plan comprehensive national policy and strategies to foster the research and development of biotechnology.

Policy Research

To investigate technology, industry, and institutional policy information and to conduct relevant statistics, patent maps, and bibliometric analysis.

Information(Issue) Gathering/Disseminating

To provide systematic information regarding biotechnology and biotechnology policy at large through portal sites (www.bioin.or.kr).

Public Relations

To publish biotechnology white papers and to organize public workshops to enhance public understanding of biotechnology.

ACHIEVEMENTS

Policy Planning

- Planning for the third Bio-Vision.
- Planning for reaching the second stage of the development goal set in Bio-Vision 2016.
- Annual Action plans for Bio-Vision 2016, Stem cell Comprehensive Plan and Bio resources Basic Plan.
- Planning of large-scale projects for Survey and analysis of national R&D programs.
- Analysis on Portfolio and positioning of National R&D project.
- Planning of National New drug Development Center, etc.

Bibliometric Analysis and Statistical Development

- Patent maps and article analysis systems are devised to assist the government in planning national R&D project strategies and to set the direction for biotechnology research projects.
- The center has published annual reports on domestic and overseas statistical data on biotechnologies categorized by investment, human resources, industry, and technology.

Policy Website

- A one-stop website was created with regard to BT policies, assisting policy makers understand detailed data on domestic and overseas BT policies.
- The site currently has 100,000 pieces of informational data.

Expert Network

- To operate the Korean Association of Biotechnology Research.
- To operate the BT forum, BT expert discussion and BT Seminar.

International Collaboration

- To participate in the annual Session of the OECD Working Party on Biotechnology, Nanotechnology and Converging technology(BNCT).



Korean Bioinformation Center

The Korean Bioinformation Center (KOBIC) is the national center for bioinformatics and bioresource information, designated by the Act on the Acquisition, Management, and Utilization of Biological Resources.

In the field of bioinformatics, we provide omics-data portal system, omics data registration system (KBRS; Korean Biodata Registration System), large-scale and cloud computing based bio big data analysis system (CLOSHA), and specialized databases and tools. We also provide data analysis service and bioinformatics education program to researchers in the nation.

In the field of bioresource information, we provide Korean Bioresource Information System (KOBIS), which integrates nationwide bio-resource and biodiversity information across institutions and ministries to facilitate sharing and utilization of the data.

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RESEARCH AREAS

Bioresource Information Team

- Construction and management of Korean Bioresource Information System (KOBIS)
- Nationwide data integration across institutions and ministries
- Strategic planning of national bioresource and biodiversity information management

System Development Team

- Development of large-scale bioinformatics databases, algorithms, tools, and systems
- Development of cloud-based bioinformatics analysis platform
- Development of omics data registration system

Bioinformatics Team

- Omics data analysis service
- Bioinformatics education service
- Development of omics portal service system
- Development of specialized bioinformatics databases, tools, and pipelines

Computer Infrastructure Team

- Development of computing infrastructure for big data
- Support for bioinformatics tool development
- Management of servers, clusters, networks, and storage systems

ACHIEVEMENTS

As the National Biological Research Resource Information Center, we developed Korean Bioresource Information System (KOBIS), which integrates nationwide bioresource and biodiversity information across institutions and ministries. To fulfill the role as the national bioresource hub to expand the impact of data sharing and utilization, we have been continuously improving data quantity and content of KOBIS since constructed in 2008.

Genomic research continuously produces incredible amounts of data that often more than individual research lab can feasibly interrogate. Therefore, infrastructure to allow bio-big data analysis and the sharing of these data provide significant opportunities to maximize the scientific potential of valuable data. As the national bioinformatics center, KOBIC has developed and host omics data registration system (KBRS), an omics data repository of research outcome from research supported by national R&D funds. KOBIC has been developing specialized databases and bioinformatics tools as well, and currently developing web-based cloud computing interface to facilitate comprehensive omics data analysis environment. KOBIC also provides education and training in bioinformatics, and offer data analysis support for researchers in need of expert analysis. Over last decade, KOBIC collaborated with research community and pioneered in developing public resources for data-sharing, database, analysis pipeline, and research, as evident in many published work, including the first Korean genome sequence in 2009. All the aforementioned activities were made possible by our ever-increasing computing infrastructure, the largest among the bioinformatics research centers in the nation, and dedicated scientists from diverse scientific disciplines including computer science, biology, chemistry, physics, and statistics.

SELECTED PUBLICATIONS

NMRre: a web server for NMR protein structure refinement with high-quality structure validation scores.

Bioinformatics. 32(4):611-3.
Jinhyuk Lee (Corresponding)

Systematic approach identifies RHOA as a potential biomarker therapeutic target for Asian gastric cancer.

Oncotarget. 7(49):81435-51.
Jinhyuk Lee (Co-first)



National Research Safety Headquarter

National Research Safety Headquarters implements project to establish a safe laboratory environment under the Act on the Establishment of Safe Laboratory Environment and project to evaluate and manage biosafety under the Transboundary Movement, Etc. of Living Modified Organism Act. It also contributes to the prevention of safety accidents and improvement of research productivity in a lab by establishing a professional and systematic safety management system in national science and technology research laboratories.

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RESEARCH AREAS

On-site coaching and check

- On-site coaching and status check of research labs and LMO research facilities
- Survey on the current status of general research facilities, organization and operation of investigation team
- Evaluation on safety management of research labs and LMO research facilities and selection of good performing facilities
- Safe management of LMO export, import, production and distribution

Project and policy

- Support for policy development and revision of acts and institutions related to safety management
- Support for improvement of environment and running good lab certification project
- Support for the response to external organizations including the government, National Assembly and regional research safety centers
- Project management, preparation and management of internal regulations

Education and academic efforts

- Development of program for safety training and exploration of contents
- Development of on/offline education materials for research labs and LMO facilities
- Development and management of tasks commissioned by research labs or LMO facilities
- Survey and information collection related to domestic and overseas latest studies and trend on safety management

Culture and information

- Running national research safety management system and LMO information system
- Holding events including Safety Day for Research Labs, LMO safety management workshop and public contest
- Planning and publication of promotional materials

ACHIEVEMENTS

- Establishment of certification for good performing research labs in terms of safety management and regulation on the operation of good performing research labs in terms of safety management (July, 2015)
- Making all safety related works go online in the national research safety information system (Feb. 2016)
- Establishment of an integrated DB for on/offline data in the information system for test and research purpose (Feb. 2016)
- Making all safety related works go online in the national research safety information system (Feb. 2016) (Reporting of accidents, designation and change of managers in charge of safety environment, reporting of the current status of holding insurances, plans to use expenses related to safety and maintenance of research labs, etc.)
- Survey on the current status of safety management in research labs (3,486 organizations) and LMO (106 organizations) (Apr. 2016)
- Distribution of Laboratory Safety Act (Apr. 2016) and "Getting to know more about the Laboratory Safety Act" (Nov. 2016)
- Publication of "Laboratory Bitgul" that provides information on safety in a laboratory (Aug. 2016, Jan. 2017)
- Publication of Acts related to LMO for test and research purpose and handbook on LMO Acts (Sept. 2016)
- Publication of Essential rules for LMO Research for foreign researchers (Sept. 2016)
- Production of guidebook on the process of order, transportation, customs clearance, goods receipt and import (Sept. 2016)
- Production of manual on the development, approval and application for LMO (Sept. 2016)
- Development of LMO self-check manual for foreign researchers (Jan. 2017)
- Development of guideline on the operation of Institutional Biosafety Committee (Jan. 2017)
- Expansion of the number of people subject to mandatory training including researchers (new and refresh training) and managers for laboratory environment (new and refresh training) (Jan. 2017)
- Establishment of standard on the compensation for the accident in a laboratory and pursuit of legislation (administrative pre-announcement in Jan. 2017)

Stem Cell Research Center

Our research goal is understanding stem cell functions and disease mechanisms to develop novel therapeutics to treat human diseases. We focus on identification of the biological and molecular mechanism of somatic cell/stem cell fate transition and development of fate control/reprogramming core technology. We also establish 3D human disease model systems using reprogrammed cells such as patient-derived induced pluripotent stem cells (iPSCs) for developing personalized and in vivo-mimic disease models. In addition, we develop alternative methods to animal testing, called 'networking organoid culture system (NOCS)' which is consisted of different kinds of organoids such as intestine, liver, cardiac, brain, etc. We hope it increase the fidelity of in vitro testing and decrease the sacrifice of research animals.

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RESEARCHERS

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- Differentiation and transdifferentiation into neural cells
- Disease modeling and development of therapeutics
- Common mechanism of reprogramming

Cho Rok Jung crjung@kribb.re.kr

- Functional validation of disease related genes and development of therapeutics
- Development of 3 dimensional cell based disease model

Myung Jin Son mjson@kribb.re.kr

- Molecular mechanisms underlying the reprogramming process
- Metabolic and mitochondrial regulation in pluripotency control

Mi-Young Son myson@kribb.re.kr

- Disease modeling based on induced pluripotent stem cell
- Stem cell-based 3D organoids as models of human development and disease

Jung Hwa Lim jhwa@kribb.re.kr

- Functional Analysis of disease related genes
- Development and evaluation of small molecule cancer drug
- Evaluation of therapeutic gene transfer for genetic disease

Hyun Mi Kang hmkang@kribb.re.kr

- Development of disease model based on 3-dimensional cells
- Research on generation/differentiation of kidney organoids

Kyung Hee Noh trolius@kribb.re.kr

- Novel mechanism for ubiquitination enzyme
- Development of novel oral bioavailability method

RESEARCH AREAS

- Studying the biological and molecular mechanism of cell fate change between somatic cells and stem cells
- Development of core technologies in cell fate change
- Modeling human diseases based on stem cells and reprogramming technology
- Characterization of genes related to various diseases including cancer and development therapeutic interventions such as small molecules, gene therapy, regenerative cells, etc
- Development of biomimetic 3D human tissue model using organoid technology and application of organoids to disease modeling

ACHIEVEMENTS

Transdifferentiation of fibroblasts to neural progenitor cells.

We demonstrated that transient overexpression of the four Yamanaka factors (Oct4, Sox2, Klf4, and c-Myc) could be biased by specific signaling inputs toward generating functional and readily expandable neural stem/progenitor cells (NPCs) or dopaminergic neural progenitors directly from fibroblasts in a surprisingly efficient manner. Our approach fundamentally changed the Yamanaka factor-based reprogramming paradigm, and dramatically expanded its utilities into lineage-specific transdifferentiation.

Restoration of mitochondrial NAD⁺ levels delays stem cell senescence and facilitates reprogramming of aged somatic cells.

The use of cells from aged individuals as sources for reprogramming or transplantation creates a major barrier in stem cell therapy with respect to cell quality and quantity. Here, we investigated the molecular features underlying senescence and rejuvenation during aged cell reprogramming and identified novel factors that can overcome age-associated barriers. Enzymes, such as nicotinamide nucleotide transhydrogenase (NNT) and nicotinamide mononucleotide adenylyltransferase 3 (NMNAT3), that control mitochondrial NAD⁺ levels appear to be susceptible to aging. Importantly, restoring mitochondrial NAD⁺ levels by overexpressing NNT and NMNAT3 enhanced reprogramming efficiency of aged somatic cells and extended the lifespan of human mesenchymal stem cells by delaying replicative senescence.

Biomarker discovery by modeling Behcet's disease with patient-specific human induced pluripotent stem cells.

Behçet's disease (BD) is a chronic inflammatory and multisystemic autoimmune disease of unknown etiology. Due to the lack of a specific test for BD, its diagnosis is very difficult, and therapeutic options are limited. Induced pluripotent stem cell (iPSC) technology, which provides inaccessible disease-relevant cell types, opens a new era for disease treatment. Here, we generated BD iPSCs from patient somatic cells and differentiated them into hematopoietic precursor cells (BD iPSC-HPCs) as BD model cells. Based on comparative transcriptome analysis using our BD model cells, we identified 8 novel BD specific genes, AGTR2, CA9, CD44, CXCL1, HTN3, IL-2, PTGER4 and TSLP, that were differentially expressed in BD patients, compared to healthy controls or patients with other immune diseases. The use of CXCL1 as a BD biomarker was further validated at the protein level using both a BD iPSC-HPC-based assay system and BD patient serum samples. Furthermore, we show that our BD iPSC-HPC-based drug screening system is highly effective for testing CXCL1 BD biomarkers, as determined by monitoring the efficacy of existing anti-inflammatory drugs. Our results shed new light on the usefulness of patient-specific iPSC technology in the development of a benchmarking platform for disease-specific biomarkers, phenotype- or target-driven drug discovery, and patient-tailored therapies.

E2-EPF UCP regulates stability and functions of missense mutant pVHL via ubiquitin mediated proteolysis.

Missense mutation of VHL gene is frequently detected in type 2 VHL diseases and linked to a wide range of pVHL functions and stability. Certain mutant pVHLs retain ability to regulate HIFs but lose their function by instability. In this case, regulating of degradation of mutant pVHLs, can be postulated as therapeutic method. Three VHL missense mutants (V155A, L158Q, and Q164R) are directly ubiquitinated by E2-EPF UCP (UCP) in vitro. Mutant pVHLs are more unstable than wild type in cell. Missense mutant pVHLs interact with UCP directly in both in vitro and cellular systems. Lacking all of lysine residues of pVHL result in resistance to ubiquitination thereby increase its stability. Missense mutant pVHLs maintained the function of E3 ligase to ubiquitinate HIF-1 α in vitro. In cells expressing mutant pVHLs, Glut-1 and VEGF were relatively upregulated compared to their levels in cells expressing wild-type. Depletion of UCP restored missense mutant pVHLs levels and inhibited cell growth. Adenovirus-mediated shUCP RNA delivery inhibited tumor growth in ex vivo mouse xenograft model. These data suggest that targeting of UCP can be one of therapeutic method in type 2 VHL disease caused by unstable but functional missense mutant pVHL.

SELECTED PUBLICATIONS

E2-EPF UCP possesses E3 ubiquitin ligase activity via its cysteine 118 residue.

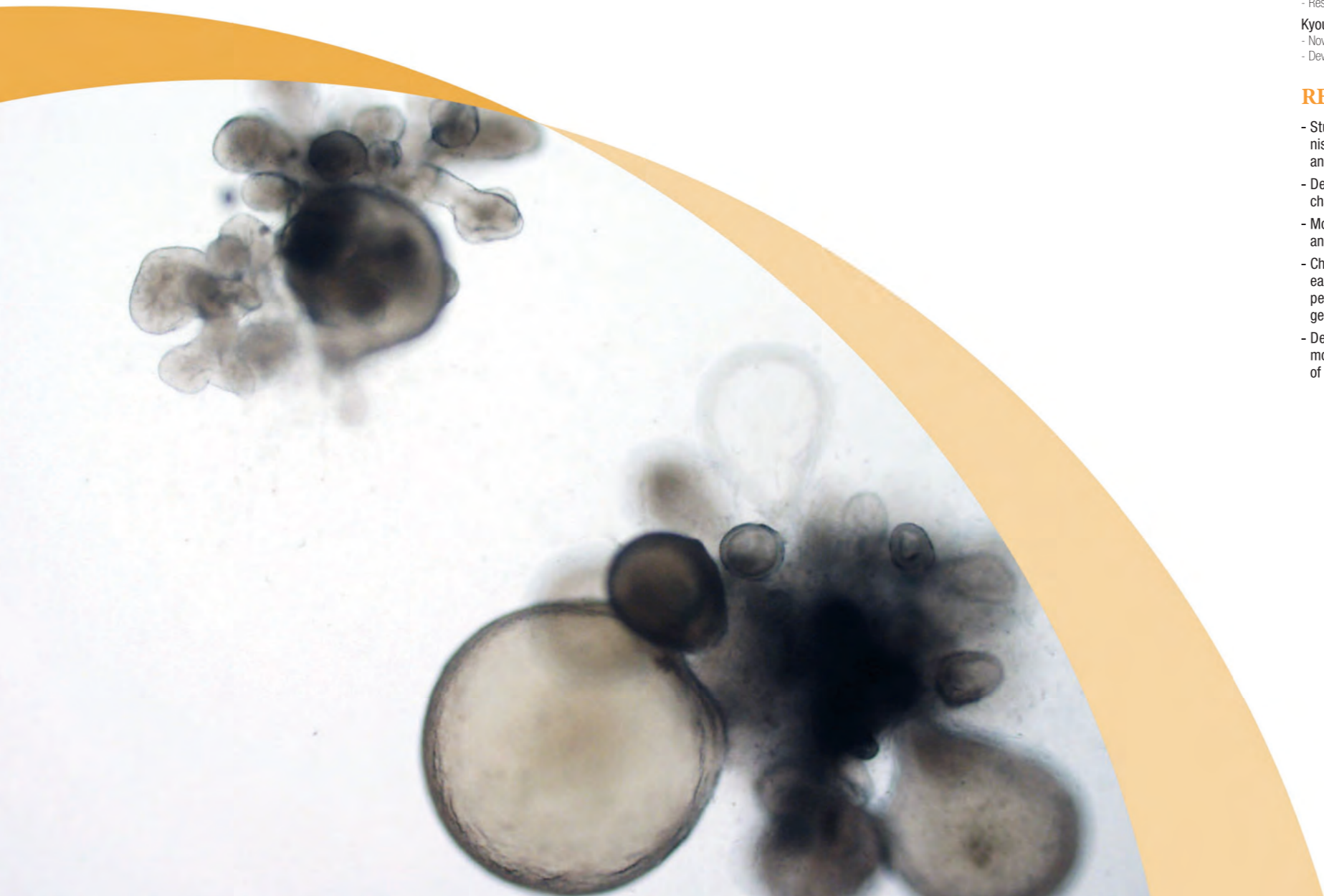
PLoS One. 11(9):e0163710.
Cho Rok Jung (Corresponding)

Plasma-treated flexible aminoclay-decorated electrospun nanofibers for neural stem cell self-renewal.

J Nanosci Nanotechnol. 16(2):1392-5.
Janghwan Kim (Co-corresponding)

Shikonin induces apoptosis of lung cancer cells via activation of FOXO3a/EGR1/SIRT1 signaling antagonized by p300.

Biochim Biophys Acta. 1863(11):2584-93.
Kyung-Sook Chung and Myung Jin Son (Co-corresponding)



Immunotherapy Convergence Research Group

Our goal is to identify the differentiating factors between adult stem cells and immune cells, and by researching their functions, develop core platform technology for immune cell therapies for targeting cancer and to develop the platform technology for anti-cancer antibody therapy and anti-cancer diagnostics.

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- Anti-tumor NK cell therapy based on NK differentiation

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- Mechanism of cancer development and metastasis
- Functional validation of novel therapeutic targets and development of molecular targeted therapy

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- Mechanism of cisplatin-resistance

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- Functional studies of target molecules in cancer cell

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- Pluripotency, Reprogramming, Differentiation, Disease Modeling

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- Molecular mechanisms of induced pluripotency
- Disease modeling using patient-derived iPSCs

Mi-Ok Lee molee@kribb.re.kr
- Differentiation of human pluripotent stem cells
- Disease modeling with hPSCs and genome editing technique

RESEARCH AREAS

NK cell therapy
- Developing platform technology for the differentiation of stem cells.
- Developing platform technology for the regulation of NK cell differentiation.
- Developing NK cell therapy for cancer treatment.
- Developing customized NK cell therapy through preclinical Study.

Antibody therapy
- Development of therapeutic target antigens.
- Development of human and humanized antibodies for cancer treatment.
- Evaluation of therapeutic antibodies.

Hematopoietic stem cell (HSC) ageing
- HSC fate decision
- HSC stress and ageing mechanism

Stem cell tech-based NK differentiation & production

Cellular reprogramming technology
- Developing platform for chemical screens to enhance reprogramming
- Developing human stem cell-based disease models to study the pathogenesis

Human pluripotent stem cells research
- Differentiation of human pluripotent stem cells into 2D/3D tissues
- Developing disease model from hPSCs by genome editing for finding therapeutics

ACHIEVEMENTS

Molecular profiling for NK cell differentiation from stem cells

NK cells develop from hematopoietic stem cells (HSCs) in the bone marrow. To understand the molecular regulation of NK cell development, serial analysis of gene expression (SAGE) was applied to HSCs, pNK, mature NK cells cultured without (-OP9) or with (+OP9) stromal cells, OP9. From 170,464 total individual tags from four SAGE libraries, 35,385 unique genes were identified. The identification of genome-wide profiles of gene expression in different stages of NK cell development affords us a fundamental basis for defining the molecular network during NK cell development.

Development of immune therapy techniques utilizing NK cells

Based on the observations in NK differentiation, immunotherapy for cancer has been designed. Platform technology for drug development of cancer immune therapy was established and has been used for the clinical trials of incurable cancer.

Molecular mechanism of HSC ageing and stress
The functions of HSCs are changed under stress and ageing. Reactive oxygen species are major players for aging and stress response of HSCs. The molecular targets for HSC stress and ageing are identified and the functions of them are investigated.

Sem cell-based NK cell differentiation
We have generated human induced pluripotent stem cells (iPSC) from peripheral blood cells and are developing the differentiation protocol for the efficient production of the functional, cytotoxic NK cells. Further optimization of our protocol will help to generate enough cytotoxic NK cells to treat different types of cancer and provides a genetically interchangeable platform to investigate causes and potential targets for cancer therapy.

A novel small molecule facilitates the reprogramming of human somatic cells into a pluripotent state and supports the maintenance of an undifferentiated state of human pluripotent stem cells

Booster of pluripotency: RSC133, a new synthetic derivative of indoleacrylic acid/indolepropionic acid, exhibits dual activity by inhibiting histone deacetylase and DNA methyltransferase. Furthermore it potentially improves the reprogramming of human somatic cells into a pluripotent state and aids the growth and maintenance of human pluripotent stem cells (hPSCs).

FD disease 3D model with hPSC
On the basis of somatic mosaicism of Fibrous dysplasia (FD), we developed isogenic paired iPS and disease relevant target cells. By developing novel 3D fibrosis models, we discovered novel molecular insight for the FD pathogenesis, which is augmented glycolysis and depended on glycolytic PFKFB4 and the activation of pro-fibrotic TGF signalling. This study also suggested novel therapeutic target to block fibrosis progression.

SELECTED PUBLICATIONS

Pro-fibrotic effects of PFKFB4-mediated glycolytic reprogramming in fibrous dysplasia.

Biomaterials. 107:61-73.
Yee Sook Cho (Corresponding)

Generation and characterization of integration-free induced pluripotent stem cells from patients with autoimmune disease.

Exp Mol Med. 48:e232.
Yee Sook Cho (Corresponding)

Thioredoxin-interacting protein regulates hematopoietic stem cell ageing and rejuvenation by inhibiting p38 kinase activity.

Nat Commun. 7:13674.
Inpyo Choi (Corresponding)

Epigenetic modification of TLR4 promotes activation of NF- κ B by regulating methyl-CpG-binding domain protein 2 and Sp1 in gastric cancer.

Oncotarget. 7(4):4195-209.
Hee Gu Lee (Corresponding)

Dehydropeptidase 1 promotes metastasis through regulation of E-cadherin expression in colon cancer.

Oncotarget. 7(8):9501-12.
Hee Gu Lee (Co-corresponding)

TMPRSS4 induces invasion and proliferation of prostate cancer cells through induction of Slug and cyclin D1.

Oncotarget. 7(31):50315-32.
Semi Kim (Corresponding)

Restoration of mitochondrial NAD⁺ levels delays stem cell senescence and facilitates reprogramming of aged somatic cells.

Stem Cells. 34(12):2840-51.
Yee Sook Cho (Corresponding)

Biodefense Research Center

Biodefense Research Center was established to respond more systematically to a growing importance of biodefense including the threat of biological weapons. The center is conducting research and development on biodefence technology and related policies for biological weapons and bioterrorism, designing R&D projects, and exchanging technical information with organizations associated to military.

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- Identification of stem cell differentiation and de-differentiation related protein and functional research

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- Development of infection models with non-human primates
- Application of animal biosafety level-3 facilities and support for bio-defense research

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- Development of influenza vaccine technologies using the reverse genetics system

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- Mechanisms of action of immunomodulatory vaccine adjuvants

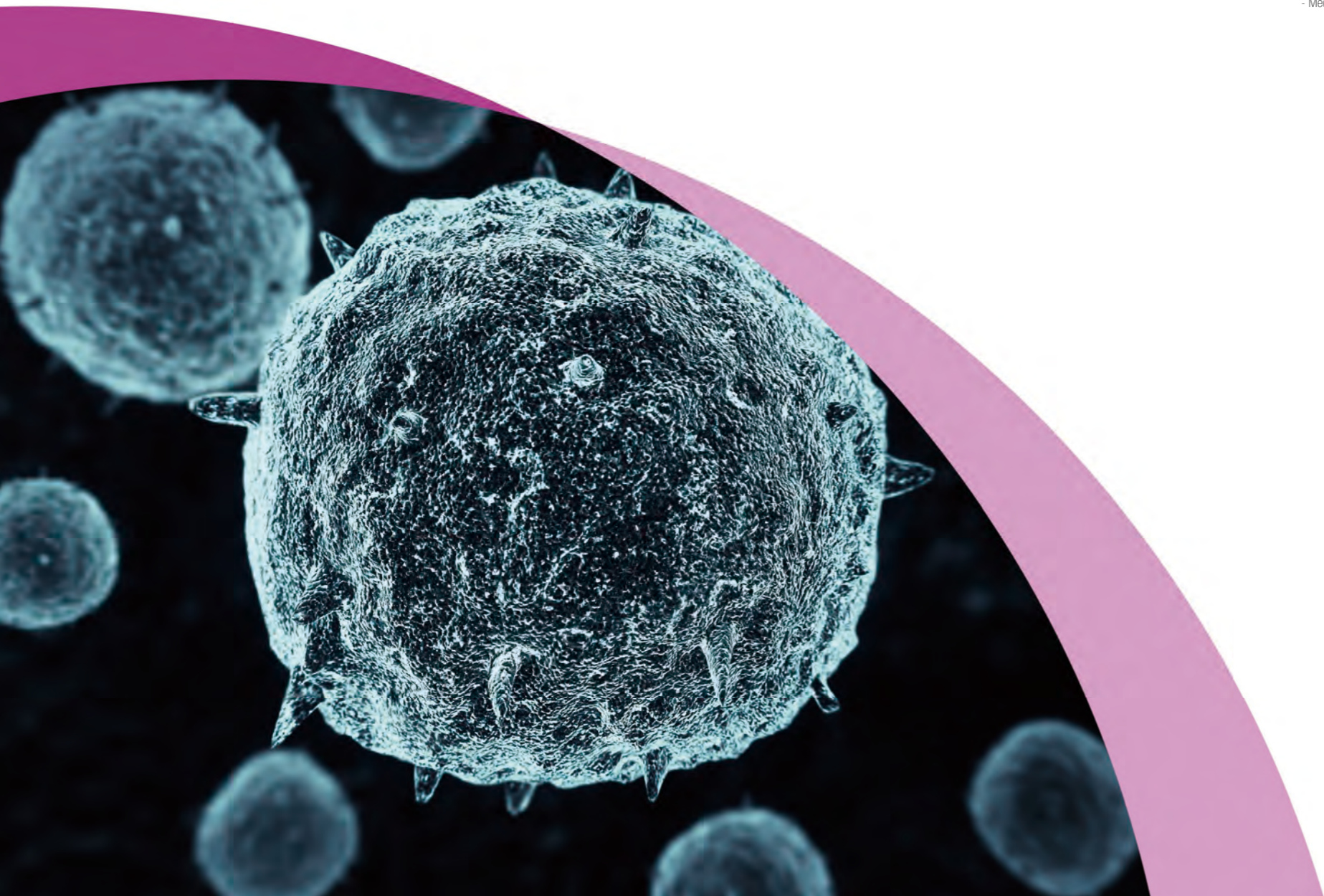
RESEARCH AREAS

Research and Development of BioDefense
- Development of technologies of wearable sensors for soldiers in the future
- Development of new biological materials for the national defense
- Development of bio-markers and diagnosis/vaccine technologies in response to a biological weapon
- Development of an animal evaluation model to build protection against biological weapons
- Development of a platform technology of biomimetics for the military

ACHIEVEMENTS

Construction and support for Animal Biosafety Level 3(ABL 3) research facilities
Support for infection experiments in primates/minipigs/rodents in response to national disaster-level infections diseases/zoonoses/bio-terror/super bacteria.

Evaluation of immunogenicity and safety of vaccine candidates
Testing and assessing the immunogenicity, efficacy and safety of various vaccines.



Ochang Branch Institute conducts research activities to build up the pipeline and platform for new bio-drugs at the national level. Major research areas include : medicinal resources assessment based on metabolomic analysis of natural products, and establishment of systems to discover new physiologically active substances. The Institute is also involved in identifying inhibitors and clinical candidates targeting diseases. The Branch Institute also has carried out supporting activities to the researchers with the infrastructure of bio-resources such as laboratory animals of mice, miniature pigs and primates, and bio-evaluation system of drug efficacy and GMO safety tests.

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Ochang Branch Institute

- Natural Medicine Research Center

Division of Bioinfrastructure

- Biological Resource Center
- Laboratory Animal Resource Center
- Bio-Evaluation Center
- Korea National Primate Research Center
- Futuristic Animal Resource & Research Center
- International Biological Material Research Center
- ABS Research Support Center



Natural Medicine Research Center

Our aim is to develop natural products for drug candidates of natural/synthetic drugs mainly from plant sources which are effective against chronic diseases such as asthma/COPD, metabolic diseases, virus and cancers.

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RESEARCHERS

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 - Identification of biologically active compounds from natural resources
 - Evaluation of natural products and/or extracts against chronic diseases
 - Metabolomic research of medicinal plants for origin discrimination and standardization of natural drugs.

Hyeong-Kyu Lee hykylee@kribb.re.kr
 - Identification of new molecular targets related to immune diseases
 - Development of active compounds for pharmaceuticals from natural products
 - Construction of natural product library

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 - Evaluation of anti-inflammatory and anti-asthmatic activity of natural products
 - Identification of new bio-markers for asthma/COPD

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 - Isolation/evaluation of anti-oxidative compounds from mushroom
 - Development of nutraceuticals and drug candidates for prevention/ treatment of neurologic disorders

Hyun-Jun Lee hjlee@kribb.re.kr
 - Control of inflammation by innate and adaptive immune mechanisms
 - Identification of bio-markers in vivo for asthma/COPD treatment

Dur Han Kwon dhkwon@kribb.re.kr
 - Screening natural sources showing anti-viral activity
 - Evaluation of anti-viral effects and development of preventive materials from natural sources.

Mun-Ock Kim mokim@kribb.re.kr
 - Validation of molecular targets involved in metabolic diseases
 - Development of in vitro & in vivo screening systems for drug discovery

Hyung Won Ryu ryuhw@kribb.re.kr
 - Isolation of active constituents from medicinal plants
 - Elucidation of natural compound structure using analytical instruments

RESEARCH AREAS

Natural product Chemistry
 - Isolation of bioactive materials from plant sources.
 - Elucidation of natural product structure using analytical instruments (HPLC/UPLC, LC/MS, NMR).
 - Management of domestic plant extract banks.

Molecular targets related to immune diseases
 - Identification of major genes & proteins involved in asthma/COPD and their functional analysis.
 - Establishment of bioassay/screening systems using the molecular targets of asthma/COPD.

Chronic disease modulation
 - Screening of cellular response modulators involved in immune cell activation.
 - Research of molecular targets for respiratory diseases and metabolic diseases.

ACHIEVEMENTS

Identification of natural products effective against chronic diseases
 We isolated active natural compounds as therapeutic candidates from plant sources and evaluated biological activities of them in inflammation, asthma/COPD, cancer and metabolic disorder.

Construction of plant extract bank
 We manage plant extract bank (over 5,000 domestic extracts were deposited) and provide them to researchers for screening active materials from plant sources and service extraction/fractionation/purification process.

Industrial research
 We have licensed out two natural drug candidates (asthma/COPD: Yungjin Pharm Co. Ltd, 2011.05.16., atherosclerosis: Korea Bio Medical Sciences Institute, 2015.03.23.) and one lead compound of synthetic pharmaceuticals for chronic inflammation (A-ju Pharmaceutical Co. Ltd, 2015.07.02). The natural drug candidate for COPD is under study in phase IIa (U.S.A. FDA). For nutraceuticals, original candidates (compounds from *Pistacia weinmannifolia*) was licensed out to a company (BTC Co. Ltd, 2016.06.29.).

SELECTED PUBLICATIONS

Verproside inhibits TNF- α -induced MUC5AC expression through suppression of the TNF- α /NF- κ B pathway in human airway epithelial cells.
Cytokine. 77:168-75.
 Sei-Ryang Oh (Corresponding)

Secondary metabolite profiling and modulation of antioxidants inwild and cultivated *Euphorbia supina*.
Ind Crop Prod. 89:215-24.
 Sei-Ryang Oh (Corresponding)

A standardized bark extract of *Pinus pinaster* Aiton (Pycnogenol[®]) attenuated chronic obstructive pulmonary disease via Erk-sp1 signaling pathway.
J Ethnopharmacol. 194:412-20.
 Kyung-Seop Ahn (Co-corresponding)

A metabolomics approach to identify factors influencing their activity relative to oleanolic acid contents in Korean mistletoe types.
J Funct Foods. 22:64-72.
 Sei-Ryang Oh (Corresponding)

The constituent, anti-inflammation, and human neutrophil elastase inhibitory activity of *Gnaphalium affine*.
J Funct Foods. 27:674-84.
 Sei-Ryang Oh (Corresponding)

Type III secretion system of *Pseudomonas aeruginosa* affects matrix metalloproteinase 12 (MMP-12) and MMP-13 expression via nuclear factor κ B signaling in human carcinoma epithelial cells and a pneumonia mouse model.
J Infect Dis. 214(6):962-9.
 Kyung-Seop Ahn (Co-corresponding)

Ostalactones A-C, β - and ε -lactones with lipase inhibitory activity from the cultured basidiomycete *Stereum ostrea*.
J Nat Prod. 79(12):3148-51.
 Jong-Pyung Kim (Corresponding)

Copper oxide nanoparticles aggravate airway inflammation and mucus production in asthmatic mice via MAPK signaling.
Nanotoxicology. 10(4):445-52.
 Kyung-Seop Ahn (Co-corresponding)

Picroside II attenuates airway inflammation by downregulating the transcription factor GATA3 and Th2-related cytokines in a mouse model of HDM-induced allergic asthma.
PLoS One. 11(11):e0167098.
 Hyun-Jun Lee (Corresponding)



Division of Bioinfrastructure

- Biological Resource Center
- Laboratory Animal Resource Center
- Bio-Evaluation Center
- Korea National Primate Research Center
- Futuristic Animal Resource & Research Center
- International Biological Material Research Center
- ABS Research Support Center

The Division of Bioinfrastructure has a key function to promote the national biotechnology R&D and industries. It has three infrastructure activities: biological resource, industrial support, and research safety and policy support. The biological resource activity establishes supporting systems for the biotechnology R&D and practical utilizations of research outcome through acquisition and utilization of bio-resources including plant, animal, microorganisms, and human-derived resources. The industrial support infrastructure provides customized services for the commercialization of research outcomes such as bio-evaluation, preclinical trial, and process development to industrial process. The policy and Safety infrastructure manages the utilization of living modified organism(LMO) and the implementation of access and benefit sharing(ABS).

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Biological Resource Center

Biological Resource Center, also called Korean Collection for Type Cultures (KCTC), is one of the largest institute in South Korea. KCTC is currently collecting, preserving and distributing over 30,000 strains that belong to diverse taxonomic groups including Archaea, Bacteria, Molds, Yeasts, Plants and Animal cell lines. All the biological materials maintained by KCTC are extensively quality-controlled by means of cultural, physiological and molecular characterization. In addition, KCTC provides a number of detailed information on the biological materials (e.g., numbers, origins, isolation source and many others of strains, and availability of genomic DNA service, etc) via the web site <http://kctc.kribb.re.kr>. KCTC also endeavors in constructing collaborative networks with other BRCs, developing probiotics for public health and discovering industrially useful biological resources, in order to support both scientific and industrial communities in related fields.

Major functions of KCTC

- Collection and preservation of biological resources and distribution to industry
- Development of core technologies for valuable bioresources
- Construction of local and international network of biological resources and information

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RESEARCHERS

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- Metabolic engineering and molecular farming for high-level production of valuable metabolites and proteins (vaccines etc.) in microbe and plant systems
- Development of plant cell and organ culture systems for production of valuable metabolites using bioreactors

Suk Weon Kim kimsw@kribb.re.kr
- General curator for plant cell resources
- Development and commercialization of plant cell resources (callus, adventitious root, shoot, micro-tuber)

Kyung Sook Bae ksbae@kribb.re.kr
- Development of actinobacterial resources

Jung-Sook Lee jslee@kribb.re.kr
- General curator for microbial resources
- Microbial diversity, taxonomy and ecology

Doo-Sang Park dsark@kribb.re.kr
- Development of lactic acid bacteria resources
- Host-microbe interaction research

Song-Gun Kim sgkim@kribb.re.kr
- Chemotaxonomy and characterization of novel bacteria from oxic and anoxic conditions
- Biotransformation and production of natural products using microbial enzymes
- Microbial diversity of environment and human related ecosystem

Jae Cheol Jeong jcjeong@kribb.re.kr
- Understanding of epigenetic regulatory mechanisms which involved in modulating embryogenesis process in plant cultured cells
- Comparative transcriptomic analysis of plants in response to abiotic and biotic stimuli

Ju Huck Lee juhuck@kribb.re.kr
- Isolation and identification of the microbiota in human and animals
- Understanding host-microbiome cross-talk
- Molecular study of Fusobacterium nucleatum pathogenesis

Seung-Hwan Park biopark@kribb.re.kr
- Isolation and identification of the gut microbiota in human and animals
- Study of bacteria-mediated cancer therapy
- Imaging analysis and application for theranostics

Jiyoung Lee jiyoung1@kribb.re.kr
- Isolation and characterization of plant growth-promoting endophytes
- Exploring the potential of endophytes from medicinal plants as sources of natural compounds.
- Understanding plant-pathogen interaction

Se Won Kang bioksw@kribb.re.kr
- Bioinformatic analysis of genome and transcriptome in animals, plants and microbiota
- Metagenome analysis of the gut microbiota in human and animals
- Phylogenetic study of biological resources

Kang Hyun Lee khlee@kribb.re.kr
- Supports for gram-negative bacterial resources

Moon Soo Rhee msrhee@kribb.re.kr
- Supports for actinobacterial resources

Keun Chul Lee kcllee@kribb.re.kr
- Supports for archaea, extremophiles, and gram-positive bacterial resources

In Soon Park ispark@kribb.re.kr
- Supports for anaerobic bacteria and lactic acid bacterial resources

Min Ok Jun ksmino@kribb.re.kr
- Management of patent resources
- Supports for gram-negative α - and β -bacterial resources
- Arrangements for Asian Consortium for the Conservation and Sustainable Use of Microbial Resources (ACM)
- Supports for workshop

RESEARCH AREAS

Curation and management of microbial resources

- Collection and preservation of core microbial resources for research activities
- Distribution of microbial resources to academia, research institutes and industries
- Service establishment and refinement of biological resources in terms of discovery, acquirement, conservation and applications

Development of core technologies for microbial resources

- Development of platform technologies for the collection, preservation, evaluation, and management of useful microbial resources

Construction of an information network and support of various services related to microbial resources

- Construction of local and global networks for biological resources
- Support of the related information, provision of workshops, conferences and consultations

Constructions and application technology development of the infra-system for Korean gut microbiome

- Establishment of the Korean gut microbiome bank
- Support of the Korean gut microbiome research and industry

Establishment and management of plant cell resources

- Development, collection and distribution of plant cell resources (callus, adventitious root, shoot, micro-tuber)
- Mass production of valuable plant cell resources using bioreactors

Development and application of valuable plant cell resources

- Development of plant cell and organ culture systems in plant species
- Establishment of bioreactor systems for plant cell and tissue culture
- High-level production of useful metabolites by elicitation of plant cells

Biotechnological application of plant-associated microbes

- Collection, isolation and identification of plant-associated microbes
- Application of useful natural products from plant-associated microbes

ACHIEVEMENTS

KCTC was established in 1985 by Korean government as an infrastructure to support biotechnological researches in Korea. KCTC has grown to the largest collection of type strains in Korea. KCTC, as a worldwide culture depository stipulated by the Budapest Treaty, also plays a significant role in deposition of international patent microorganisms. In addition, as the national repository for bio-research resources from the national R&D projects, KCTC is responsible for the general management of biological materials including microbes, plants (seeds, cell lines), animals (cell lines) and genetic materials.

Collection, preservation and distribution of microbial resources

A total number of biological resources retained by KCTC is 30,924 including 5,584 patent strains, 4,342 molds, 2,658 yeasts, 3,741 Firmicutes, 4,206 Actinobacteria, 4,606 Proteobacteria and 231 Archaea. KCTC also has 1,656 microalgae, 781 plant cell lines and 181 animal cell lines (as of October 2016). Total distribution to research institutes or universities at home and abroad was 8,299 strains in 2016. KCTC members published 33 scientific papers comprised of the description of 10 microbial taxa and 9 genome sequences of KCTC type strains.

Construction of an information network and support of various services

KCTC has constructed local and global networks of Biological Resource Center (BRC). Domestic and international databases are connected through KCTC's main services that provides microbial resource information to the public (<http://kctc.kribb.re.kr>). KCTC held 35th and 6th in domestic and international workshops, respectively and offered technical supports for management of biological resources including microbes, plant cells and patent strains. In addition, the citation number of microbial resources of KCTC is continued to grow over 10% annually during 2012-2016 (Google scholar).

SELECTED PUBLICATIONS

Ethylene induced a high accumulation of dietary isoflavones and expression of isoflavonoid biosynthetic genes in soybean (*Glycine max*) leaves.

J Agric Food Chem. 64(39):7315-24.
Cha Young Kim (Co-corresponding)

Complete genome sequence of the *Aneurinibacillus soli* CB4^T from soil of mountain.

J Biotechnol. 221:116-7.
Jung-Sook Lee (Corresponding)

Enhanced production of resveratrol derivatives in tobacco plants by improving the metabolic flux of intermediates in the phenylpropanoid pathway.

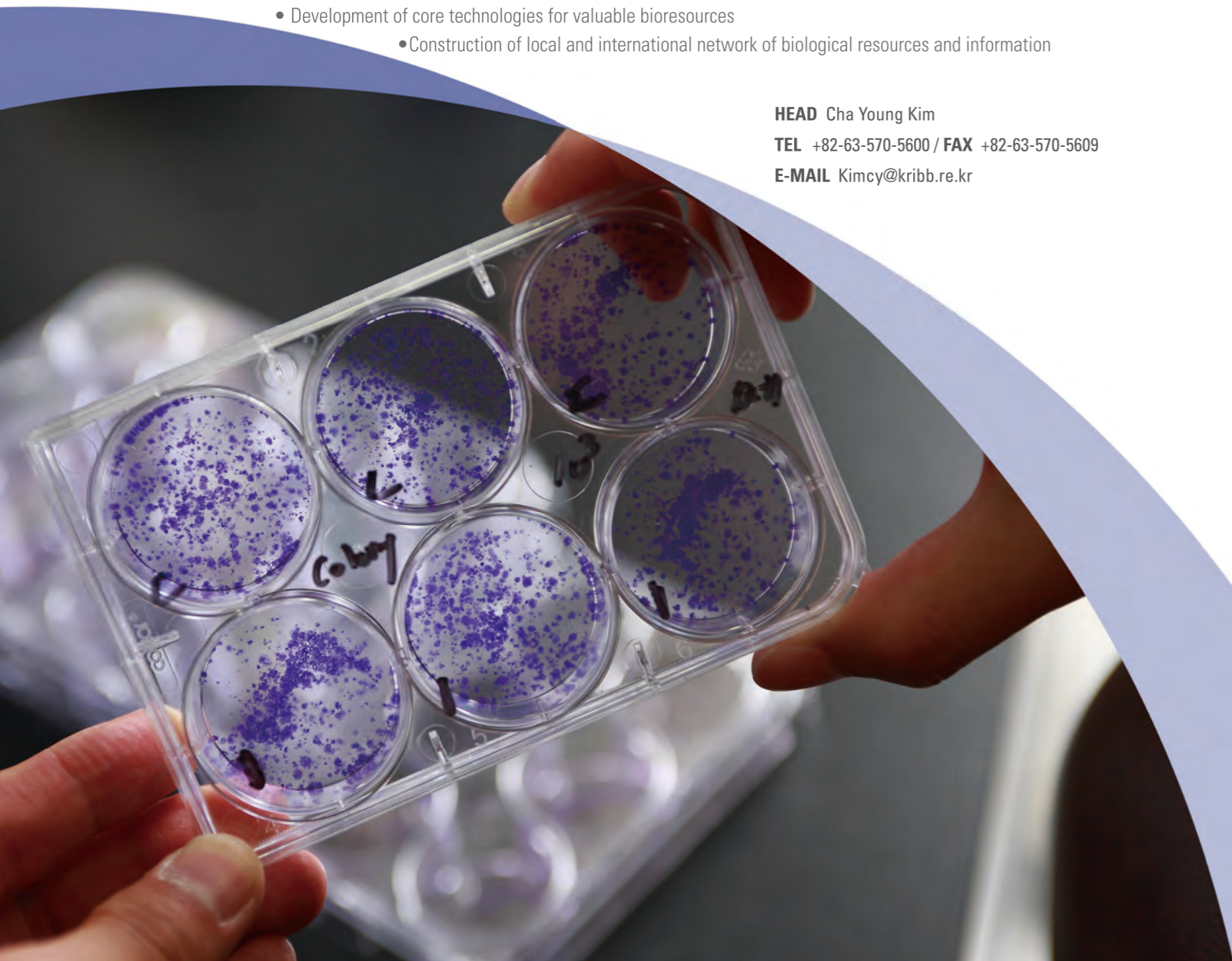
Plant Mol Biol. 92(1):117-29.
Cha Young Kim (Corresponding)

CLUSTOM-CLOUD: in-memory data grid-based software for clustering 16S rRNA sequence data in the cloud environment.

PLoS One. 11(3):e0151064.
Kyung Mo Kim (Co-corresponding)

RGD peptide cell-surface display enhances the targeting and therapeutic efficacy of attenuated *Salmonella*-mediated cancer therapy.

Theranostics. 6(10):1672-82.
Seung-Hwan Park (First)



Laboratory Animal Resource Center

The goals of our center are to establish national infrastructures for laboratory animal resources and intramural service core for animal experimentations. For these purposes, we have been collecting mouse resources, developing quality control technologies, generating animal models for human diseases, and providing animal resources and services for researchers in biomedical research fields since 1984. Recently, we started to produce the genetically engineered mice (GEM) and to run a broad-based primary mouse phenotyping system which is established in cooperation with Korea Mouse Phenotyping Consortium (KMPC) and International Mouse Phenotyping Consortium (IMPC).

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RESEARCHERS

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- Experimental Animal Medicine,
- Toxicology of Drug Development
- Health Safety of LMO

Chul-Ho Lee chullee@kribb.re.kr

- Development and functional validation of animal models for human diseases
- Genetic quality control of laboratory animals

Ki-Hoan Nam namk@kribb.re.kr

- Laboratory Animal Science/Immunology
- Reproductive engineering/Phenotyping of mutant mice

Won-Kee Yoon wkyoon@kribb.re.kr

- Veterinary Pathology
- Genetic monitoring of laboratory animals
- Health Safety of LMO

Young-Suk Won yswon@kribb.re.kr

- Bacteriology
- Health monitoring of laboratory animals

Jung Hwan Hwang coccs99@kribb.re.kr

- Development of genetically altered laboratory animal models
- Phenotyping of functional genes associated with metabolic diseases

Kyung-Shim Kim kskim@kribb.re.kr

- Development and phenotyping of animal models for brain and neurological diseases
- Discovery of bioactive materials for human brain and neurological diseases

Yong-Hoon Kim milknut@kribb.re.kr

- Supports for veterinary care and histopathological diagnosis
- Functional phenotyping of cardiovascular and liver disease models

Hoyoung Ghang kangho@kribb.re.kr

- Genome and phenome association study with model animals
- Bioinformatics

RESEARCH AREAS

- Collection and maintenance of laboratory animal resources.
- Production, expansion and distribution of laboratory animal resources to research communities.
- Permanent preservation of laboratory animal resources as frozen resources.
- Establishment of a laboratory animal database.
- Quality control of laboratory animals (microbiological and genetic monitoring, microbiological clearing of animals contaminated with pathogens)
- Phenotyping of mutant mice.
- Development of animal models for human diseases.
- Research supports for animal experiments.
- Functional validation of the genes associated with human diseases.
- Providing basics of laboratory animal experimentation techniques to animal technicians and researchers.

ACHIEVEMENTS

The largest laboratory animal resource bank in Korea

- Deposits of laboratory animal resources: 924 strains
- Distribution of laboratory animal resources animals : 11,240

Quality control center for laboratory animals

- Health monitoring: 4,448 animals
- Mouse genotyping: 4,540 animals
- Animal clearing: 110 strains

Training workshop for laboratory animal techniques

- The 39th Laboratory Animal Workshop was held on November 22-23, 2016.

International cooperation with ICLAS, AMMRA, AMPC, IMPC

- ICLAS: International Council for Laboratory Animal Science.
- AMMRA: Asian Mouse Mutagenesis Resource Association.
- AMPC: Asia Mouse Phenotyping Consortium.
- IMPC: International Mouse Phenotyping Consortium.

Supports for animal experiments

- IACUC-approved animal experiments: 137 cases
- Pathological diagnosis services: 65 cases
- Hematology and blood biochemistry services: 209 cases

SELECTED PUBLICATIONS

STEP signaling pathway mediates psychomotor stimulation and morphine withdrawal symptoms, but not for reward, analgesia and tolerance.
Exp Mol Med. 48:e212.

Kyung-Shim Kim and Hyun-Jun Lee (Co-corresponding)

Gadd45 β ameliorates L-DOPA-induced dyskinesia in a Parkinson's disease mouse model.

Neurobiol Dis. 89:169-79.

Kyung-Shim Kim and Chul-Ho Lee (Co-corresponding)

Comparative toxicity and biodistribution assessments in rats following subchronic oral exposure to copper nanoparticles and microparticles.

Part Fibre Toxicol. 13(1):56.

Hyoung-Chin Kim (Co-corresponding)

Orphan nuclear receptor SHP regulates iron metabolism through inhibition of BMP6-mediated hepcidin expression.

Sci Rep. 6:34630.

Chul-Ho Lee (Co-corresponding)

Genetically obese (ob/ob) mice are resistant to the lethal effects of thioacetamide hepatotoxicity.

Toxicol Appl Pharmacol. 291:38-45.

Young-Suk Won (First)

Bio-Evaluation Center

Our aim is to establish a collective and specific infrastructure of techniques, facilities, and manpower to support the effective and successful development of biotech products. For this purpose, we have not only constructed the infrastructure for optimizing, analyzing, and standardizing LMO (living modified organisms) and drug candidates; but also assessed the usefulness and risks of biotech research and development processes and the biotech products themselves, to facilitate their commercialization.

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RESEARCHERS

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- Molecular Genetic Characterization of LMOs
- Soybean Genomics
- Chang-Gi Kim** cgkim@kribb.re.kr
- Plant ecology
- Environmental risk assessment of LMOs
- Jung-Ho Park** jungho@kribb.re.kr
- Protein Engineering
- Human risk assessment of LMOs
- Jong Soon Kang** kanjon@kribb.re.kr
- Molecular Pharmacology
- Efficacy evaluation of drug candidates
- Jieun Yun** jyun@kribb.re.kr
- Cancer biology
- Efficacy evaluation of anti-cancer agents
- Soo Jin Oh** diatree@kribb.re.kr
- Drug metabolism and pharmacokinetics in drug discovery

RESEARCH AREAS

- Living modified organisms (LMOs)**
Conducting genetic analysis and assessing the risks of LMOs.
- New drugs**
Discovery and preclinical evaluation of new drug candidates.

ACHIEVEMENTS

- Living modified organisms**
We have established and developed infrastructure for genetic analysis and risk assessments of living modified organisms. In particular, we have been assessing the potential risks of domestically developed transgenic crops (rice, chilli pepper, potato, poplar, and soybean) and microorganisms.
- Drug discovery**
We developed and implemented an integrated infrastructure for drug discovery encompassing preclinical efficacy and DMPK evaluations. We have applied this technology platform to the discovery and preclinical evaluation of drug candidates in the areas of cancer and immune-related diseases and supported drug discovery in the pharmaceutical industry, academia and research institutes.

SELECTED PUBLICATIONS

- Hepatic expression of cytochrome P450 in Zucker diabetic fatty rats.**
Food Chem Toxicol. 96:244-53.
Soo Jin Oh (Co-corresponding)
- Comparative analysis of chemical compositions between non-transgenic soybean seeds and those from plants over-expressing AtJMT, the gene for jasmonic acid carboxyl methyltransferase.**
Food Chem. 196:236-41.
Chang-Gi Kim (Corresponding)
- Transgenic cabbage expressing Cry1Ac1 does not affect the survival and growth of the wolf spider, *Pardosa astrigera* L. Koch (Araneae: Lycosidae).**
PLoS One. 11(4):e0153395.
Chang-Gi Kim (Corresponding)
- miR-6734 up-regulates p21 gene expression and induces cell cycle arrest and apoptosis in colon cancer cells.**
PLoS One. 11(8):e0160961.
Jong Soon Kang (Corresponding)
- Identification of haplotypes at the Rsv4 genomic region in soybean associated with durable resistance to soybean mosaic virus.**
Theor Appl Genet. 129(3):453-68.
Soon-Chun Jeong (Co-corresponding)



Korea National Primate Research Center

The NPRC was established within KRIBB as a major national nonhuman primate infrastructure to support industrial/academic/institutional researches including xenotransplantation, regenerative medicine and new-drug discovery for incurable diseases.

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RESEARCHERS

Sang-Rae Lee srlee@kribb.re.kr
- Development of brain disease models (Stroke, Dementia, Parkinson's disease) with nonhuman primates
- Establishment of efficacy test system with brain disease models

Jae-Won Huh huhjw@kribb.re.kr
- Human and nonhuman primate comparative genomics
- Molecular genetics & Primatology
- Identification and molecular characterization of nonhuman primate genes

Ji-Su Kim kimjs@kribb.re.kr
- Development of transgenic animal model in Xenotransplantation research and support
- Molecular studies and technology on early embryo development
- Establishment of developmental biotechnology and regenerative medicine in nonhuman primates

Young-Hyun Kim kyh@kribb.re.kr
- Maintaining quality standards of nonhuman primate resources by SPF health monitoring
- Comparative analysis of human and nonhuman primate genome
- Identification and molecular characterization of nonhuman primate genes

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- Infectious experiments with indigenous or exotic agents using Animal Biosafety Level 3(ABL 3) facility
- Pathologic diagnosis of nonhuman primates and minipigs

Youngjeon Lee neurosci@kribb.re.kr
- Neuroscience and behavioral science
- Development and preclinical evaluation of nonhuman primate models for Alzheimer's disease and Parkinson's disease

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- Molecular genetics of human and nonhuman primates
- Identification and characterization of transposable elements (TEs)-related genes
- Quantitative analysis of various species genes

Jung Joo Hong hong75@kribb.re.kr
- Comparative immunology of human and nonhuman primates
- Understanding the immunologic mechanisms in health, disease, and vaccination using nonhuman primate models
- Analyzing the efficacy of immunomodulator in vitro and a nonhuman primate model

Bon-Sang Koo porco9@kribb.re.kr
- Veterinary preventive medicine
- Veterinary clinical diagnosis and care for nonhuman primates and minipigs
- Pathologic and molecular characterization of infectious agents using *in vitro* and *in vivo* systems including minipigs and nonhuman primates

Jong-Hee Lee jonglee@kribb.re.kr
- Stem cell biology of nonhuman primates and minipigs
- Understanding the developmental and disease mechanisms and providing new therapeutics using stem cell technology from nonhuman primate and minipig models

RESEARCH AREAS

Acquisition, propagation and distribution of specific pathogen free (SPF) nonhuman primate resources
Acquiring and distributing SPF nonhuman primate resources to industrial, academic and research institutions.

Standardization in handling of and regulating lab requirements for nonhuman primate research
- Maintaining quality standards of nonhuman primate resources by monitoring bacteria, viruses and other general health parameters.
- Establishing a standard operating procedure (SOP) by providing guidelines for the breeding and management of nonhuman primate resources at the international level.

Xenotransplantation research
Transplanting organs (e.g. pancreatic islet, heart) from transgenic germ-free minipig into SPF nonhuman primate and analyzing the efficacy and safety of the organs transplanted.

Regenerative medical research and applications
Using nonhuman primate disease models in cell therapy and gene therapy research, and evaluating their efficacy and safety for the treatment of incurable diseases.

Preclinical efficacy assessments of newly developed drug candidates
Applying various biodrugs and biomaterials to SPF nonhuman primate to evaluate efficacy.

Evaluation of immunogenicity and safety of vaccine candidates
Testing and assessing the immunogenicity, efficacy and safety of AIDS and various other vaccines.

Development of disease models
- Constructing disease models for incurable nonhuman primate diseases, which have metabolic pathways most similar to man, and thus developing new drugs and applications for organ and regenerative research.
- Developmental biotechnologies and applications.
- Establishing cell resources, including embryonic stem cells and a variety of tissue cells, and applying them to cell therapies, nuclear transfers, and the study of molecular mechanisms.

Genome research and establish genomic database
Construction and support for Animal Biosafety Level 3(ABL 3) research facilities
Support for infection experiments in nonhuman primates/minipigs/rodents in response to national disaster-level infections diseases/zoonoses/bio-terror/super bacteria.

Collaboration and support for nationwide non-institutional research involving nonhuman primates
Providing specialized technologies and information about nonhuman primate care and facilities to other researchers, and conducting collaborative research for the development of related technologies.

ACHIEVEMENTS

Procurement of SPF nonhuman primate resources, maintenance and breeding of healthy SPF animals, and preclinical evaluation of biomedical technologies
The NPRC currently houses SPF nonhuman primates: rhesus monkeys, cynomolgus monkeys.

Transfer of nonhuman primate-related resources and techniques to national partners of industrial, academic and research institutions
The NPRC shares its nonhuman primate-related expertise with researchers nationwide, in fields such as neuroscience, pharmacokinetics, etc. We provide services for the upkeep of SPF nonhuman primates, including microbiological monitoring, quarantine and maintenance workshops, and train the personnel (e.g. veterinarians and breeders) who work with nonhuman primates.

Establishment of disease models using nonhuman primate
Establishment of production technology of three brain disease model (Stroke, Alzheimer's disease, and Parkinson's disease). For the establishment of non-invasive evaluation system of nonhuman primate brain disease model, MRI and PET-CT system is equipped in NPRC.

Collaboration with national and international research teams
We conducted collaborative studies in various fields, including xenotransplantation and the pharmacokinetic evaluation of therapeutic drugs against aplastic anemia. We are currently collaborating with world-renown researchers in embryo implantation and development. We are also working with domestic companies for the development of minipigs useful in organ xenotransplantation.

Construction of self-sustaining nonhuman primate resource research facilities to prepare for a turbulent supply of primate resources (Jeonbuk Jeongeup Science-Industry Town)

SELECTED PUBLICATIONS

Silencing of ST6Gal I enhances colorectal cancer metastasis by down-regulating KAI1 via exosome-mediated exportation and thereby rescues integrin signaling.
Carcinogenesis. 37(11):1089-97.
Yeung Bae Jin (Co-first)

Neurorestorative role of stem cells in Alzheimer's disease: astrocyte involvement.
Curr Alzheimer Res. 13(4):419-27.
Sang-Rae Lee (Co-first)

The dynamics of T and B cells in lymph node during chronic HIV infection: TFH and HIV, unhappy dance partners?
Front Immunol. 7:522.
Jung Joo Hong (First)



Futuristic Animal Resource & Research Center

The FARRC has been established for contributing to the vitalization of future bio-industries, including new bio-drug discovery, xeno-transplantation and regenerative medicine, and the settlement of national/social issues, such as artificial blood and foot-and-mouth disease, by developing research support system that can be utilized across the government ministries based on national mini-pig infrastructure that combines the world's best resources, materials, technologies, instruments, facilities and specialists.

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RESEARCHERS

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- Establishment of developmental biotechnology and regenerative medicine in mini-pigs
- Development and derivation of research resources from mini-pigs
- Establishment of phenotyping system in mini-pigs

Bong-Seok Song sbs6401@kribb.re.kr
- Establishment of developmental biotechnology for generation of transgenic mini-pigs
- Production of porcine early embryos with high developmental competence

Young-Ho Park pyh2877@kribb.re.kr
- Development of vector system for transgenesis in mini-pigs
- Establishment of molecular phenotyping system in mini-pigs

Bo-Woong Sim embryont@kribb.re.kr
- Establishment of micromanipulation system for generation of transgenic mini-pigs
- Development of advanced cloning technology in mini-pigs

Phil-Yong Kang gt1300@kribb.re.kr
- Reproduction and maintenance of SPF mini-pigs

RESEARCH AREAS

Obtainment and standardization of specific pathogen free (SPF) mini-pig resources

- Obtainment of mini-pig resources and developing new breed
- Standardization of mini-pig resources by SPF/-+health monitoring

Supply of mini-pig resources/materials/techniques/information

- Development and support of transgenesis techniques in mini-pigs
- Generation and support of transgenic/cloned mini-pigs
- Generation and support of induced/transgenic disease model from mini-pig
- Development and support of mini-pig research resources, including tissues, cells, bloods, nucleic acid, etc.

Industrial-academical-institutional support

- Basic biomedical research: Neuroscience, Genomics, Bioinformatics, Developmental biotechnology, etc.
- Advanced biotechnology: New Bio-drug discovery, Xenotransplantation, Stem cell medication, Regenerative medicine, etc.
- National/social Issue: National-wide infectious diseases, Bio-terror, Chronic incurable diseases, etc.

Establishment of research need-customizing/leading infrastructure

- Establishment of user-customizing infrastructure by on/off-line research needs analysis
- Establishment of user-leading infrastructure by expecting future research fields

ACHIEVEMENTS

Reproduction and maintenance of SPF mini-pigs

- Our center has obtained 124 heads (cumulative number) of mini-pigs by breeding and maintenance under stable SPF environment.

Derivation of research resources from SPF mini-pigs

- To support the industrial-academical-institutional research demands and to establish somatic cell nuclear transfer method, total 55 primary somatic cell lines were established from a variety of mini-pig tissues.

Establishment of transgenesis/cloning system in mini-pigs

- Three transgenic mini-pigs were successfully generated by production of cloned embryos, embryo transfer into foster mothers, delivery by cesarian section and artificial nursing, indicating the successful establishment of overall transgenesis/cloning system in mini-pigs.

SELECTED PUBLICATIONS

Macaca specific exon creation event generates a novel ZKSCAN5 transcript.

Gene. 577(2):236-43.
Bong-Seok Song (Co-first)

Identification of alternative variants and insertion of the novel polymorphic *AluY17* in *TSEN54* gene during primate evolution.

Int J Genomics. 2016:1679574.
Young-Hyun Kim (Co-first)



International Biological Material Research Center

We are aiming at procuring biological materials from four overseas regional centers and their neighboring countries through legal routes within the scope of international collaborative research projects. Our mission is not only to provide researchers with a variety of materials, including indigenous medicinal knowledge, but also to establish the nation's core infrastructure for developing new natural drugs and nutraceuticals, along with other commercially important natural products.

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RESEARCHERS

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- Plant taxonomy, Biodiversity

Mijin Park mjpark@kribb.re.kr
- Management of Four Regional Research Centers and extract supply

RESEARCH AREAS

- Operation and management of four collaborative biological material research centers for the collection and preparation of biological materials worldwide

- Establishment and operation of a comprehensive system and database to manage biological materials and related traditional medicinal knowledge procured from four regional centers and their neighboring countries

- A study on the standardization of highly active biological materials (massive cultivation and quality control) for establishment and operation of a supply system to leading research groups within the scope of the assigned project

- Phylogenetic Analysis and Development of screening method for the identification of Medicinal plants

- A study on the information resources (biological resource access and benefit sharing, related laws, and system, local information) for the promotion of cooperation and utilization

ACHIEVEMENTS

Establishment and operation of the International Biological Material Research Center (IBMRC)

- Center organization has been completed.
- Highly sensitive equipment (Optical Microscope System, Plant Radiography System, Scanning electron microscope, Automated Centrifugal DNA/RNA Extractor etc.)
- Expanded herbarium (over 100,000 voucher specimens) and 2,000,000 plant extracts have been distributed
- Retain Biological Materials: 32,580 no.

Operation and management of four collaborative biological material research centers

- Korea-China Biological Material Research Center (Kunming)
- Korea-Costa Rica Biological Material Research Center (de Heredia)
- Korea-Indonesia Biological Material Research Center (Tangerang)
- Korea-Vietnam Biological Material Research Center (Hanoi)

International collaboration research

- Status of Partnership (2016): 14 countries, 20 Institution

Exchange program

- Host 'International Symposium and Exhibition for program of International Biological Material Collection and Utilization' (25th May 2016, The-K Hotel)

Books and Report

- Useful Plants of the World Vol.1
- Ethnomedicinal Plants of Bangladesh
- Useful Flowering Plants in Vietnam III
- Useful Flowering Plants in Mongolia
- List of Biological Material list in China II
- List of Biological Material list in Costa Rica II
- List of Biological Material list in Indonesia II
- List of Biological Material list in Vietnam II

SELECTED PUBLICATIONS

Two newly recorded species of the genus *Medinilla* from Cambodia

Kor J Plant Taxon. 46(3):301-5.
Seung-Hyun Cho (First)

KOREA · CHINA Biological Material Research Center



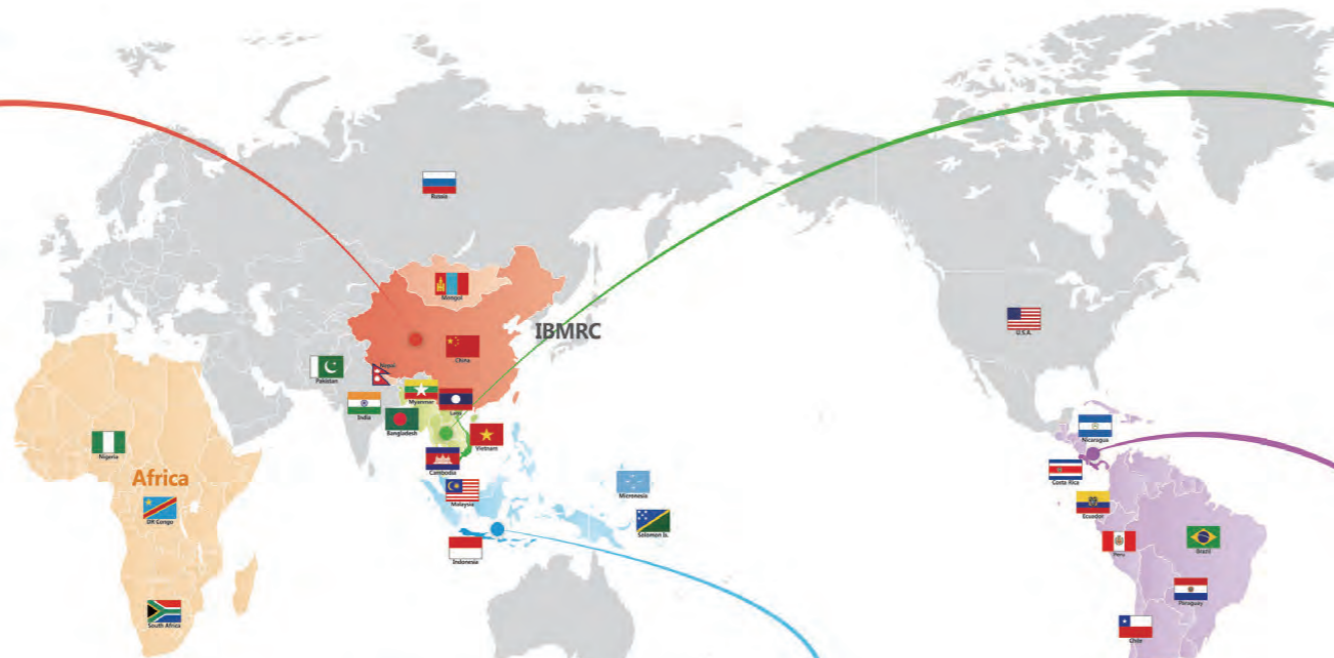
KOREA · VIETNAM Biological Material Research Center



KOREA · COSTA RICA Biological Material Research Center



KOREA · INDONESIA Biological Material Research Center



ABS Research Support Center

As an executive office of a national competent authority for biological resources management, ABS Research Support Center plays a main role in the project of comprehensive services for the Access to genetic resources and Benefit-Sharing (ABS) rule under the supervision of the Ministry of Science, ICT and Future Planning. ABS center also operate Advanced bioResource Information System (ARIS) and ABS Help-Desk to provide valuable information on the ABS issues and utilization of biological resources. The other primary responsibility is a management of three committees of institutional authority in the area of legal regulations on a biosafety; Institutional Review Board (IRB), Institutional Animal Care and Use Committee(IACUC) and Institutional Biosafety Committee (IBC).

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RESEARCHERS

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- Managemt ofen ABS Research Support Center
- Operating a ABS help-desk
- Researching laws, regulations, and current international trends on ABS agenda

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- Researching laws, regulations, and current international trends on ABS agenda

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- Operating a IRB, IACUC, and IBC

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- Institutional operator for bio-safety and bio-security

RESEARCH AREAS

Project of comprehensive services for ABS agenda
- Researching laws, regulations, and current international trends on ABS
- Capacity building and raising awareness through seminars and presentations
- Consulting on access to and utilization of domestic and foreign genetic resources.

ACHIEVEMENTS

Capacity building and raising public awareness for ABS
- Press and distribute ABS guidebook on the Nagoya protocol
- Seminars for public awareness raising

Manage institutional IRB, IACUC, and IBC

SELECTED PUBLICATIONS

Clostridium kogasensis sp. nov., a novel member of the genus *Clostridium*, isolated from soil under a corroded gas pipeline.
Anaerobe. 39:14-8.
Young Hyo Chang (Corresponding)



Jeonbuk Branch Institute

- Natural Product Research Center
- Microbial Biotechnology Research Center

Jeonbuk Branch Institute was established with the core objective of developing functional materials through the application of biotechnology techniques, such as development of functional materials, mass production of biomaterials, metabolic engineering, and bioprocess engineering. Finally, our goal is to industrialize these biomaterials for applications in energy, food, agriculture, livestock, marine, and the environment.

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Natural Product Research Center

Our research goal is to develop natural biomaterials with a broad range of biological activity against infectious/contagious diseases of human beings or livestock, immunological synapse, inflammatory and immune-mediated diseases from the natural resources (plants, microorganisms, and marine sources).

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RESEARCHERS

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- Isolation of active fractions or compounds from natural products such as plants and microbes and the identification of structure for active compounds
- Identification of new target molecules related to several immune diseases and establishment of screening system to develop biomaterials or compounds with a therapeutic activity against inflammation and several immune diseases

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- Identification of infection related target molecules and establishment of screening systems for infectious diseases
- Isolation and structure elucidation of bioactive compounds

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- Development of active biomaterials by studies of in vitro and in vivo antiviral activity and action mechanisms
- Molecular genetic analysis and pathogenesis of viruses causing enteritis & pneumonia (Coronavirus, Rotavirus, Influenza virus, etc.) in cows, pigs and poultry
- Histopathologic, immunohistochemical, and electromicroscope studies

Young Bae Ryu ybryu@kribb.re.kr

- Isolation and structural identification of bioactive compound from natural product
- Disease target enzyme inhibition and kinetic study

Kyungsook Jung jungks@kribb.re.kr

- Therapeutic mechanism of the active materials and compounds on experimental animal models for immune diseases

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- Veterinary viral infectious diseases and antiviral study
- Development of active biomaterials by studies of in vitro and in vivo antiviral activity and action mechanisms

Ji Young Park loveme@kribb.re.kr

- Establishment of a library and securing bio-materials through the establishment of an effective searching system for bioactive substances
- Purification of bioactive substances from natural materials

Chan Sun Park chansun@kribb.re.kr

- Microorganism screening, sequencing and application

Soyoung Lee sylee@kribb.re.kr

- Evaluation of efficacy and immunotoxicity of nature products and underlying mechanisms
- Development of the animal model for immune diseases (Inflammatory Bowel Disease, hypersensitivity, allergic inflammation)

Seung Woong Lee lswdoc@kribb.re.kr

- Activity-guided isolation of bioactive constituents from natural products
- Chemical structure determination of natural products

In-Chul Lee leeic@kribb.re.kr

- Development of the animal models for viral/bacterial diseases and evaluation of in vivo efficacy using infectious models
- Evaluation of general toxicity and efficacy of active biomaterials using animal models (metabolic syndrome and inflammatory diseases)

Seung-Jae Lee seung99@kribb.re.kr

- Development of functional material include the animal and plant from natural products
- Evaluation of inflammatory diseases using in vitro screening system

RESEARCH AREAS

Construction of a bioassay system related to infectious and immune diseases

- Establishment of a bioassay and screening system for such compounds against infectious diseases (virus, bacteria and malaria).
- Development of specifically active compounds such as inhibitors of neuraminidase for the anti-avian influenza virus.
- Establishment of a bioassay and screening system searching biomaterials or compounds which have a therapeutic effect against immune diseases including infectious and inflammatory diseases.
- Development of active compounds such as inhibitors of cell adhesion molecules, inflammatory cytokine and chemokine.
- Development of active materials or compounds regulating the innate immune system including Toll-like receptor family.
- Development of active materials or compounds boosting immunity such as a Type I interferon family.
- Development of plant-made vaccines against diseases

Development of mass-production technologies for useful biological compounds and research into practical technologies via field applications

- Development of mass-production technologies for useful biological compounds using pilot plants.
- Development of technologies for field applications and the commercialization of useful compounds.

Construction of a natural product fraction library

- Construction and utilization of both fractions from plant and microbial culture extracts and a natural compound library.

ACHIEVEMENTS

Identification of biomaterials against infectious diseases

Influenza viruses bind to sialic acid on the surface of the host cell to initiate infection. Since sialic acids are ubiquitous, this presents two problems for the virus: (1) the virus may bind to a wide variety of cells, regardless of whether or not the cell can support virus replication, and (2) the virus particles themselves have sialic acid incorporated into their surface glycoproteins, so potential virus particles will bind to each other. Neuraminidase promotes the release of the influenza virus from infected cells and facilitates the spread of the virus within the respiratory tract. Therefore, we have developed active biomaterials from natural resources with in vitro assay systems for infectious diseases, and have obtained bioactive compounds from selected biomaterials using chromatographic techniques.

Identification of new molecular targets related to infectious diseases

By conducting research into molecular targets such as proteomics and genomics, new target candidates of viral infection disease have been identified. We have established assay and screening systems for viral diseases.

In vitro and in vivo antiviral evaluations

We have identified methods of culture and quantitative titration for several viruses including influenza virus, porcine reproductive and respiratory syndrome virus, rotavirus, coronavirus, rhinovirus, and enterovirus; and we are developing new active biomaterials and immune-therapies against viruses by investigating mechanism of action, in vitro antiviral assay and in vivo animal models based on virology.

Identification of biomaterials against inflammatory diseases

- Development and utilization of cell-based screening system for new active substrates with anti-inflammatory activity:
- Screening system for inhibitor of cell adhesion molecules like VCAM-1/ VLA-4 and sialic glycosaminoglycan/P-selectin.
- Screening system for the inhibitor of IL-6 signaling.
- Screening system for the inhibitor of Toll-like receptors.
- Purify active compounds from natural resources and determine the structure of the compounds:
- Development of active compounds showing anti-inflammatory activity through inhibition of cell adhesion molecules, TLRs and IL-6 signaling.
- Identify biological target and pharmacological properties:
- Norkurarinol showed anti-viral activity through activation of IRF-3, followed by IFN-beta induction.
- Demonstrate anti-viral effect of KR-200 after coxsackievirus A21 infection: KR-200 inhibited NF-kB and AP-1 activation and inflammatory cytokine production induced by coxsackievirus A21 infection.
- KR-300 and the active compounds showed inhibition of IL-6 signaling.
- Verify in vivo anti-inflammatory activity:
- KR-200 and KR-300 inhibited expression of pro-inflammatory cytokines (IL-1beta, IL-6, and TNF-alpha) and mRNA of inflammatory genes in mice with inflammation.
- KR-300 also ameliorated atopic dermatitis, osteoarthritis, and rheumatic arthritis.

Natural product fraction library

We have built a natural product fraction library, and are collecting plant resources and utilizing both plant extracts through open column chromatography and a natural products library.

SELECTED PUBLICATIONS

Melamine and cyanuric acid co-exposure causes renal dysfunction and structural damage via MAPKs and mitochondrial signaling.

Food Chem Toxicol. 96:254-62.
In-Chul Lee (First)

Synthesis and characterization of glucosyl steviolside using *Leuconostoc* dextranucrase.

Food Chem. 211:577-82.
Young Bae Ryu (Co-corresponding)

Development of novel *In vitro* human digestion systems for screening the bioavailability and digestibility of foods.

J Funct Foods. 22:113-21.
Seung-Jae Lee (First)

Chemical constituents and anti-inflammatory activity of the aerial parts of *Curcuma longa*.

J Funct Foods. 26:485-93.
Woo Song Lee and Young Bae Ryu (Co-corresponding)



Microbial Biotechnology Research Center

Our goal is to develop biotechnologies and bioprocesses for the production of microbial metabolites, proteins, industrial enzymes and bioenergy, all of which are useful for the pharmaceutic, nutraceutic, dietetic, cosmetic, feed, fine chemical and other industries.

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RESEARCHERS

Jae Jun Song jjsong@kribb.re.kr
- Development of platform technologies for massive screening and the commercialization of industrially valuable enzymes using the HTS system
- Development of the technology to prepare genomic library from single unculturable microorganism sorted from nature

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- Development of microbial strains and bioprocess for integrated biorefinery
- Development of biotechnology for bio-oil production and utilization using microorganisms

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- Biorefinery and Bioenergy, Functional biomaterials, Bioprocess

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- Development of function food ingredients using microbial strains

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- Development of platform technologies for screening useful enzymes/ metabolic pathways using high throughput technology
- Development of the tool box applicable to the white biotechnology based on synthetic biotechnology

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- Glycoengineering and glyco(bio)technology
- Development of sugar platform technologies using renewable bioresources

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- Development of bioprocess engineering
- Biofuels and biochemicals production

Ji Young Kang jiyoka@kribb.re.kr
- Development of microbial strains for biorefinery and bioenergy

RESEARCH AREAS

Microbial metabolic engineering
- Production of microbial metabolites.
- Metabolic engineering of industrial microorganisms.

Bioconversion technology
- High throughput screening of novel biocatalysts.
- Directed evolution of industrial enzymes.
- Production of useful biomaterials by bioconversion.

Molecular bioprocess engineering
- Production of therapeutic recombinant proteins.
- Development of bio-refinery technologies.

ACHIEVEMENTS

Microbial strains and processes to produce chemicals

Microbial strains and processes optimized to produce valuable chemicals (1,3-propanediol, 2,3-butanediol, 3-hydroxypropionic acid and etc.) using crude glycerol derived from biodiesel industry were developed through genetic and metabolic engineering, which would be applicable for platform chemicals for eco-friendly biochemical industries such as bio-plastics, textiles and so on.

Production and utilization of microbial oil
Oleaginous heterotrophic microalgal strains to produce lipid containing functional substances such as polyunsaturated fatty acids were isolated and the optimal process was developed. The microbial oil would be valuable as a feedstock source for biofuel, chemicals and active substance (for drug, food and feed ingredient).

Bioenergy
Lignocellulosic biomass is a renewable bioresource for second-generation bioethanol production. These potential sugar resources, derived from various agricultural residuals, containing cellulose, hemicellulose, and lignin can be hydrolyzed or enzymatically degraded to sugars, and then be fermented to produce bioethanol. Also these sugar flat form technology could be applied to various biorefinery process as an environmentally friendly process.

High-Throughput Screening System and Its Biotechnological Applications

We developed mass screening methods for various enzymes from metagenomic libraries using HTS system based on robot. We could screen new enzymes such as cellobiohydrolases, glycosyltransferases, BMO, coldadapted esterase and deoxyribose 5-phosphate aldolase(DERA) based on fluorescence intensity. These new strategies combined with HTS system could screen various new enzymes more fast, sensitive and easy than previously reported screening methods. This approach would be applied for other useful enzyme and metabolic pathway screening from metagenomic resources.

Screening enzyme from single cell based polymerase Fosmid cloning

A new method was developed for enrichment minor bacteria from environmental samples. And single cell based fosmid libraries generated from this minor bacterial pools. This method is based on the Fluorescence in situ hybridization (FISH), Fluorescence associated cell sorter (FACS), and Multiple displacement amplification (MDA). We demonstrated enrichment minor bacteria from artificial microbial community and single cell based MDA followed by fosmid library construction for activity screening.

SELECTED PUBLICATIONS

Itaconic acid production from glycerol using *Escherichia coli* harboring a random synonymous codon-substituted 5'-coding region variant of the *cadA* gene.

Biotechnol Bioeng. 113(7):1504-10.
Jong Hyun Choi and Jae Jun Song (Co-corresponding)



APPENDIX

- SOCIAL CONTRIBUTION
- DONATION FOR EDUCATION
- OUTSTANDING RESEARCH ACHIEVEMENTS
- RESEARCHER INDEX

SOCIAL CONTRIBUTION

The KRIBB will spare no effort to create a better world where all people live a happy life under the notion that it values the human the most.

It has been doing its best to create a healthier and happier society where a culture of sharing blooms between people by implementing social contribution activities. The sharing culture is our solemn responsibility and the noblest thing we should fulfill in our daily lives.

The KRIBB promises to become an institute together with neighbors by devoting itself to making all people healthy and happy and to embracing socially excluded or marginalized people with love.





DONATION FOR EDUCATION

We specifically focus on educating and nurturing the growing children. The KRIBB will be committed to fostering an environment where all gifted and talented students can have equal opportunity to fulfill their potential regardless of where they come from through "donation for education" which is a creative culture of sharing.

The KRIBB has actively conducted and participated in donation activities for education to realize science and technology in daily lives and to create an environment where people get more familiar with science and technology. It was designated as the certified organization of donation for education from KOFAC(Korea Foundation for the Advancement of Science and Creativity) in 2012, and has provided a variety of information on biotechnology to teachers and students through a wide range of donation activities for education.

OUTSTANDING RESEARCH ACHIEVEMENTS

Developing a nano capsule that can diagnose a cancer within 24 hours with a shot

Oh Seok Kwon [Jan. 2016]

Recently, domestic researcher team developed a nano capsule that can diagnose more than 2 types of cancer at the same time within 24 hours.

Dr. Oh Seok Kwon of KRIBB said “the upconversion nano capsule was possible because we have a technology to hold organic fluorescent pigments for upconversion of energy in silica capsule in liquid form. In particular, the organic fluorescent pigment is based on triplet-triplet state upconversion and the research is meaningful in that the technology is applied to research on selective cancer multidagnostic”.

Finding a clue to bio energy source with symbiosis bacteria

Hee-Sik Kim [Feb. 2016]

The research team provided a systematic and theoretic foundation for interaction between microalgae and bacteria from the perspective of evolution theory and ecology for the first time and presented the possibility of applying the research outcome to microalgae industry with actual research examples.

Dr. Hee-Sik Kim of KRIBB said “the utilization of microalgae symbiosis bacteria in the bio technology will promote the speed of microalgae growth and simplify the harvesting process through self-clustering resulting in remarkable improvement of microalgae biomass productivity”.

Development of Highly-Efficient Drug Screening Technology Using Nanopore

Seung-Wook Chi [Apr. 2016]

The research team used nanopore technology for the purpose of identifying anti-cancer drugs that deters interaction of protein and protein which is the important target for cancer treatment and successfully developed technology that can screen anti-cancer drug that deters protein-protein interaction rapidly with extremely small amount of picomole (1 mole by 1 trillion).

Dr. Seung-Wook Chi said “the research outcome is that we developed the highly-efficient screening platform technology for drug that deters protein-protein interaction through single molecule analysis with no marker, extremely small amount and high sensitivity using nanopore”.

The Key to Resolving Neural Cancer and Neurodegenerative Diseases is to Adjust Calcium

Kyu-Sun Lee [Apr. 2016]

A domestic team of researchers identified the impact of the changes of a certain protein in mitochondria cell on maintaining neural stem cells and cell division by controlling calcium within mitochondria. It is expected to be used as a new mark for development of treatment for cancer, metabolic diseases and neurodegenerative diseases by controlling calcium in mitochondria and homeostasis.

Developing a technology that makes adult stem cells move to wound area

Doo-Byoung Oh [Jul. 2016]

The team led by Dr. Doo-Byoung Oh revealed that the efficiency of delivering gene is improved significantly by putting useful genes on minicircle and using microporation method and the expressed amount is maintained at a high level for more than a week.

Dr. Doo-Byoung Oh said “the research is meaningful in that the useful genes are delivered effectively to mesenchymal stem cells without using virus improving the ability to move to damaged tissues. We expect that the mesenchymal stem cells can be developed as a cell treatment that regenerates damaged tissues effectively using this technology”.

Developing a last antibiotic mixing technology to eradicate super bacteria

Choong-Min Ryu [Jul. 2016]

The Ministry of Science, ICT and Future Planning (Minister Choi Yang-hee) announced that it developed a technology to eradicate super bacteria, which is the major culprit for infection within a hospital by mixing polymyxin, which is an antibiotic whose use is limited due to toxicity and resistance, with netropsin, which is a kind of carcinostatic substances.

The results can be used to develop a new way to eradicate super bacteria that has become a social issue such as infection within a hospital”.

Development of materials for food and medicine utilizing overseas biological resources and technology transfer

Sei-Ryang Oh [Aug. 2016]

A research team led by Dr. Sei-Ryang Oh confirmed the anti-inflammatory effect of Pistacia weinmanniifolia J. Poiss. ex Franch extract in cell lines and animal models. The team also confirmed its effect on deterring asthma and chronic obstructive pulmonary disease (COPD) in animal models. The patent registration for materials including new natural materials separated from Pistacia weinmanniifolia J. Poiss. ex Franch is made in Korea and patent application for those materials was done in other countries (China, US, EU).

This development is meaningful in that exemplary case of sharing academic and industrial achievements with countries that provide resources from exploration to commercialization of overseas biological resources was presented overcoming the limitation of insufficient domestic resources.

Finding a treatment for diabetes with the discovery of new gene related to diabetes caused by obesity

Kweon Yu, Kyu-Sun Lee [Aug. 2016]

Domestic researcher group discovered a new gene (tribbles/TRB3) that causes a diabetes and identified molecule mechanism by developing a disease model system for fruit flies with diabetes caused by obesity.

The model animal system is expected to be widely used for research and development of metabolic disease control technologies and the newly found genes will be utilized as a new marker for the development of treatment for metabolic diseases.



Discovery of Protein’s New Function to Suppress a Viral Infection

Myung Hee Kim [Sep. 2016]

The outcome of the study has proven that the enzyme complex restricts the growth of a virus by protecting the protein (MAVS), which plays a critical function in an antiviral immunity response through the release of EPRS protein, immediately after it detects an infection by a RNA virus, such as the influenza A virus, in the body.

Dr. Myung Hee Kim, the chief researcher of the study from KRIBB said "Especially the discovery of an activation mechanism of antiviral immunity in EPRS protein among enzyme complexes is expected to make great contributions to the development of a treatment against a wide range of viruses, which uniquely responds to antiviral protein (MAVS)."

Development of Fluorescent Platform for Low-cost and Highly-efficient Customized Search for Microorganisms

Seung-Goo Lee [Sep. 2016]

Korea Research Institute of Bioscience and Biotechnology (KRIBB) (President Kyu Tae Chang) has announced that the team led by Dr. Seung-Goo Lee developed for the first time in the world a platform that enables a customized search for a certain active microorganism or core enzyme in a short period of time upon an insertion of the designed probe material.

Dr. Seung-Goo Lee added "Amid situations where the Nagoya Protocol is about to be ratified in which the use of genetic resources requires an advanced permission according to the law of the pertinent country, it is expected to make great contributions to securing indigenous genetic resources."

Sweet Potato, an Alternative Crop in Years of Poor Harvest, Rediscovered as an Industrial Plant to Tackle Global Climate Change

Sang-Soo Kwak [Sep. 2016]

The team of Dr. Sang-Soo Kwak from KRIBB has uncovered the function of orange protein, separated from sweet potato (species: Shinhwangmi) with beta-carotene in high quantities, that accumulates carotenoid to enable the plant to normally photosynthesize.

As orange protein, discovered in the recent study, is applicable to all plants and may be utilized to develop industrial plants that produce a high quantity of antioxidant substances (such as beta-carotene) and are strong against disasters, such as high temperatures, it is expected not only to resolve food shortages or health issues, but to secure carbon emission rights through an increase in biomass by growing them in large quantities in a local or foreign area in poor conditions (such as desertified land or contaminated areas).

Development of Transforming Poplar, Rapidly Growing Even in Highly Saline Environment

Sang-Soo Kwak [Nov. 2016]

The team of Dr. Sang-Soo Kwak from KRIBB has separated from poplar plants as xylophyte, three strains of Gl gene, which react to environmental stresses and involve in the regulation of their blooming time and biorhythm, and identified its functions in Arabidopsis thaliana, an herbaceous plant, and poplar plants.

It is expected to tackle global climate change by securing carbon emission rights with a higher quantity of biomass coming from their growth in large quantities in highly saline areas both home and abroad (reclaimed or desertified areas). In addition, this study offers a presumption that Gl gene exists in all plants, including xylophytic and herbaceous plants, as well as a possibility of improving useful plants through regulations of the expression of Gl gene.

New identification of increase in chromosome of rose of sharon and unique blooming mechanism

Yong-Min Kim [Dec. 2016]

A domestic research team identified the phenomenon of diploidization of plant and mechanism of rose of sharon blooming that continues for 100 days through genome sequencing.

It seems that a number of diploidization have occurred due to abnormal meiosis of gamete in the rose of sharon caused by low temperature and genome sequencing result showed that diploidization has occurred two times after the speciation from cotton plant.

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