2013

KRIBB

Annual **Report**

KOREA RESEARCH INSTITUTE OF
BIOSCIENCE AND BIOTECHNOLOGY

KOREA RESEARCH INSTITUTE of BIOSCIENCE and BIOTECHNOLOGY

CONTENTS

INTRODUCTIONS

DIVISIONS

APPENDICES

SCIENCE OF HUMAN AND SCIENCE FOR HUMAN

A message from the President

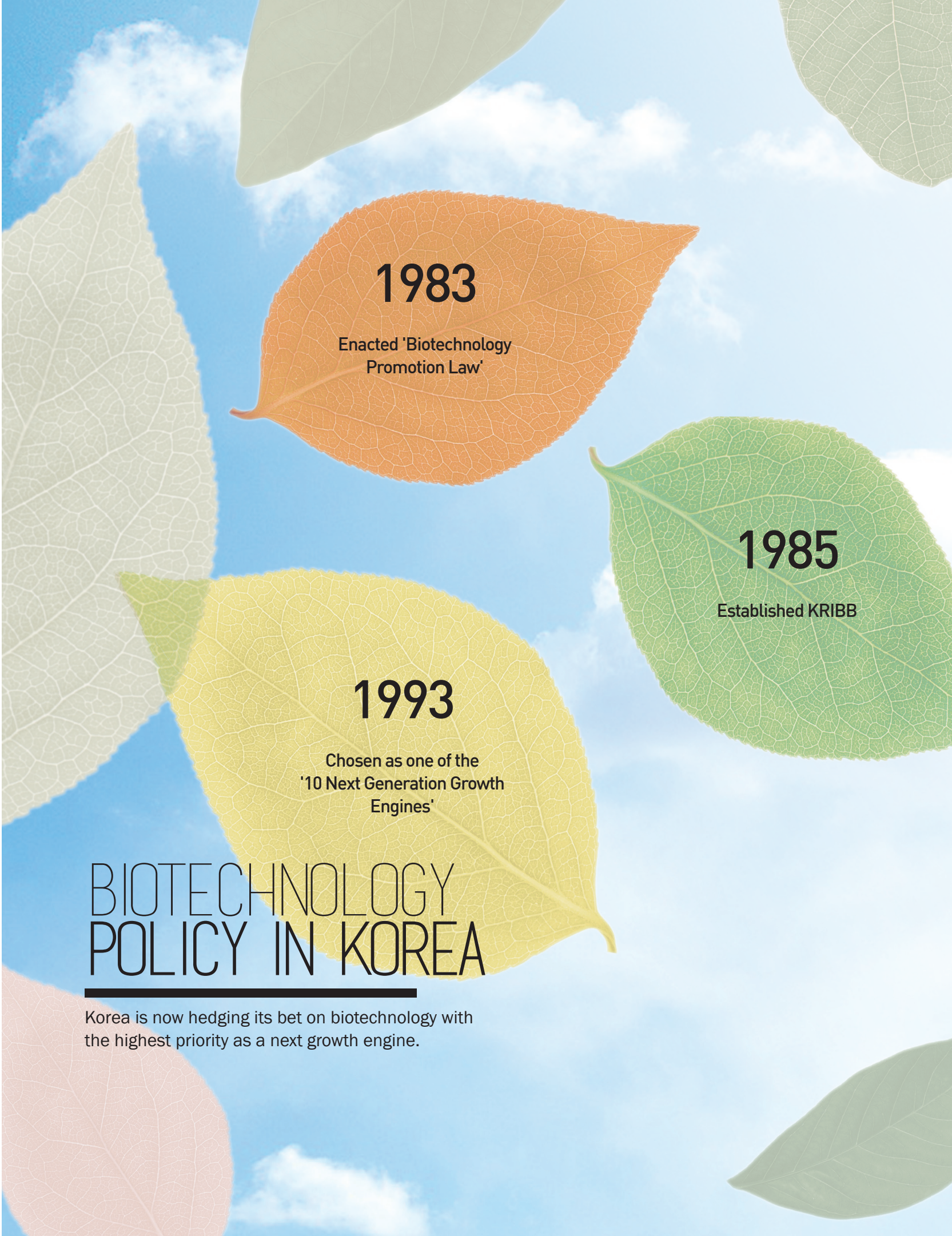
Biotechnology plays an important role in human welfare, in the living environment and economic growth. The Korea Research Institute of Bioscience and Biotechnology (KRIBB) has provided cutting-edge technologies in the areas of public health, agriculture, bio-nanotechnology and bio-energy over the 28 years since its establishment in 1985. Now KRIBB has three campuses in Daejeok headquarter and two other branch institutes in Ochang and Jeongup province with total of 1,300 employees and annual budget of 160 million dollars.

Last year, KRIBB successfully implemented innovation policies to reestablish unique functions as the only government research institute dedicated to biotechnology research with an aim to be a global leading research institute. KRIBB has laid the foundation for nurturing global top research groups by establishing a large-scale and collaboration-focused professional research institute (convergence, aging science) which is centralized and specialized for nurturing global leading groups and creating a representative brand for KRIBB. KRIBB enhanced its position as a national BT professional research institute by bringing in global frontier projects, leading convergence projects and building the business ecosystem in Biorefinery.

KRIBB has been spreaded throughout the world by signing the MOU with nine international institutes such as Buck Institute for Research on Aging, SIRIM(Standard and Industrial Research Institute of Malaysia), etc. and working with world-class research teams of professional research institutes.

Under our vision of being “A Global Research Institute, Leading Biotechnology Innovations for Humankind”, KRIBB will continue to pursue innovative new ways of adding value to bioindustry and improving our living environment through biotechnology.

President
Tae Kwang Oh, Ph.D.



BIOTECHNOLOGY POLICY IN KOREA

Korea is now hedging its bet on biotechnology with the highest priority as a next growth engine.

2000

Set up
'Phase 1 of Bio-Vision 2016'
[2007~2016]

2003

Set up 'Biotech2000'
[1994~2007]

2011

Set up 'Phase 2 of Bio-Vision 2016'
[2012~2016]

nature DNA sequence and comparative analysis of chimpanzee chromosome 22 (2004)
Genome evolution and adaptation in a long-term experiment with *Escherichia coli* (2009)

Science Construction and analysis of a human-chimpanzee comparative clone map (2002)

Cell Structural Basis of the Redox Switch in the OxyR Transcription Factor (2001)

Cell metabolism TXNIP Maintains the Hematopoietic Cell Pool by Switching the Function of p53 under Oxidative Stress (2013)

nature commun Nterspecific bacterial sensing through airborne signals modulates locomotion and drug resistance(2013)

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)

nature cell biology

Drosophila short neuropeptide F signalling regulates growth by ERK-mediated insulin signalling (2008)

nature biotechnology

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

nature structural & molecular biology

Bilateral inhibition of HAUSP deubiquitinase by a viral interferon regulatory factor protein (2011)

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.

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

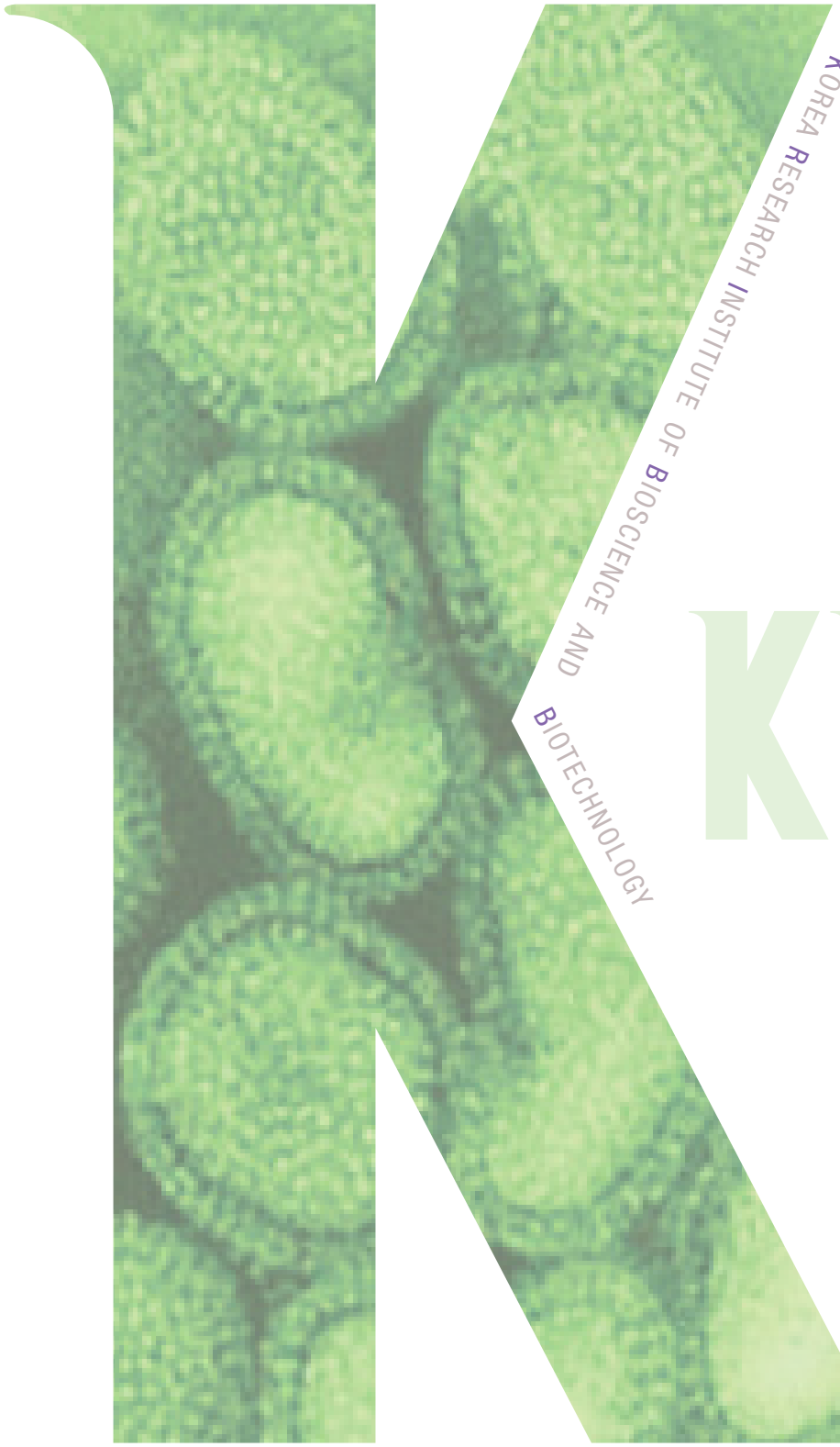
Global Research Institute Leading Bio-Innovation for the Humankind

Generating New Economic Growth Engine
: Five World-class Platform Technologies

Providing Solutions to National Agenda
: Three Internationally Competitive R&D groups

Establishing World-class Research Infrastructure
: World's Top Five Biotechnology Research Infrastructure

MAJOR OBJECTIVE



KOREA RESEARCH INSTITUTE OF BIOSCIENCE AND BIOTECHNOLOGY

KRIBB

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

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

OPEN INNOVATION STRATEGY "SPECIALIZED RESEARCH INSTITUTE"

• Purpose
- To enhance core competence for leading R&D in specific fields
- To promote collaboration with domestic and international top researchers & groups

• Bioconvergence Res. Inst.
- BioNano RC
- Super Bacteria RC
- BioChemical RC

• Aging Res. Inst.
- Aging Science RC
- Cell Defense Mechanism RC
- Stem Cell RC
- Cell Therapy RC

GENERAL INFORMATION

FOUNDATION BASIS

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

KEY FUNCTIONS

Advanced R&D and development & distribution of platform technologies in bioscience and biotechnology

- Convergence technology, personalized bio-medicine, bio green technology, bio-based national agenda

Providing infrastructure for supporting public research on bioscience and biotechnology

- Infrastructure development, national policy think-tank, specialized education and training

HISTORY

Feb. 1985 Established as a Genetic Engineering Research Center (Seoul)
Jul. 1990 Moved to Daejeon, Current Location
Mar. 1995 Changed its name to the 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

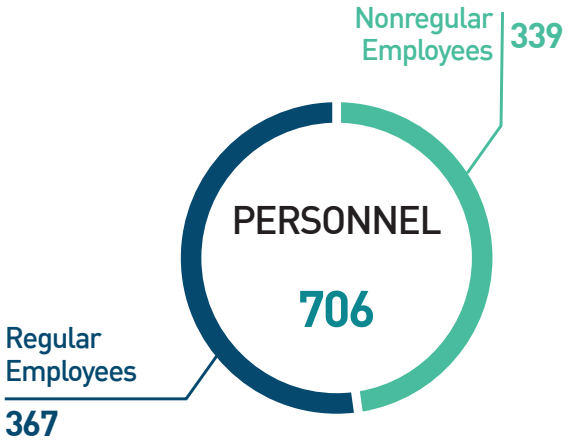
FACILITY

• Headquarters : 100,978 m^2
- Human Gene Bank, Plant Extract Bank, KCTC

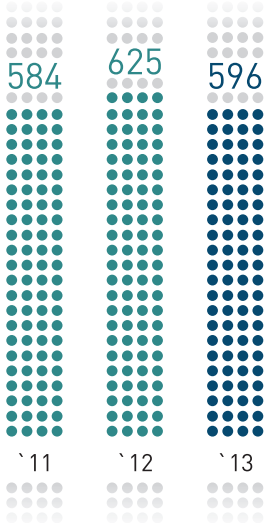
• Ochang Branch Institute : 212,258 m^2
- National Primate Research Center, Bio-Evaluation Center

• Jeonbuk Branch Institute : 45,814 m^2
- Applied Microbiology Research Center, Infection Control Material Research Center

YEARLY PROGRESS

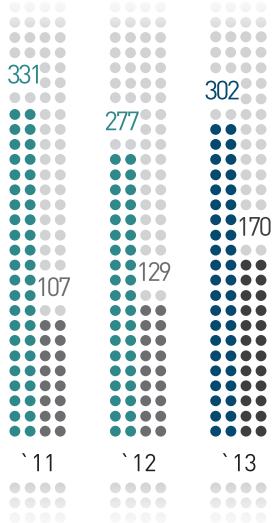


PUBLICATIONS (items)
596



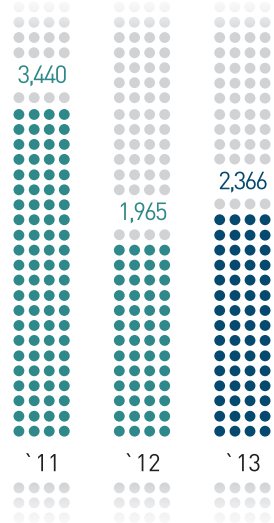
Domestic **95**
Overseas **501**

PATENTS (items)
302 / 170

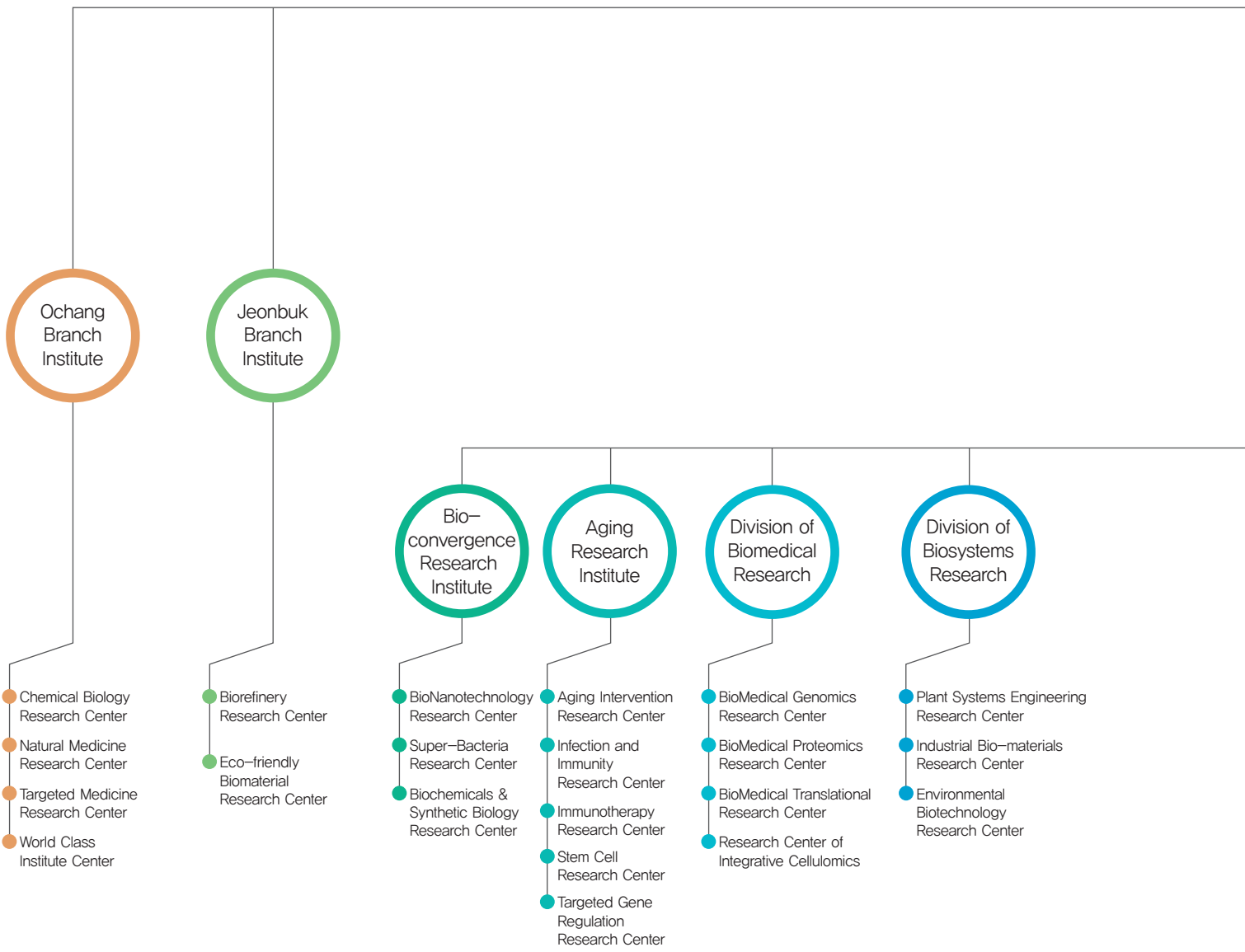


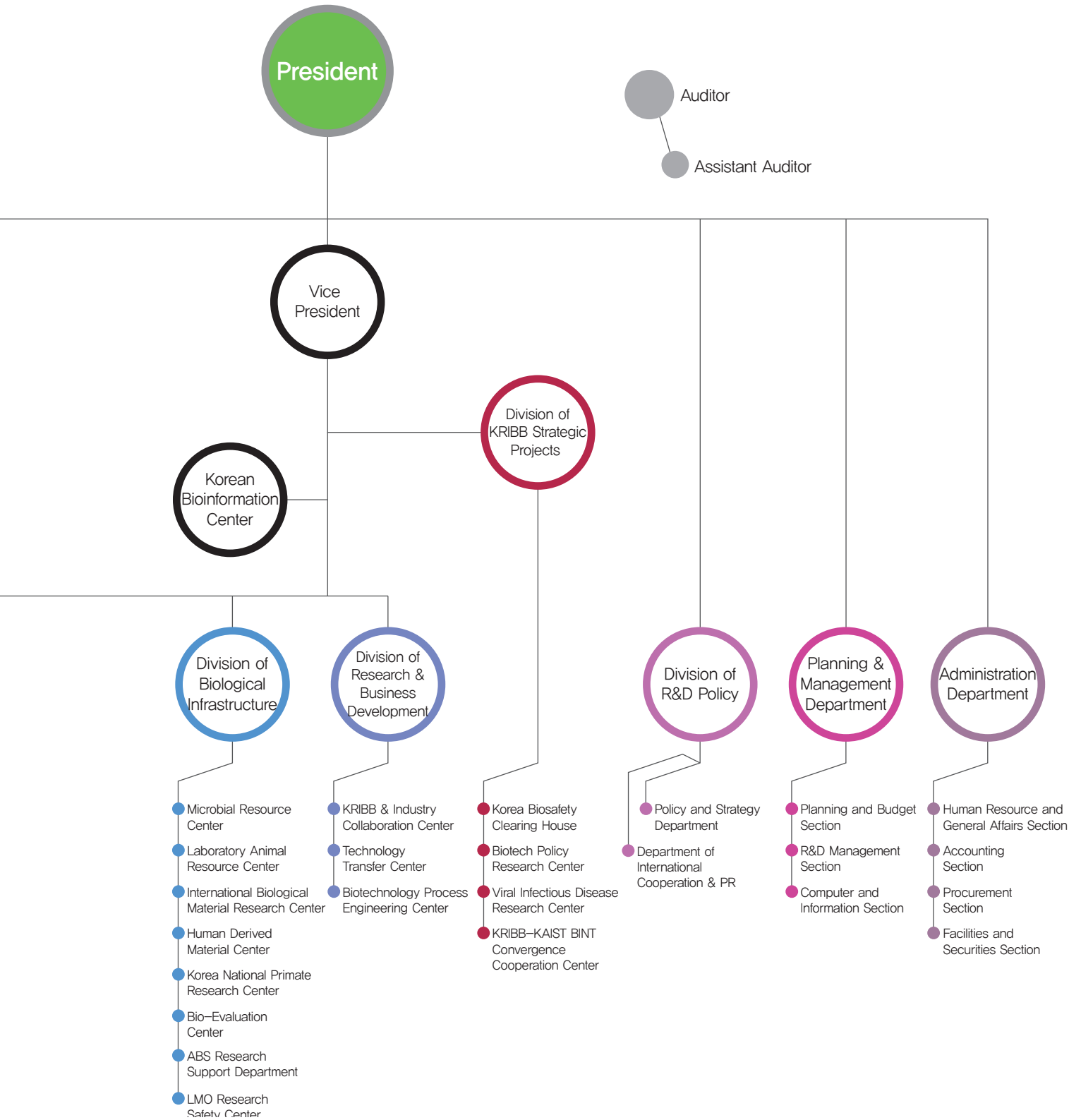
Domestic & Overseas Application **302**
Domestic & Overseas Registration **170**

TECHNOLGY TRANSFERS
(million won)
2,366



ORGANIZATION




President
Auditor
Assistant Auditor
Vice President
Division of KRIBB Strategic Projects
Korean Bioinformation Center
Division of Biological Infrastructure
Division of Research & Business Development
Division of R&D Policy
Planning & Management Department
Administration Department
Microbial Resource Center
Laboratory Animal Resource Center
International Biological Material Research Center
Human Derived Material Center
Korea National Primate Research Center
Bio-Evaluation Center
ABS Research Support Department
LMO Research Safety Center
KRIBB & Industry Collaboration Center
Technology Transfer Center
Biotechnology Process Engineering Center
Korea Biosafety Clearing House
Biotech Policy Research Center
Viral Infectious Disease Research Center
KRIBB-KAIST BINT Convergence Cooperation Center
Policy and Strategy Department
Department of International Cooperation & PR
Planning and Budget Section
R&D Management Section
Computer and Information Section
Human Resource and General Affairs Section
Accounting Section
Procurement Section
Facilities and Securities Section


1985
Biological Resource Center
1995
Biotechnology Process Engineering Center
2003
Human Gene Bank
2005
National Primate Research Center
2006
Bio-Evaluation Center
2010
Korean Bioinformation Center

RESEARCH INFRASTRUCTURE

2013

Eco-friendly Bio material R&D
Hurb Research Center

2012

Research Infrastructure for
Xeno-Transplantation R&D

RESEARCH DIRECTION

KOREA RESEARCH INSTITUTE of BIOSCIENCE and BIOTECHNOLOGY

OCHANG BRANCH INSTITUTE

- Drug Discovery
- Oriental Medicine
- Bioinfrastructure : Toxicology

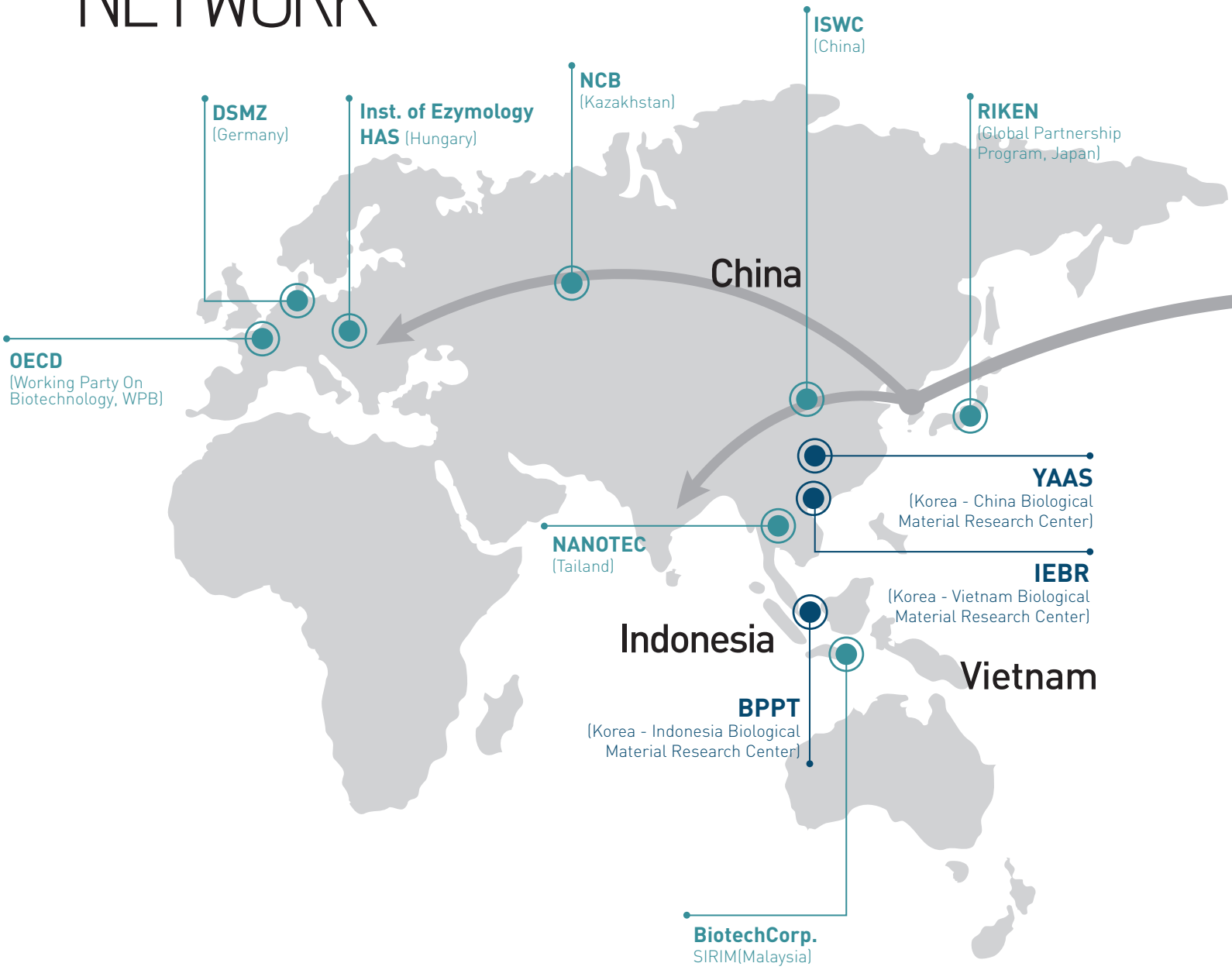
DAEJEON HQ

- Genomics
- Proteomics
- BioNanotech
- Neurobiology
- Bioinformatics
- Oncology
- Plant Biotech
- Industrial Biotech
- Microbiology

JEONBUK BRANCH INSTITUTE

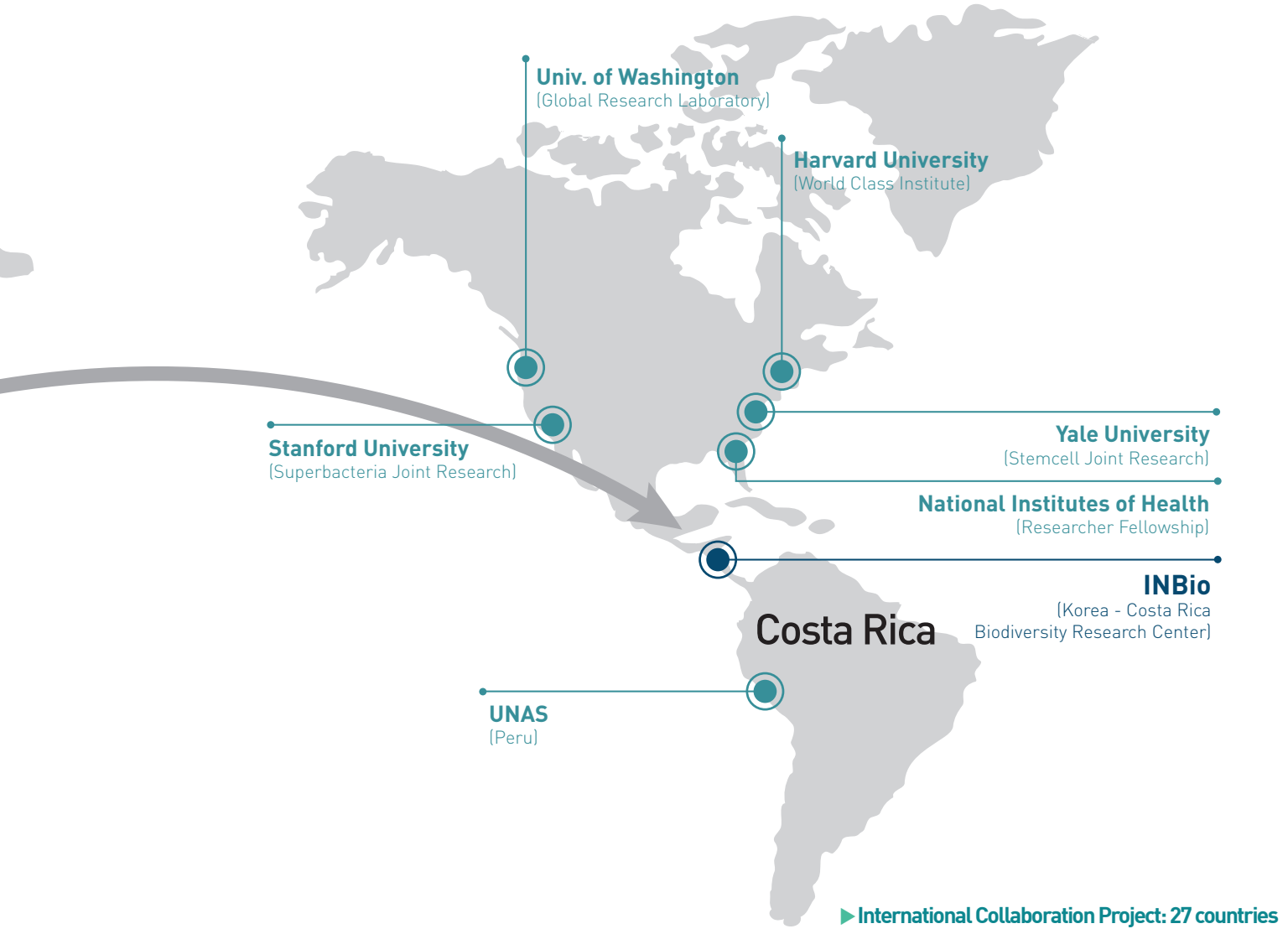
- Microbial Tech
- Bio-Materials
- Biorefinery

INTERNATIONAL NETWORK

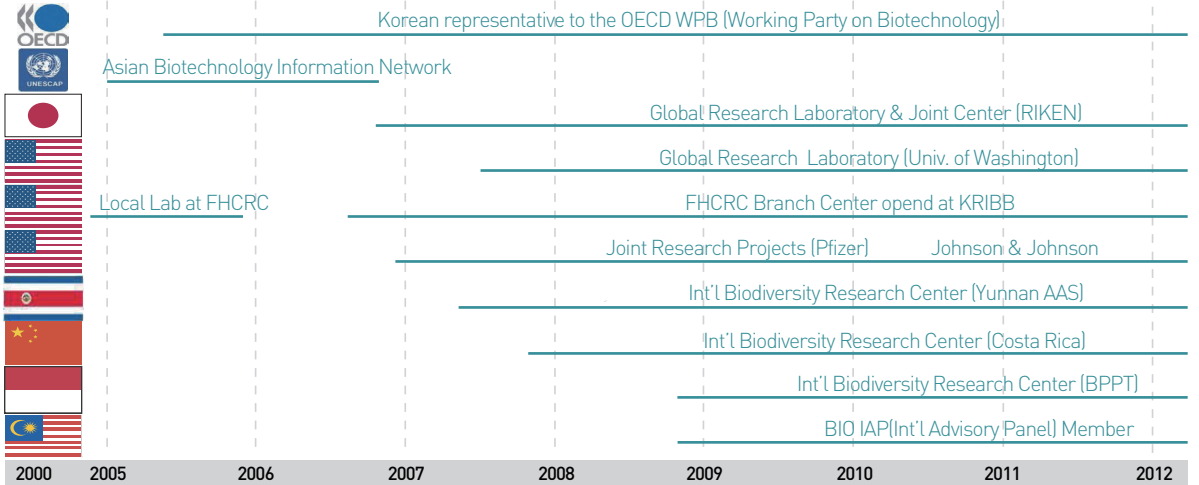


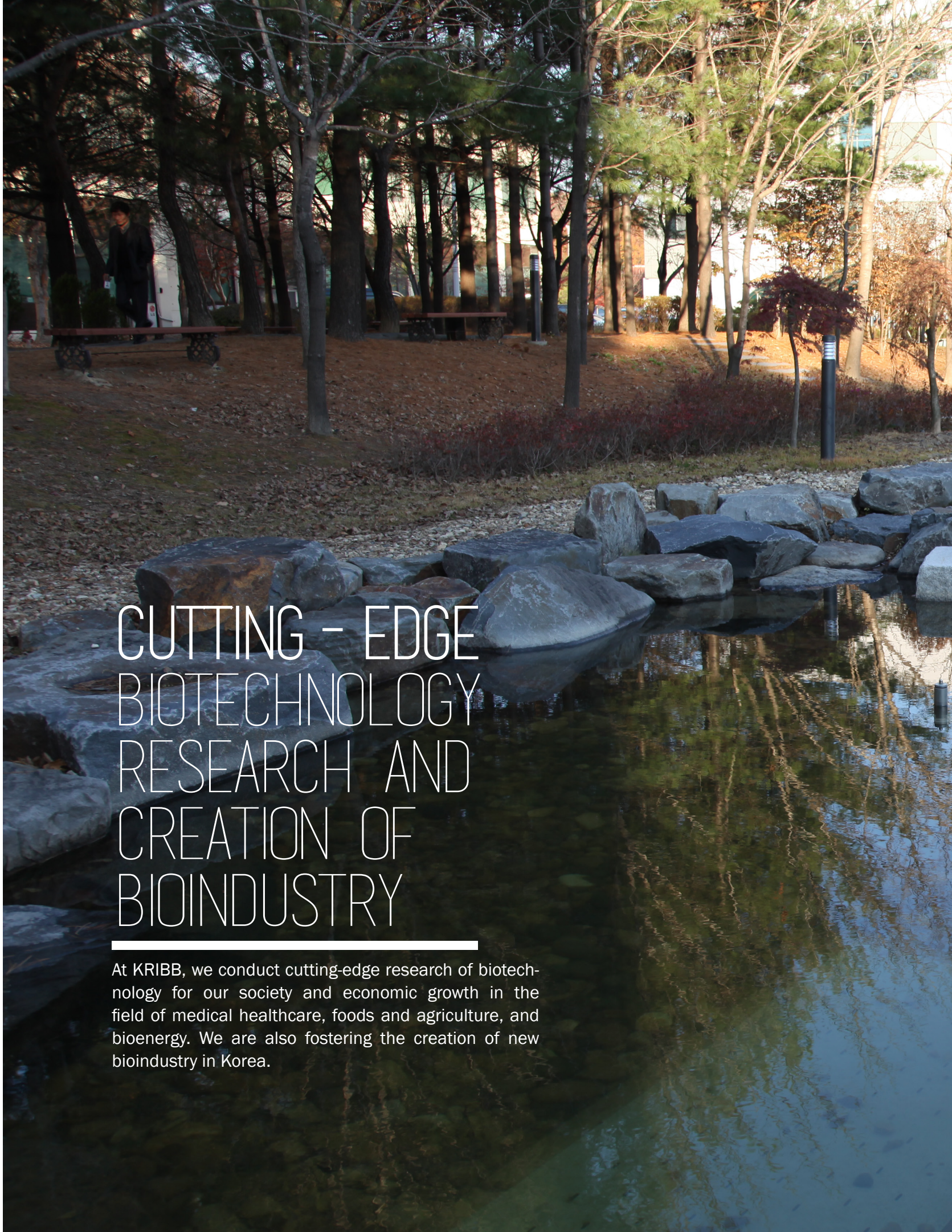
To strengthen its global cooperation in mutually beneficial relationships

- R&D globalization by the Ministry of Science, ICT, Future Planning
  - World Class Institute (WCI) Program, Global Research Laboratory (GRL)
- Research collaboration with industry such as Univ. of Washington, OECD and RIKEN
- Establishment of networks for the preservation and utilization of biological materials with China, Vietnam, Costa Rica and Indonesia.



▶ **International Collaboration Project: 27 countries**





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, foods and agriculture, and bioenergy. We are also fostering the creation of new bioindustry in Korea.

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BIOCONVERGENCE RESEARCH INSTITUTE

- BIONANOTECHNOLOGY RESEARCH CENTER
- SUPERBACTERIA RESEARCH CENTER
- BIOCHEMICALS & SYNTHETIC BIOLOGY RESEARCH CENTER

Serving as the bioconvergence hub of Korea, the Bioconvergence Research Institute contributes a great potential to growth of the country by promoting the creation of new businesses related to bioconvergence while developing bioconvergence technologies to respond to national-level disasters and social issues.

BIONANOTECHNOLOGY RESEARCH CENTER

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Our research center is involved in the development of nano-biochips, nanobiosensors and nano-biomaterials based on the exploitation and utilization of bio-content. By conducting integrated research in the fields of biotechnology (BT), nanotechnology (NT) and information technology (IT)

Our goal is to develop tools to facilitate new drug discovery as well as new technologies for the diagnosis and treatment of diseases, which will contributeto the creation of new businesses and realize our dream of pro-longing human life.

RESEARCHERS

Chang-Soo Lee cslee@kribb.re.kr
- Nanotechnology, molecular self-assembly

Bong Hyun Chung chungbh@kribb.re.kr
- Bionanotechnology, biochemistry

Kweon Yu kweonyu@kribb.re.kr
- Molecular genetic studies on neurophysiology using the Drosophila model

Myung Kyu Lee mklee@kribb.re.kr
- Bionanotechnology, biochemistry

Taejoon Kang kangtaejoon@kribb.re.kr
- Nanomaterials, biosensor

Moonil Kim kimm@kribb.re.kr
- Bioelectronics, Living Biosensor

Kyu-Sun Lee ekuse74@kribb.re.kr
- Development of a Drosophila model system for studying age-related diseases such as diabetes and neurodegenerative diseases

Jeong Soo Lee jeongsoo@kribb.re.kr
- Developing zebrafish as a model system for studying human genetic disorders related to neural development, angiogenesis, and cancer

Juyeon Jung jjung@kribb.re.kr
- Antibody engineering, biological chemistry

Jin Young Jeong jyjeong@kribb.re.kr
- Nanomaterials, Bionanomedicine

Eun-Kyung Lim eklim1112@kribb.re.kr
- Nanomaterials, Nanomedicine, Theragnosis

RESEARCH AREAS

Protein chips
- Development of platform technologies to construct a new generation of protein chips, whose detection systems are free of fluorescence and radioisotopes.
- Creation of protein chips with bio-content that can be employed in disease diagnosis and in high throughput screening of potential pharmaceuticals.

Nanomaterials and Bioimaging
Development of new functional nanomaterials for biomedical applications. Conjugation of inorganic materials, such as metals andmagnetic nano-particles, to various organic molecules in order to investigate the characteristics of proteins and to develop new drugs.

Nanobiosensors
Development of platform technologies to establish and to economically implement biosensors in early disease diagnosis.
- Label-free, ultrasensitive nanobiosensing.
- Bio-content and hardware interfacing.
- Disease diagnosis biomarker design and production.

Mobile Life Care System
Development of technology for Mobile Life Care Systems, enabling portable healthcare, by combining IT with biochips and biosensor technology.

Antibody Engineering
Screening and engineering of antibodies for nano-biosensor and nanobiomaterials application and development of biointerfacing technologies.

ACHIEVEMENTS

Developed Source Nanomaterial for Multiple Imaging Technology
The team has successfully developed a source nanomaterial for new-concept, multiple bioimaging technology, which is useful for a wide variety of applications ranging from new drug development, disease diagnosis to verification of bio- phenomena. The development was achieved through synthesis technology of organic and inorganic nanomaterial and interfacing technology between biomaterial and nanomaterial.

The team invented a hybrid nano-imaging probe capable of optical imaging and magnetic resonance imaging. The invention was made through the development of perfluorocarbon having a unique nuclear magnetic resonance spectrum and a quantum dot with high fluorescence ratio and little cell toxicity.

These nano-probes are made of highly sensitive, biocompatible nanomaterial, which are capable of monitoring in-vivo cell movement. They support real-time monitoring of in-vivo images including the movement of immune cells within the body and the process of cancer cell treatment, which is particularly useful for cancer treatment.

Furthermore, the team independently developed a next-generation bio-imaging system whereby it is possible to monitor in-vivo cell movement using smart phones and smart pads. The system allows researchers to check various image data in real-time, mobile environment without any geographical constraint. The technology is particularly promising for remote diagnosis and medical equipment.

Developed Source Technology for Null Micro RNA Analysis
Recently, the team successfully developed a series of array analysis methods for null micro RNA multiple analysis. The methods utilize structure-specific RNA-binding protein or hexane plasmodium. It is particularly noteworthy that the null micro RNA analysis method using hexane plasmodium demonstrates 10 fM sensitivity and higher specificity than any other existing methods, which presents promising opportunity for standardization of micro RNA analysis method. Furthermore, the technology is suitable for a variety of solid-surface applications, which opens up positive prospects for device application of nano-structured material or microfluidics.

SELECTED PUBLICATIONS

Bong Hyun Chung (Corresponding)
Biomaterials. 34(24):6504-14.
Imaging and therapy of liver fibrosis using bioreducible polyethylenimine/siRNA complexes conjugated with N-acetylglucosamine as a targeting moiety

Bong Hyun Chung (Corresponding)
Biosens Bioelect. 41(1):827-32.
Nuclease-resistant DNA aptamer on gold nanoparticles for the simultaneous detection of Pb^{2+} and Hg^{2+} in human serum

Bong Hyun Chung (Corresponding)
Chem Commun. 49(59):6596-8.
A simple, fast and highly sensitive assay for the detection of telomerase activity

Bong Hyun Chung (Corresponding)
Chem Commun. 49(83):9585-7.
Anchoring foreign substances on live cell surfaces using sortase A specific binding peptide

Kyu-Sun Lee (First)
Gene Develop. 27(24):2642-7.
Roles of PINK1, mTORC2, and mitochondria in preserving brain tumor-forming stem cells in a noncanonical Notch signaling pathway

Myung Kyu Lee (Corresponding)
J Cell Biochem. 114(4):864-73.
Differential in vitro and cellular effects of iron chelators for hypoxia inducible factor hydroxylases

Kweon Yu (Corresponding)
PLoS One. 8(7):e68641.
Drosophila adiponectin receptor in insulin producing cells regulates glucose and lipid metabolism by controlling insulin secretion

SUPERBACTERIA RESEARCH CENTER

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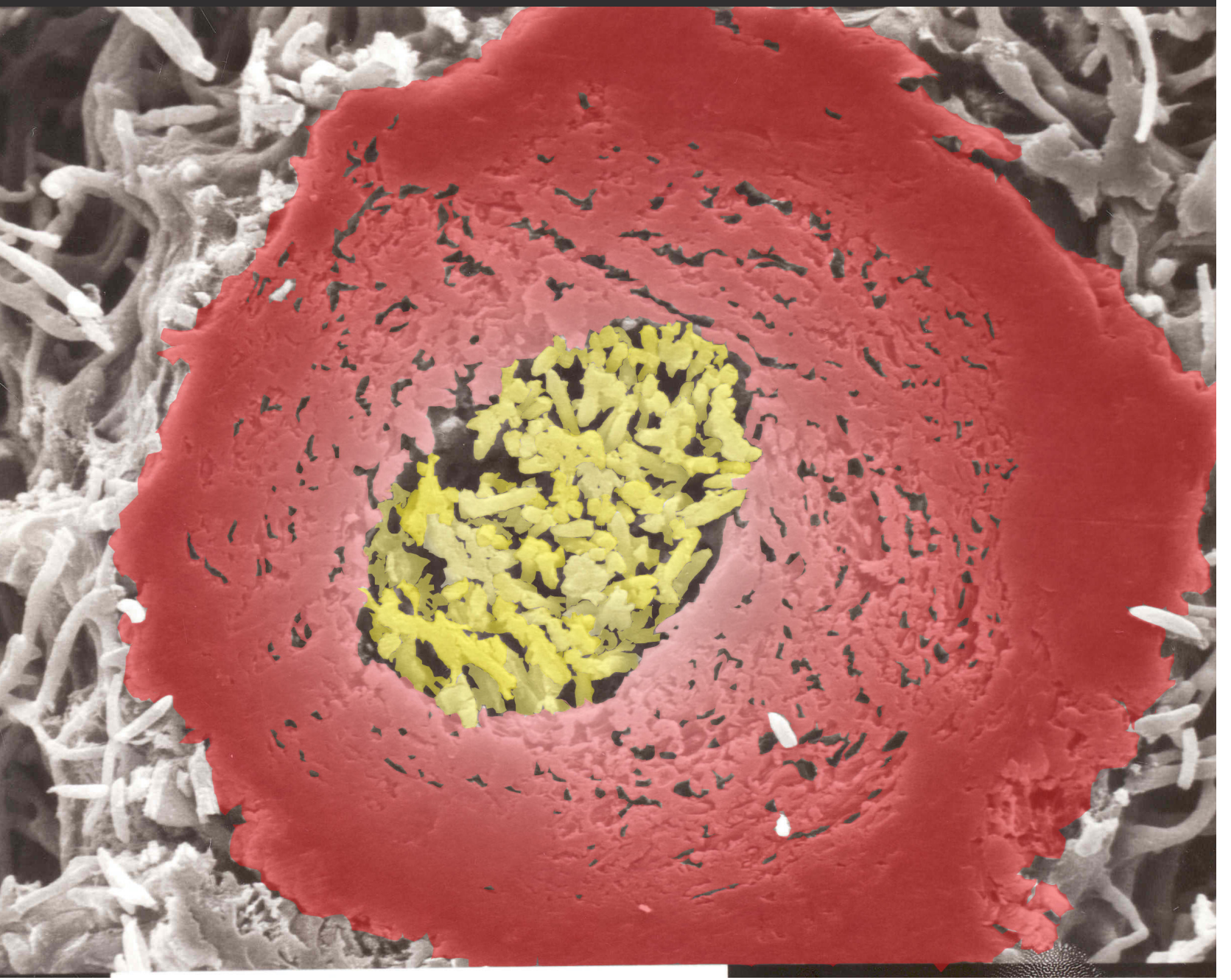
Bacteria being resistant to major antibiotics are evolving into untreatable 'superbacteria'. Although science achievements in genomcis, synthetic biology and other high-throughput biotechnology toolbox are unparalleled, incentives for developing anti-microbials are under-appreciated.

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.



RESEARCHERS

Jae Gu Pan jgpan@kribb.re.kr
- Molecular microbial physiology and antimicrobial genomics

Won-Gon Kim wgkim@kribb.re.kr
- Microbial natural product chemistry / Antibacterial discovery

Choong-Min Ryu cmryu@kribb.re.kr
- Bacteria-bacteria communication, Bacteria-plant interactions, plant immunity

Seung-Hwan Park shpark@kribb.re.kr
- Functional genomic study on Bacillus spp. and peptide antibiotics

Soo-Keun Choi sookeun@kribb.re.kr
- Genetics and genomics of Gram-positive bacteria

Kwang-Sun Kim sunny06@kribb.re.kr
- Biology of small noncoding RNAs, Modulation of ribonuclease activity

RESEARCH AREAS

- Microbial genome analysis and recombineering for enhanced antibiotics production.
- Small RNA biology and induced resistance related to the pathogenic bacteria.
- Antibacterials discovery and target identification with genomic library.
- Bacterial display of enzymes and antigens: directed evolution.
- Bacterial acetylproteomes.
- Bacteria-host interactions.

ACHIEVEMENTS

Dissecting probiotic Paenibacillus-plant interactions and their genome analysis

Understanding and applying Paenibacillus elicited plant growth promotion and induced resistance.

Identification of NRPS gene clusters from *Paenibacillus polymyxa*

Genome-based identification of polymyxin and fusaricidin biosynthetic gene clusters, regulation of their expressions and engineering to generate novel derivatives.

Discovery of antibacterials with new mode of action

Discovery of new antibacterials/ Development of new natural antibacterials from edible plants. Identification of novel antibacterial targets through genomics approach/combination antibacterials.

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.

SELECTED PUBLICATIONS

Jae Gu Pan (Corresponding)
Appl Environ Microbiol. 79(24):7905-15.
Evolved cobalamin-independent methionine synthase (MetE) improves the acetate and thermal tolerance of *Escherichia coli*

Kwang-Sun Kim (Corresponding)
BMC Microbiol. 13:266.
Escherichia coli YmdB regulates biofilm formation independently of its role as an RNase III modulator

Choong-Min Ryu (Corresponding)
Nature Commun. 4:1809.
Interspecific bacterial sensing through airborne signals modulates locomotion and drug resistance

Won-Gon Kim (Corresponding)
PLoS One. 8(11):e78922.
Meleagrin, a new FabI inhibitor from *Penicillium chryosogenum* with at least one additional mode of action

Jae Gu Pan (Corresponding)
Proteomics. 13(10):1726-36.
The acetylproteome of Gram-positive model bacterium *Bacillus subtilis*

BIOCHEMICALS & SYNTHETIC BIOLOGY RESEARCH CENTER

Biotechnology is undoubtedly recognized as 21st century-leading technology due to the potentials of producing high-profit pharmaceuticals, replacing commercial chemical products, and generating new markets with innumerable products from biodiversity. Rational reengineering of biology for biochemicals production requires deep understanding of all functional interactions of relevant components within cells.

We are developing microbial cell factories for pharmaceuticals and biorefinery products such as biomonomers and key chemical products. Our systems/synthetic biology approaches facilitate the rational circuit design and biosystem construction, and revolutionize the development of new biotechnology processes.

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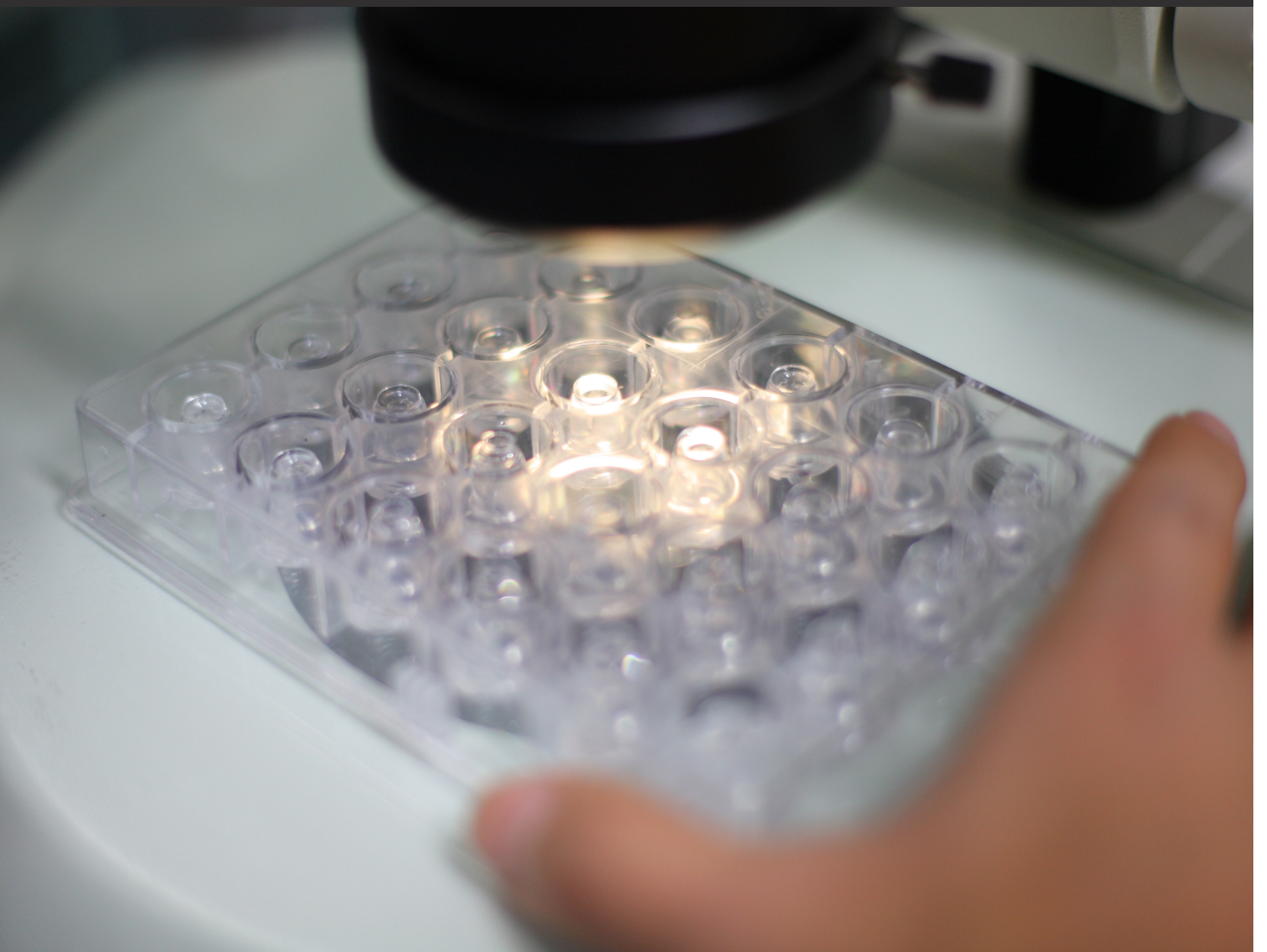

RESEARCHERS

Seung Goo Lee sglee@kribb.re.kr
- Synthetic biology, Protein engineering, Biomolecular imaging

Eui Sung Choi choi4162@kribb.re.kr
- Yeast expression system, Metabolic engineering

Jung Hoon Sohn sohn4090@kribb.re.kr
- Yeast protein factory, Bioenergy

Ohsuk Kwon oskwon@kribb.re.kr
- Microbial functional genomics, Synthetic biology

Heung-Chae Jung hcjung@kribb.re.kr
- Industrial microbiology, Cell surface display for bio-convergence technology

Doo-Byoung Oh dhoh@kribb.re.kr
- Glycoengineering, Glycan remodeling

Sung Ho Yoon moncher@kribb.re.kr
- Systems biology, Metabolic engineering, Bioinformatics

Dae-Hee Lee dhlee@kribb.re.kr
- Evolutionary engineering, E. coli cell factory, Synthetic biology

Ha Seong Kim haseong@kribb.re.kr
- Systems biology, Bioinformatics, Biostatistics

Soo-Jin Yeom sujin258@kribb.re.kr
- Enzyme engineering, Synthetic biology

RESEARCH AREAS

Synthetic biology

Synthesis of novel biological functions, systems, and life forms by utilizing bio-parts, genetic circuitries, and metabolic pathways.

Systems biology

Integrative analysis of multiple omics data and in silico modeling and simulation of biological networks.

Microbial cell / protein factory

Developing novel expression systems with yeast and bacteria, metabolic pathways engineering, and molecular bacteria-plant interactions.

Biocatalyst innovation

Custom-made enzymes, biomolecular engineering, and innovative biocatalysis processes.

ACHIEVEMENTS

Artificial genetic circuits for the development of bio-based chemicals and synthetic biology applications
- Genetic analysis and screening platforms to detect key metabolites and enzymes in cell
- Flow cytometry and high throughput colony imaging techniques, eventually to develop microbial cell factories for pharmaceutical and biochemical products syntheses

Genome analysis of microbes and integrative omics-based cell factory engineering

Genome sequencing and analysis of prokaryotic or eukaryotic microbes of environmental, biotechnological or scientific importance; Genome dynamics, the evolution of bacteria, functional genomic studies, remodeling of signal transduction networks and protein glycosylation pathways

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

Molecular biosensors exhibiting increased signal output and novel specificity

Development of highly-responsive molecular sensors by combinatorial assembly of protein domains

Process development for bio-based chemicals

Bioreactors and fermentation processes for consolidated bioprocessing and enzymatic production of bio-based chemicals

SELECTED PUBLICATIONS

Seung Goo Lee (Corresponding)
PLoS One. 8(11):e79979.
Generating *In vivo* cloning vectors for parallel cloning of large gene clusters by homologous recombination

Doo-Byoung Oh (Corresponding)
Anal Chem. 85(15):7462-70.
Efficient adhesion-based plasma membrane isolation for cell surface *N*-glycan analysis

Ohsuk Kwon (Corresponding)
Bioproc Biosyst Eng. 36(10):1509-18.
Transcriptome analysis of xylose metabolism in the thermotolerant methylotrophic yeast *Hansenula polymorpha*

Sung Ho Yoon (First)
Genome Res. 23(11):1839-51.
A systems level predictive model for global gene regulation of methanogenesis in a hydrogenotrophic methanogen

Eui Sung Choi (Corresponding)
Metabol Eng. 18(1):53-9.
Engineered heterologous FPP synthases-mediated *Z,E*-FPP synthesis in E. coli

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AGING RESEARCH INSTITUTE

- AGING INTERVENTION RESEARCH CENTER
- INFECTION AND IMMUNITY RESEARCH CENTER
- IMMUNOTHERAPY RESEARCH CENTER
- STEM CELL RESEARCH CENTER
- TARGETED GENE REGULATION RESEARCH CENTER

Biomedical Science Institute develops core technologies for future medical care, including the source technology to control aging-associated chronic diseases. The Institute is also committed to develop personalized targeted immunotherapy and biodefense pathogens vaccines. It conducts stem cell research as well to realize personalized/regenerative therapies. Building on these efforts, the Institute will establish a platform for prevention and early diagnosis of intractable diseases. The Biomedical Science Institute ultimately aims to extend the human life span and pioneer new frontiers in the biomedical industry.

AGING INTERVENTION RESEARCH CENTER

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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.

RESEARCHERS

Ki-Sun Kwon kwonks@kribb.re.kr
- Characterizing the function of age-associated genes in human muscular aging
- Understanding the molecular mechanisms in aging-related diseases

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
- Studies on the cell biology underpinning protein-misfolding diseases using fission yeast as a model system

Sung Sup Park sspark@kribb.re.kr
- Understanding the pathogenesis of muscle dysfunction
- Molecular mechanisms in neuronal cell death

Youngwoo Park ywpark@kribb.re.kr
- Therapeutic human antibodies and validation of new cancer targets
- Human antibodies and receptor fusion proteins for Rheumatoid Arthritis

Dae-Yeul Yu dyyu10@kribb.re.kr
- Studies on cellular senescence regulated by antioxidant enzymes and aging-associated molecules using MEF cells

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

Kwang Pyo Lee kplee@kribb.re.kr
- Molecular mechanisms of myoblast (satellite cell) differentiation, dysfunction and diseases (aging and sarcopenia)

Siyoung Yang yangsy@kribb.re.kr
- Studies on molecular mechanism of age-associated joint disorder; chondrocyte dedifferentiation, cartilage destruction and immune response in arthritis

Seokho Kim kims@kribb.re.kr
- Investigation of immune cells in the tumor microenvironment

RESEARCH AREAS

- 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 aging-related genes using model worms, flies and mice.
- Development of drug candidates and biologics for the control of aging-associated diseases.
- roles of gut microbe in host healthspan and longevity.
- Characterize the molecular pathogenic mechanism of arthritis, age-associated joint disorder, using *in vitro* analysis and in vivo mouse model

ACHIEVEMENTS

- Identification of aging-related genes in human muscles: We identified up-regulated genes which are involved in the RNA maturation and splicing and various transcriptional regulators, and also discovered down-regulated genes involved in the activities of cell surface receptors and enzymes in mitochondrial electron transport chain.
- Identification of muscular aging-associated miRNA: We are studying the function of down-regulated miRNAs in old muscles and their targets to improve muscular function in old animals
- 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.
- We are developing the biologics on the basis of a new ligand interacting with a receptor related with muscular aging (ACVRII) (under patent registration and technology transfer).
- Identification of cellular target of a given drug: For the first time, we established DNA-chip based growth defect measurement of genome-wide deletion strains of S. pombe, and then applied 47 drugs. In our approach, putative drug targets were inferred from strains hypersensitive to given drugs.
- Identification of aging-related genes in arthritis: We are identifying arthritis induced genes with *in silico* analysis and characterizing the novel function with in vivo and *in vitro* analysis.

SELECTED PUBLICATIONS

Dae Yeul Yu (Corresponding)
Antioxid Redox Signal. 19(5):482-96.
Prx I suppresses K-ras-driven lung tumorigenesis by opposing redox-sensitive ERK/cyclin D1 pathway

Ki Sun Kwon and Sung Sup Park (Corresponding)
J Neurochem. 127(1):139-48.
PI3Kγ contributes to MEK1/2 activation in oxidative glutamate toxicity via PDK1

Young Woo Park (Corresponding)
Oncogene. 32(8):1018-29.
Identification of a pivotal endocytosis motif in c-Met and selective modulation of HGF-dependent aggressiveness of cancer using the 16-mer endocytic peptide

Dong Uk Kim (First)
Open Biol. 3(5):130053.
A genome-wide resource of cell cycle and cell shape genes of fission yeast

Ki Sun Kwon (Corresponding)
PLoS Biol. 11(6):1001588.
Control of cellular Bcl-x_L levels by deamidation-regulated degradation

INFECTION AND IMMUNITY RESEARCH CENTER

Research in the Infection and Immunity Research Center (IIRC) focuses on development of a more refined model of host-pathogen interaction and mechanism during microbial pathogenesis. We are performing multidisciplinary efforts to better understand host athogenesis and infection. Researchers in our center also investigate the primary molecular mechanism of infectious disease and host immunity using protein structural analysisbased cellular study.

Genome-wide functional metabolic analysis, novel viral vaccine technology and animal disease models in broad array of bacterial and viral pathogens. To effectively address unresolved questions regarding infectious diseases, we have established local, domestic and international scientific collaboration with investigators at the universities, academic institutions and state-of-art intramural facility.

The goal of IIRC is to be a global frontier, make links to the biotech industry and show integral leadership in emerging and known infections and bio-defense research to protect the public against infectious agents. Furthermore, by focusing on the scientific bottlenecks for the development of therapeutic antimicrobial drug and vaccine to fight against pathogens, the center make significant contributions to overcome global health challenges.

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RESEARCHERS

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- Multidisciplinary understanding of the microbe-host interaction, molecular pathogenesis, and immune defenses

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- Development of vaccine adjuvants and study of their immune mechanism
- Development of new recombinant vaccines using lactobacillus as a vehicle

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- Microbial molecular genetics & genomics
- Prokaryotic transcriptional regulation
- Metabolism & physiology
- Systems metabolomics

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- Cellular microbiology
- Microbial molecular pathogenesis
- Microbe-Host Interaction
- Intracellular signaling
- Host responses

Jungwon Hwang jwhwang@kribb.re.kr
- Molecular pathogenic mechanism based on the protein structure and function

RESEARCH AREAS

Molecular mechanisms of pathogenesis
- Structural biology and biochemistry-based microbe-host interaction and molecular pathogenesis.
- Non-canonical functions of aminoacyl-tRNA synthetases.

Development of new vaccine technologies and vaccine adjuvant
- Design of the vaccine antigen and vaccine adjuvant.
- Immunological mechanism study of vaccine and vaccine adjuvants.

Microbial pathogenomics and pathomics

Functional genomics & interactomics of pathogenic microorganisms, comparative metabolomics of pathogenic & non-pathogenic bacteria.

Cellular microbiology

Investigation on the interface mechanism of bacterial virulence factors with host key cells.

ACHIEVEMENTS

Structural basis and mechanism of microbehost interaction

Understanding the molecular basis of interaction between microbe and host, and the mechanism of microbial pathogenesis.

Microbe-induced host cellular signaling to lead stress-activated pathogenesis

Characterization on mammalian host cellular responses including cell death, ER stress, autophagy in infection by primary virulence factors.

Vaccine development

Evaluate the efficacy of vaccines and vaccine adjuvants and characterize the immunological mechanism of viral infection.

Genome-wide analysis of gene regulatory and biochemical reactions to understand microbial physiological and metabolic stress

Elucidation of fundamental energy balance and metabolic stress mechanisms of prokaryotic microbes with clinical or biotechnological importance by metabolomics and transcriptomics approaches.

SELECTED PUBLICATIONS

Myung Hee Kim (Corresponding)
Proced Natl Acad Sci. 110(30):e2829-37.
Structural insights into the regulation of sialic acid catabolism by the *Vibrio vulnificus* transcriptional repressor NanR

Haryoung Poo (Corresponding)
Angewandte Chem. 52(30):7684-9.
Polymer nanomicelles for efficient mucus delivery and antigen-specific high mucosal immunity

Haryoung Poo (Corresponding)
Evid Based Compl Altern Med. 2013:635960.
A single-center, randomized double-blind placebo-controlled study evaluating the effects of poly-gamma-glutamate on human NK cell activity after an 8-week oral administration in healthy volunteers

Sang Jun Lee (Corresponding)
Metabol Eng. 18(1):44-52.
Genome-wide analysis of redox reactions reveals metabolic engineering targets for D-lactate overproduction in *Escherichia coli*

IMMUNOTHERAPY RESEARCH CENTER

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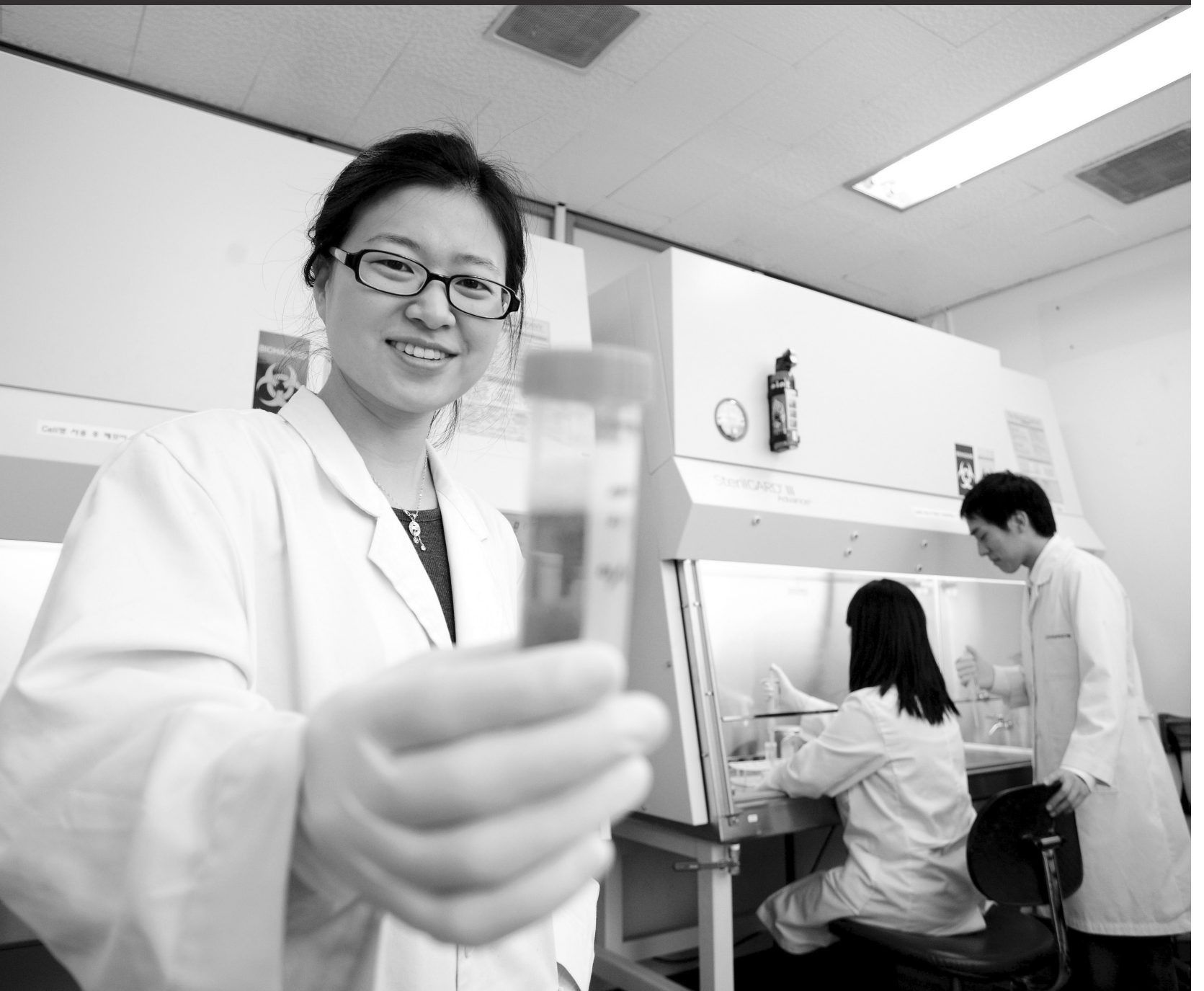
Our goal is to identify the differentiating factors between adult stem cells and immune cells, and by researching their functions, develop core platform technology for immune cell therapies for targeting cancer and to develop the platform technology for anti-cancer antibody therapy and anti-cancer diagnostics.



RESEARCHERS

Inpyo Choi ipchoi@kribb.re.kr
- Differentiation of NK cells from hematopoietic stem cells
- Anti-tumor NK cell therapy based on NK differentiation

Semi Kim semikim@kribb.re.kr
- Mechanism of cancer development and metastasis
- Functional validation of novel therapeutic targets and development of moleculartargeted therapy

Suk Ran Yoon sryoon@kribb.re.kr
- NK cell therapy, Regulation of NK cell differentiation

Tae-Don Kim tdkim@kribb.re.kr
- Molecular mechanism and regulation of NK activation

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- Immune regulation

Haiyoung Jung haiyoung@kribb.re.kr
- Fate decision of hematopoietic stem cells

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 NKcell 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.

High efficient diagnosis
- Construction of molecular diagnostic devices.
- Nano-particle for molecular diagnosis.
- Analysis of diagnostic technology.

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 in the treatment of incurable diseases involving immune cells.

Identification of PAUF and anti-PAUF antibody development

Based on DNA microarray, it was found that PAUF is highly expressed in patients with pancreatic cancer and that the factor roles in pancreatic cancer metastasis. Anti-PAUF antibody blocked the tumor growth in vivo successfully.

SELECTED PUBLICATIONS

Inpyo Choi (Corresponding)
Cell Metabol. 18(1):75-85.
TXNIP maintains the hematopoietic cell pool by switching the function of p53 under oxidative stress

Semi Kim (Corresponding)
Bioorg Med Chem Lett. 23(6):1748-51.
Discovery of novel 2-hydroxydiarylamide derivatives as TMPRSS4 inhibitors

Sang Seok Koh (Corresponding)
Carcinogenesis. 34(3):694-702.
Collagen triple helix repeat containing-1 promotes pancreatic cancer progression by regulating migration and adhesion of tumor cells

Sang Seok Koh (Corresponding)
Oncogene. 32(31):3638-47.
Pancreatic adenocarcinoma upregulated factor, a novel endothelial activator, promotes angiogenesis and vascular permeability

Inpyo Choi (Corresponding)
PLoS Pathogen. 9(10):1003646.
TXNIP deficiency exacerbates endotoxic shock via the induction of excessive nitric oxide synthesis

STEM CELL RESEARCH CENTER

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Our research goal is understanding stem cell functions and disease mechanisms to develop regenerative therapies to treat human diseases. We focus on human stem cells hat have potential to differentiate into a wide range of cell types.

We take molecular, cellular and epigenetic approaches to identify critical factors and to investigate fundamental regulatory mechanisms in self-renewal and differentiation of human stem cells and reprogrammed cells. We also establish human disease model systems using patient-derived induced pluripotent stem cells (iPSCs) and reprogrammed cells to search the way to cure human diseases.

RESEARCHERS

Yee Sook Cho june@kribb.re.kr
- Stem cell biology
- Pluropotency control
- Cellular reprogramming
- Cell-based disease modeling

Janghwan Kim janghwan.kim@kribb.re.kr
- Direct lineage reprogramming
- Neural differentiation of pluripotent stem cells
- Reprogramming to pluripotent cells

Myung Jin Son mjson@kribb.re.kr
- Molecular mechanisms underlying the reprogramming process

Jae Eun Kwak jekwark@kribb.re.kr
- Molecular mechanisms of stemness factors
- Small RNA pathways in hESCs/hiPSCs

Mi-Young Son myson@kribb.re.kr
- The molecular mechanism for maintaining and regaining pluripotency
- Disease modeling using patient-specific iPSCs

Mi-Ok Lee molee@kribb.re.kr
- Signaling pathway regulating stem cell pluripotency
- Disease modeling using patient-derived iPSC

Jungwoon Lee jwlee821@kribb.re.kr
- Molecular mechanisms of induced pluripotency
- Efficient approaches for cellular reprogramming

Da Yong Lee daylee@kribb.re.kr
- The mechanisms of neural differentiation during brain development
- Brain disease modeling using animals

RESEARCH AREAS

- Biological and molecular features of pluripotency and reprogramming.
- Cellular reprogramming technology.
- Human stem cell-based disease modeling.

ACHIEVEMENTS

Involvement of neuropeptide Y and its Y1 and Y5 receptors in maintaining self-renewal and proliferation of human embryonic stem cells

We showed that neuropeptide Y (NPY) and its Y1 and Y5 receptors have a role in maintaining human embryonic stem cell (hESC) selfrenewal and pluripotency through AKT/protein kinase B and extracellular signal-regulated kinase 1/2 (ERK1/2) pathways. We demonstrated that addition of NPY improved a defined and xeno-free culture for the large-scale propagation of undifferentiated hESCs.

Physical passaging of embryoid bodies generated from human pluripotent stem cells

Embryoid bodies (EBs), have been widely used in in vitro differentiation protocols for human pluripotent stem cells. We provided evidence that a simple periodic passaging markedly improved hEB culture condition and thus allowed the size-controlled, mass production of human EBs. The passaging culture method of hEBs, which is simple, readily expandable, and reproducible, could be a powerful tool for improving
a robust and scalable in vitro differentiation system of human pluripotent stem cells.

Generation of human induced pluripotent stem cells from osteoarthritis patient-derived synovial cells

We generated human induced pluripotent stem cells (iPSCs) from synovial cells of patients with osteoarthritis (OA) and showed that these iPSCs are differentiated into functional chondrocytes. Our findings indicate that patientderived synovial cells are an attractive source of iPSCs and have the potential to advance cartilage tissue engineering and cell-based models of cartilage defects.

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) directly from fibroblasts in a surprisingly efficient manner. Our approach fundamentally changed the Yamanaka-factorbased reprogramming paradigm, and dramatically expanded its utilities into lineage-specific transdifferentiation.

Interference with the mitochondrial bioenergetics fuels reprogramming to pluripotency via facilitation of the glycolytic transition

We demonstrate that the disturbance of mitochondrial metabolism enhances metabolic reprogramming toward a glycolytic state, enabling the highly efficient generation of induced pluripotent stem cells. Our findings indicate that changes in mitochondrial bioenergetics are a novel mechanism involved in the regulation of cell fate in the reprogramming of cells to pluripotency.

SELECTED PUBLICATIONS

Yee Sook Cho (Corresponding)
Biomaterials. 34(33):8149-60.
Endothelial progenitor cells from human dental pulp-derived iPS cells as a therapeutic target for ischemic vascular diseases

Yee Sook Cho (Corresponding)
Int J Biochem Cell Biol. 45(11):2512-8.
Interference with the mitochondrial bioenergetics fuels reprogramming to pluripotency *via* facilitation of the glycolytic transition

Mi-Ok Lee (First)
Proced Natl Acad Sci. 110(35):e3281-90.
Inhibition of pluripotent stem cell-derived teratoma formation by small molecules

Yee Sook Cho (Corresponding)
Stem Cells. 31(6):1121-35.
Nicotinamide overcomes pluripotency deficits and reprogramming barriers

Yee Sook Cho (Corresponding)
Stem Cells. 31(11):2374-87.
Unveiling the critical role of REX1 in the regulation of human stem cell pluripotency

TARGETED GENE REGULATION RESEARCH CENTER

Our research goal is understanding stem cell functions and disease mechanisms to develop regenerative therapies to treat human diseases. We focus on embryonic stem cells that have potential to differentiate into a wide range of cell types. We take molecular, cellular and epigenetic approaches to identify critical factors and to investigate fundamental regulatory mechanisms in self-renewal and differentiation of stem cells and reprogramming of adult cells. We also establish human disease model systems using patient-derived induced pluripotent stem cells (iPSCs) to search the way to cure human diseases.

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RESEARCHERS

Yong-Sam Kim omsys1@kribb.re.kr
- Gene knock-out and knock-in technology using TALE and/or CRISPR/Cas system
- Development of disease biomarkers and validation methods with high sensitivity and specificity
- Functional study on molecular dynamics during cancer progression.

Jeong-Hoon Kim jhoonkim@kribb.re.kr
- Epigenetic regulation of cancer development/progression
- Post-translational modification study using Mass spectrometry
- Signal transduction pathway

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- Functional study of epigenetic modulators including methylcytosine dioxygenase Tet 1 and histone deacethylase
- Development of targeted gene regulation technique using TALE and CRISPR/Cas system

RESEARCH AREAS

- Establishment of targeted gene regulation system based on TALE and CRISPR/Cas system
- Development of cancer biomarkers for in vitro cancer diagnostic system
- Functional study on cancer metastasis focused on molecular basis for acquisition of EMT and anoikis during cancer progression.
- Histone modification/epigenetic regulation of gene expression
- NF-κB and mTOR signaling pathways
- Development of targeted epigenetic regulation system based on TALE and CRISPR/Cas system
- Validation of targeted epigenetic regulation system via induction of iPSC

ACHIEVEMENTS

- Regulation of MT1-MMP by GnT-V during cancer progression

We provide evidence that GnT-V guided MT1-MMP in cancer cells. The activated MT1-MMP expression had dual effects on cancer progression. It not only promoted proteolytic activity for cancer cells per se, but also led to the activation of MMP-2. The activation of the two MMPs triggered by GnT-V intensified the invasive potential. A quantitative analysis using clinical tissues revealed a relatively strong correlation between GnT-V overexpression and MT1-MMP upregulation. In this study, we report for the first time that GnT-V directs cancer progression by modulating MMPs in cancer.

- Dimerization of pro-oncogenic protein Anterior Gradient 2 is required for the interaction with BiP/GRP78

Anterior Gradient 2 (AGR2), an ER stress-inducible protein, has been reported to be localized in Endoplasmic Reticulum (ER) and its level is elevated in numerous metastatic cancers. Recently, it has been demonstrated that AGR2 is involved in the control of ER homeostasis. However, the molecular mechanism how AGR2 regulates ER stress response remains unclear. Herein we show that AGR2 homo-dimerizes through an intermolecular disulfide bond. Moreover, dimerization of AGR2 attenuates ER stress-induced cell death through the association with BiP/GRP78. Thus, these results suggest that dimerization of AGR2 is crucial in mediating the ER stress signaling pathway.

- Investigation into the role of PHLPP1 in cell contact inhibition

we report that PHLPP1 is a binding protein for Mst1 and it modulates the Hippo pathway by dephosphorylating Mst1 at the inhibitory Thr(387) of Mst1. Yap1 was localized predominantly in the nucleus but marginally in the cytoplasm in HeLa cells under sparse conditions, whereas the functional protein was more directed to sequestration in the cytoplasm under dense environments. Furthermore, loss of PHLPP1 resulted in a failure of the apoptotic control. It is interesting that down-regulated expression of PHLPP1 appears to mimic the loss of contact inhibition, a hallmark of cancer.

SELECTED PUBLICATIONS

Yong-Sam Kim (Corresponding)
Biochem Biophys Res Comm. 431(4):658-63.
N-Acetylglucosaminyltransferase V triggers overexpression of MT1-MMP and reinforces the invasive/metastatic potential of cancer cells

Jeong-Hoon Kim (Corresponding)
Biochem Biophys Res Comm. 430, 610-615.
Dimerization of pro-oncogenic protein Anterior Gradient 2 is required for the interaction with BiP/GRP78.

Jeong-Gu Kang (First)
Biochem Biophys Res Commun. 2014 Jan 24;443(4):1263-9
PHLPP1 regulates contact inhibition by dephosphorylating Mst1 at the inhibitory site.

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DIVISION OF BIOMEDICAL RESEARCH

- BIOMEDICAL GENOMICS RESEARCH CENTER
- BIOMEDICAL PROTEOMICS RESEARCH CENTER
- BIOMEDICAL TRANSLATIONAL RESEARCH CENTER
- RESEARCH CENTER OF INTEGRATIVE CELLULOMICS

Division of Biomedical Research develops the platform technologies for diagnosis and treatment of cancer and aging-related diseases. Its activities also include discovery of cancer biomarkers and development of cancer diagnosis system, which was approved by KFDA (the Korean Food and Drug Administration). The Division of Biomedical Research is preparing to launch clinical trial of anticancer substances through translational research.

BIOMEDICAL GENOMICS RESEARCH CENTER

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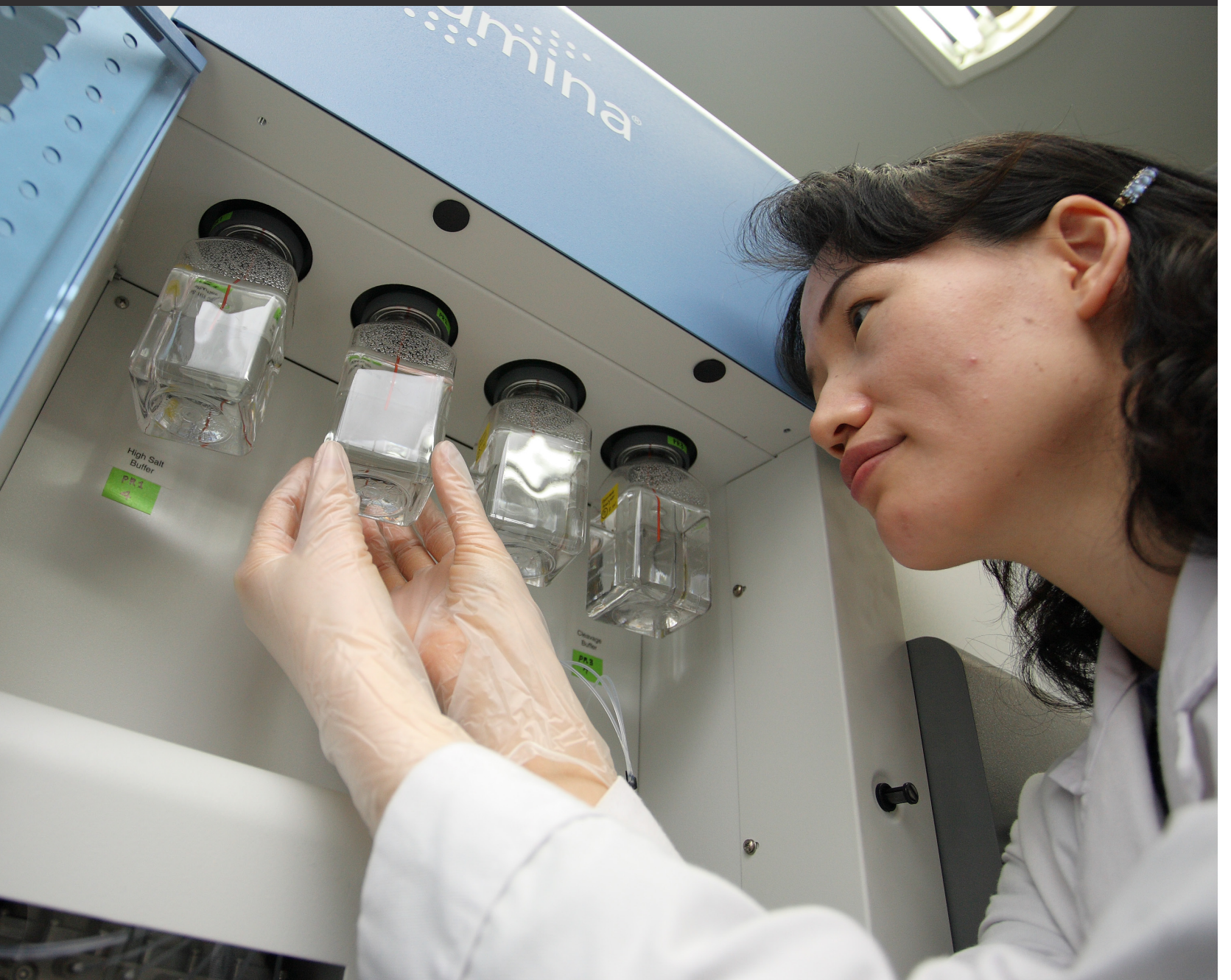
Our goal is to establish world-class genomics-based technology platforms and to apply them to biomedical research programs. This will achieve highthroughput identification and global function analysis of the genes associated with diseases most prevalent in the Korean population, such as colon, stomach and liver cancers. We also conduct functional and chemical genomics research to discover validated targets and biomarkers for the development of effective diagnostics and therapeutics.



RESEARCHERS

Nam-Soon Kim nskim37@kribb.re.kr
- Identification and functional study of therapeutic novel targets related to cancers and large-scale collection of full-length human cDNAs

Yong-Kyung Choe ykccoruk@kribb.re.kr
- Identification and characterization of cancer related genes

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- Identification and validation of target for cancer therapy

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- Epigenomics in gastric and colon cancers

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- Chemical biology and genomics for identification of target molecules and modulators involved in tumor progression and metastasis.

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- Functional validation of candidate target genes and development of anticancer drugs by chemical screening and study of modes of action

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- Development of anticancer drugs by chemical screening and study of modes of action

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- Histone modifications involved in cancer progression

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- Discovery of non-coding RNA biomarker and identification of epigenetic gene regulation mechanism in cancer

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- Epigenetic alterations during human carcinogenesis, Epigenetic mechanisms in stem cell differentiation

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- Study of regulation mechanism and validation of therapeutic target

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- Chemical biology in cancer research

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- Study developing a new cancer therapy targeting histone methyltransferase and demethylase

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- Identification and validation of target for cancer therapy and developing UCP inhibitors as anticancer therapeutics

RESEARCH AREAS

- Establishment of a functional and chemical genomics research infrastructure and technology platforms.
- Large-scale screening and identification of disease related genes.
- Functional validation of candidate target genes and biomarkers for therapeutics and diagnostics development.
- Development of tools and strategies for modulating therapeutic targets and monitoring biomarkers Development of a diagnostic assay system.
- Production and application of antibodies for functional analysis of novel genes.

ACHIEVEMENTS

Identification of Malate Dehydrogenase 2 as a Target Protein for a HIF-1 Inhibitor LW6 Using Chemical Probes

HIF-1α has been recognized as a crucial molecular target for cancer therapy, and various HIF-1α inhibitors derived from natural products or a chemical library have been developed. We have reported the synthesis and biological evaluation of LW6, which is now commercially available as a HIF-1α inhibitor. To isolate the binding molecule of LW6, a series of LW6-derived chemical probes were designed and synthesized by installing a clickable tag and a photoactivatable moiety. Using an clickable probe with flourescent tag, we found that LW6 localized in the mitochondria. In addition, Malate dehydrogenase 2 (MDH2) of TCA cycle was identified as a target protein of LW6 by 2-D PAGE with double photolabeling of both LW6 and a negative control. In parallel with the MDH2 inhibition, LW6 and MDH2 inhibitor L-thyroxine suppressed hypoxia-induced HIF-1a accumulation by inhibiting mitochondrial respiration. LW6 binds to MDH2 blocking mitochondrial respiration, resulting in increased local oxygen tension for degradation of HIF-1α. A high level of MDH2 expression was associated with shorter, relapse-free survival and chemoresistance of prostate cancer patients. The study of the HIF-1α inhibitor LW6 concerning inhibition of MDH2 activity will provide information on the relevance of MDH2 to cancer and its clinical benefit.

The novel function of Cystatin SN in human colorectal tumorigenesis

Cystatin SN (CST1) is one of several salivary cystatins that form tight equimolar complexes with cysteine proteases, such as the cathepsins. High expression of CST1 is correlated with advanced pTNM stage in gastric cancer. However, the functional role of CST1 in tumorigenesis has not been elucidated. In this study, we showed that CST1 was highly expressed in colon tumor tissues, compared to nontumor regions. Increased cell proliferation and invasiveness were observed in HCT116 cell lines stably transfected with CST1 cDNA, but not in CST3-transfected cells. We also demonstrated that CST1-overexpressing cell lines exhibited increased tumor growth as well as metastasis in a xenograft a nude mouse model. CST1 interacted with cystatin C with a higher affinity than the interaction between CST3 and CTSB in the extracellular space of HCT116 cells. CTSB-mediated cellular invasiveness and proteolytic activities were strongly inhibited by CST3, but, in the presence of CST1, CTSB activities recovered significantly. These results suggest that CST1 upregulation might be involved in colorectal tumorigenesis and acts by neutralizing the inhibition of CTSB proteolytic activity by CST3.

Dynamic changes in DNA methylation and hydroxymethylation when hES cells undergo differentiation toward a neuronal lineage

DNA methylation and hydroxymethylation have been implicated in normal development and differentiation, but our knowledge is limited about the genome-wide distribution of 5-methylcytosine (5mC) and 5-hydroxymethylcytosine (5hmC) during cellular differentiation. Using an in vitro model system of gradual differentiation of human embryonic stem (hES) cells into ventral midbrain-type neural precursor cells and terminally into dopamine neurons, we observed dramatic genome-wide changes in 5mC and 5hmC patterns during lineage commitment. The 5hmC pattern was dynamic in promoters, exons, and enhancers. DNA hydroxymethylation within the gene body was associated with gene activation. The neurogenesis-related genes NOTCH1, RGMA, and AKT1 acquired 5hmC in the gene body and were up-regulated during differentiation. DNA methylation in the promoter was associated with gene repression. The pluripotency-related genes POU5F1, ZFP42, and HMGA1 acquired 5mC in their promoters and were down-regulated during differentiation. Promoter methylation also acted as a locking mechanism to maintain gene silencing. The mesoderm development–related genes NKX2-8, TNFSF11, and NFATC1 acquired promoter methylation during neural differentiation even though they were already silenced in hES cells. Our findings will help elucidate the molecular mechanisms underlying lineage-specific differentiation of pluripotent stem cells during human embryonic development.

SELECTED PUBLICATIONS

Mi sun Won (Corresponding)
Angewandte Chem. 52(39):10286-9.
Identification of malate dehydrogenase 2 as a target protein of the HIF-1 inhibitor LW6 using chemical probes

Kyung-Sook Chung (Corresponding)
Apoptosis. 18(7):870-81.
Reactive oxygen species-mediated activation of the Akt/ASK1/p38 signaling cascade and $p21^{Cip1}$ down-regulation are required for shikonin-induced apoptosis

Yong Sung Kim (Corresponding)
British J Cancer. 108(9):1862-9.
Feasibility of proposed single-nucleotide polymorphisms as predictive markers for targeted regimens in metastatic colorectal cancer

Hee Gu Lee (Corresponding)
Cell Death Dis. 4:e974.
Cystatin SN neutralizes the inhibitory effect of cystatin C on cathepsin B activity

Seon-Young Kim (Corresponding)
Forensic Sci Int Genet. 7(1):143-50.
Genome-wide mRNA profiling and multiplex quantitative RT-PCR for forensic body fluid identification

Byoung-Mog Kwon and Dong Cho Han (Corresponding)
J Biol Chem. 288(40):28713-26.
The natural compound cantharidin induces cancer cell death through inhibition of heat shock protein 70 and Bcl-2-associated athanogene domain 3 expression by blocking heat shock factor 1 binding to promoters

Jae Wha Kim (Corresponding)
Oncol Rep. 30(4):1890-8.
NDRG2 positively regulates E-cadherin expression and prolongs overall survival in colon cancer patients

BIOMEDICAL PROTEOMICS RESEARCH CENTER

We will become the R&D hub of nationwide PTPome research in Korea using functional and structural proteomics as a research tool. We are establishing close collaborations with many partner groups in basic research and clinical medicine. Our major research interests include autoimmune disorders, apoptosis, neurodegenerative diseases, stem cell differentiation, and cell signaling.

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RESEARCHERS

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- Target mining and validation using proteomics, Signal transduction

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- Structural studies on anti-oxidant proteins and protein tyrosine phosphatases
- Drug development using 3-D structural information

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- Structural biology studies on apoptosisregulating proteins
- Structure-based design of anticancer drugs and drug repositioning

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- Mass spectrometry, Proteomics, Protein Dynamics, Protein Quantification

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- Structural and functional studies on DNase and proteins in apoptosis
- Hormone nuclear receptors and their application

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- Structural proteomics, Virtual screening for lead compounds

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- New functions of microglia in synapse formation

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- Neutron & X-ray Crystallography, Structural Proteomics, Space Biology

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- Design, organic synthesis, and biological applications of new biocompatible compounds based on supramolecules / macromolecules for the treatment and diagnosis of diseases such as cancer, cardiovascular diseases, macular degeneration, etc

Bonsu Ku bku@kribb.re.kr
- Protein X-ray crystallography

RESEARCH AREAS

Autoimmune disorders

Discovery and functional verifications of biomarkers from patients suffering from immune diseases, e.g. atopic dermatitis, asthma, and rheumatoid arthritis.

Apoptosis

Identification and functional studies on new substrates of caspases, key regulators of apoptosis.

Neuroscience and neurodegenerative diseases

- Proteomic research on neuronal cell functions and neurodegenerative diseases.

Cell signaling

Research on the mechanisms of key cell signaling pathways, e.g. MAPK and NF-kB pathways.

Research on structure and function

Ascertainment of structures, based on X-ray crystallography and NMR, which will lead to findings concerning the unique functions and mechanisms of various proteins (such as protein tyrosine phosphatases and hormone receptors) with medical and industrial importance.

ACHIEVEMENTS

Proteomic research on neuronal cell death

Proteomic research led to the discovery of key proteins involved in the apoptosis of neuronal cells. Functional studies of these proteins were conducted.

Research on apoptosis and cell signaling

Proteomic research led to the discovery of regulators of cellular apoptosis and cell signaling. The results were published in major scientific journals.

Structural studies on human protein tyrosine phosphatases (PTPs)

Efforts to determine the complete PTP structure and broadening our understanding of the functions of human PTPs.

SELECTED PUBLICATIONS

Sunghyun Kang, Eui-Jeon Woo and Tae-Sung Yoon (Corresponding)
ACTA Crystall D. 69(4):555-63.
Structural and biochemical characterization of the cytosolic wheat cyclophilin TaCypA-1

Seung Jun Kim and Seung-Wook Chi (Corresponding)
ACTA Crystall D. 69(6):1160-70.
High-resolution crystal structure of the catalytic domain of human dual-specificity phosphatase 26

Seung Jun Kim (Corresponding)
ACTA Crystall D. 69(8):1514-21.
Structural asymmetry of procaspase-7 bound to a specific inhibitor

Seung Jun Kim (Corresponding)
ACTA Crystall D. 69(8):1522-9.
Structural basis for the dephosphorylating activity of PTPRQ towards phosphatidylinositide substrates

Yoonkyung Kim (Corresponding)
Chem Commun. 49(68):7528-30.
One-pot synthesis of monodispersed silica nanoparticles for diarylethene-based reversible fluorescence photoswitching in living cells

Seung-Wook Chi (Corresponding)
J Biol Chem. 288(10):7387-98.
Dual-site interactions of p53 protein transactivation domain with anti-apoptotic bcl-2 family proteins reveal a highly convergent mechanism of divergent p53 pathways

Jae-Ran Lee (Corresponding)
PLoS One. 8(11):e81218.
Neuronal synapse formation induced by microglia and interleukin 10

BIOMEDICAL TRANSLATIONAL RESEARCH CENTER

Translational research refers to the “bench-to-bedside” enterprise of harnessing knowledge from basic sciences to produce new drugs, devices, and treatment options for patients. Biomedical Translational Research Center was established to develop core technologies and infra-structures required for the effective translation of new knowledge from basic science into new approaches for prevention, diagnosis, and treatment of disease.

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RESEARCHERS

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- Discovery of auto-antibody-based biomarkers that show changes in the serum of cancer patients and Developement of cancer diagnostics

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- Discovery of cancer biomarkers that show changes both in quantity and quality, with highly positive prediction values
- Functional studies that relate the candidate biomarker proteins to the biology of a cancer

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- Epigenetic regulation of early mammalian development
- Molecular genetics on cell de-differentiation and reprogramming

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- Structural Biology, Intrinsically Unfolded/ Disordered Protein (IUP/IDP), NMR Spectroscopy, Peptide Drug, Molecular Computation, Nanoparticle

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- Screening of novel Th17 differentiation factors in Mouse and Human system
- TLR(Toll Like Receptors) signal studies in inflammation
- Innate Immunity

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- Somatic cell nuclear transfer
- Micromanipulation of mouse, porcine and bovine eggs

RESEARCH AREAS

- Translational research for the development of innovative anti-cancer drugs: Establishment of animal models and monitoring systems for testing biological efficacy of anticancer drugs.
- Discovery of novel targets to control cancer metastasis.
- Characterization of the novel intrinsically unfolded / unstructured proteins (IUPs).
- Immunology: screening of Th17 differentiation factors, TLR signaling in inflammation, and innate immunity.

ACHIEVEMENTS

Diagnosis of breast cancer using circulating anti-cytokeratin 8/18 antibody.

A novel circulating tumor-associated autoantibody obtained from a hepatocellular carcinoma (HCC) mouse model was characterized. The target antigen was expressed in various tumor cell lines, and its secretion was detectable using MCF-7 breast carcinoma cells. It was identified as a complex between CK8 and CK18, which was confirmed by analysis using recombinant CK8 and CK18 proteins. To formulate an assay for anti-CK8/18 complex autoantibody, a mimotope peptide was selected from loop-constrained heptapeptide (-CX7C-) display phage library and ELISA using phage-displayed peptide as a coating antigen was able to discriminate breast cancer patients from normal subjects with a sensitivity of 50% and a specificity of 82.61%.

Cardioprotective molecules enriched in beating cardiomyocytes derived from human embryonic stem cells

Cardiomyocytes derived from human embryonic stem cells (hESC-CMs) have attracted attention because of their cardiac regenerative potential *in vivo*. As a first step toward understanding the different molecular conditions of beating and non-beating hESC-CMs, we studied their differential expression patterns and their relevance to in vivo functioning in cardiac injury repair. The results of this study provide further evidence supporting a cardiac regenerative approach using an ptimized cell source derived from hESCs

Studies on intrinsically unfolded / unstructured proteins (IUPs)
- Dr. Han is one of the world pioneer in the IUP area and discovered the first Pre-Structured Motifs (PreSMos) in the trans-activation domain of tumor suppressor p53 in 1995. The results were published in the Journal of Biological Chemistry in 2000 [cited more than 120 times].
- He wrote an invited review that summarizes the novel concept of PreSMos which was published in the Current Protein and Peptide Science in 2012.
- Two patents have been filed on the anticancer peptide derivatives of PreSMos.

SELECTED PUBLICATIONS

Kyou Hoon Han (Corresponding)
BBA-Protein Proteom. 1834(1):342-50.
Structural disorder and local order of hNopp140

Yong-Kook Kang (Corresponding)
Genes Cells. 18(8):694-703.
Regulated nuclear entry of over-expressed Setdb1

Yong-Kook Kang (Corresponding)
Int J Cardiol. 165(2):341-54.
Cardioprotective molecules are enriched in beating cardiomyocytes derived from human embryonic stem cells

Eun Wie Cho (Corresponding)
Int J Oncol. 42(1):65-74.
Identification of a mimotope for circulating anti-cytokeratin 8/18 antibody and its usage for the diagnosis of breast cancer

RESEARCH CENTER OF INTEGRATIVE CELLULOMICS

The main research goal of Research Center for Integrated Cellulomics is to understand the regulation network during differentiation into specific lineages. Our center consists of three research divisions (Differentiation Regulation Core, Signal Monitoring Core, Animal Model Core), which should ultimately enable us to control the cell differentiation. We are establishing intimate collaborations with many research partner groups.

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- Target mining and validation using proteomics approaches
- Studies on proteins involved in stem cell differentiation and metabolic disorders

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- Regulation of Angiogenesis & Vascular inflammation, Identification and validation of new anti-cancer drug target, Regulation of stem cell differentiation

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- Developing bio-analytical technologies using optoelectronics/biosensor-chip technology

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- Studies on regulation of stem cell differentiation
- Discovery and functional analysis of novel cellular biomarkers

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

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- Nano-polymer chemistry

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- Developing nanobiomaterials for biosensor applications
- Syntheses of organic materials for biodevices

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- Translational research for anti-cancer drugs
- Cancer biology (metastasis research)

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- Stem cell biology and neurodegenerative disease

Sang Jick Kim sjick@kribb.re.kr
- Construction of phage displayed antibody library
- Therapeutic protein production using mammalian expression systems

Won Kon Kim wkkim@kribb.re.kr
- Regulation of adipocyte differentiation
- Transdifferentiation of white adipocytes into brown adipocytes
- Research on metabolic diseases

Kyung Jin Oh kjoh80@kribb.re.kr
- Molecular mechanism of metabolic disorder
- Metabolic network

RESEARCH AREAS

Neuroscience and neurodegenerative diseases

Proteomic and animal model studies on neuronal cell functions and neurodegenerative diseases.

Stem cell differentiation and its regulation

Discovery and functional verification of genes and marker proteins, which are involved in the differentiation of stem cells into various lineages.

Stem cell-derived toxicity evaluation system
- Establishing standardization of cellular differentiation to specific lineages.
- Developing technologies for stem cell-derived toxicity/efficacy evaluation system.

Functional studies on key cellular proteins
- Studies concerning the unique functions and mechanisms of protein tyrosine phosphatases with medical and industrial importance.
- Studies on microenvironment of cancers.

Point-of care biosensors & highly sensitive biomaterials-based devices
- Constructing point-of-care biosensors with high sensitivity.
- Developing detection devices.

ACHIEVEMENTS

Mining of cancer biomarkers involved in cancer progress and chemosensitivity
- Discovery of key proteins involved in tumor behavior and chemosensitivity.
- Inhibition of tumor growth and metastasis.

Research on brown beige adipogenesis
- Roles of protein tyrosine phosphatase family in brown adipogenesis.
- Regulation of brown beige adipogenesis.

Studies of stem cell differentiation
- Comparative proteomic analysis of induced pluripotent stem cells.
- Acetylome analysis during adipocyte differentiation of mesenchymal stem cells.

Immunosensing using biosensors
- Graphene oxide-based immunosensing.
- Immunosensing using a metal clad leaky waveguide biosensor.

SELECTED PUBLICATIONS

Yong Beom Shin (Corresponding)
Biosens Bioelect. 42(1):403-8.
Label-free homogeneous FRET immunoassay for the detection of mycotoxins that utilizes quenching of the intrinsic fluorescence of antibodies

Jang-Seong Kim (Corresponding)
Clin Cancer Res. 19(19):5340-50.
Characterization of $CD45^-/CD31^+/CD105^+$ circulating cells in the peripheral blood of patients with gynecologic malignancies

Im Sik Chung (Corresponding)
Crystal Growth Des. 13(9):4131-7.
Bovine serum albumin as an effective surface regulating biopolymer for morphology control of gold polyhedrons

Sang Chul Lee and Kwang-Hee Bae (Corresponding)
J Proteomics. 94:327-36.
Investigation of adipocyte proteome during the differentiation of brown preadipocytes

Tai Hwan Ha (Corresponding)
Tetrahedron Lett. 54(50):6841-7.
Solvent effect and amine interference on colorimetric changes of azobenzene-conjugated dithiaazadioxo crown ether mercury sensor

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DIVISION OF BIOSYSTEMS RESEARCH

- PLANT SYSTEMS ENGINEERING RESEARCH CENTER
- INDUSTRIAL BIO-MATERIALS RESEARCH CENTER
- ENVIRONMENTAL BIOTECHNOLOGY RESEARCH CENTER

Solving critical problems facing our planet and maximizing our natural resources for a sustainable future is an important area of activity at KRIBB. Unveiling the hidden secrets of plants, microorganisms and insects and using them to brew new technologies for biomaterials and bioenergy. These are some examples of our endeavors in this applied biotechnology.

PLANT SYSTEMS ENGINEERING RESEARCH CENTER

We focus on the development of platform technologies for the use in plant science and the improvement of industrially important crop plants. These include identifying functionally important genes as well as establishing a novel transformation system and new transgenic plants with useful traits. We are currently expanding our genomics platform technology for improving useful crops and developing breeding tools. In addition, we are generating industrial transgenic plants with enhanced tolerance to environmental stresses for sustainable development on global marginal lands.

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RESEARCHERS

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- Transgenic plants such as sweetpotato, alfalfa and poplar with enhanced tolerance to multiple stresses for sustainable development on global marginal lands

Haeng-Soon Lee hslee@kribb.re.kr
- Molecular breeding of tuber crops by metabolic engineering of pigment antioxidants

Jae Heung Jeon jeonjh@kribb.re.kr
- Mass production of the seeds or seedling of useful vegetative-propagation crops, and establishment of the optimal system (eg, glycosylation pattern, RNAi knockdown) for molecular farming

Sung Ran Min srmin@kribb.re.kr
- Development of stress resistant and functional crop through nuclear and chloroplast transformation

Won Joong Jeong wonjoong@kribb.re.kr
- Algal biotechnology for biofuel and biomass

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- Mass production of the seeds or seedling of useful vegetative-propagation crops and establishment of the optimal system (eg, glycosylation pattern, RNAi knockdown) for molecular farming

Suk Yoon Kwon sykwon@kribb.re.kr
- Structural and functional genomics of plants, and 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 and identification of the genes involved in the development by virus-induced gene silencing

Jeong Mee Park jmpark@kribb.re.kr
- Molecular plant-microbe interactions and immune signaling pathways in plants

Hye Sun Cho hscho@kribb.re.kr
- Studies on the roles and fine-tuning mechanism of post-translational regulation (PPIase) during plant abiotic stresses, and development of GM crops for increasing biomass

HyeRan Kim kimhr@kribb.re.kr
- Genomics based Crop genetics, breeding and evolution

Jae Cheol Jeong jcjeong@kribb.re.kr
- Understanding of sweetpotato antioxidation mechanism and sweetpotato genomics

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- Crop nutrient molecular biology and Genetics
- Crop nutrient improvement

RESEARCH AREAS

- Plant genome structural, functional and evolutionary genomics
- Functional genomics of plant-microbe interactions
- Development of an environmentally-friendly binary vector system
- Signal transduction network of pathogen-induced plant cell death
- CyanoCrop using cyanobacterial genes
- Post-translational mechanism under stress
- Interactions of human pathogens and plants

ACHIEVEMENTS

Development of transgenic sweetpotato with enhanced pigment antioxidants

Transgneic sweetpotato calli with high yields of β -carotene by down-regulation of lycopen ε-cyclase were generated and characterized. Transgenic sweetpotato plants to produce both anthocyanin and carotenoids in one storage tubers were generated by introducing IbOrange gene responsible for carotenoid accumulation into purple-fleshed sweetpotato.

Development of plant-based production system of useful protein

We have successfully developed and overexpressed synthetic viral coat proteins (CPs) with only the coding sequence for CPs in a host plant, and these CPs showed self-assembly into VLPs. Based on these results, we confirm that these artificially constructed CPs can be developed for the role of carrier target proteins.

Development of genomics assisted breeding tools

We have embarked on an ambitious genomics program entitled the 'Cabbage genomics assisted breeding support project'. The long-term objective of the project is to create a genome-level closed breeding system for the Brassica oleracea that can be used as a research platform to study evolution, development, genome organization, polyploidy, domestication, gene regulatory networks and crop improvement

Development of algal biotechnology

We have developing algal biotechnology using Chlamydomonas, Chlorella, and Porphyra. Our goals are (1) understanding of algal genome using NGS and functional genomics and (2) genetic engineering for basic and applied biology in algae.

Functional analysis of novel immunophilins

Identified novel immunophilins which play roles in maintaining photosynthetic acclimation under various environmental stresses, and developed the GM crops for enhanced tolerance to abiotic stresses using these genes

Interactions between human enteropathogenic bacteria and plants

Development of an experimental system for studying interaction between human enteropathogenic bacteria and Arabidopsis thaliana as the host.

Involvement of ER stress on plant cell death induced by pathogen

Elucidation of the role of endoplasmic reticulum stress on plant-virus interactions by using molecular, biochemical and cell biological studies.

SELECTED PUBLICATIONS

Haeng Soon Lee and Sang-Soo Kwak (Corresponding)
Physiol Plant. 147(4):432-42.
Downregulation of the lycopene epsilon-cyclase gene increases carotenoid synthesis via the β-branch-specific pathway and enhances salt-stress tolerance in sweetpotato transgenic calli

Hye-Ran Kim (Corresponding)
J Agricul Food Chem. 61(46):11222-30.
Metabolic differentiation of diamondback moth (*Plutella xylostella* (L.)) resistnace in cabbage (*Brassica oleracea* L. ssp. *capitata*)

Hye Sun Cho (Corresponding)
Int J Mol Sci. 14(3):5899-919.
A rice immunophilin gene, *OsFKBP16-3*, confers tolerance to environmental stress in *Arabidopsis* and rice

Jeong Mee Park (Corresponding)
Int J Mol Sci. 14(11):22782-95.
Identification of novel pepper genes involved in Bax- or INF1-mediated cell death responses by high-throughput virus-induced gene silencing

Jae Sun Moon (Corresponding)
Archiv Virol. 158(8):1817-20.
Complete genome sequence of keunjorong mosaic virus, a potyvirus from *Cynanchum wilfordii*

INDUSTRIAL BIO-MATERIALS RESEARCH CENTER

Based on bio-diversity of insects, microorganisms, plants and marine organisms, our group is trying to figure out and build-up new platform technologies that can make new biomaterials, diverse enzymes(including feed enzymes and saccharification enzymes), functional foods, nutraceuticals and biopesticides.

- New industrial enzymes from insects and related microflora
- Nutraceuticals and functional foods for metabolic disorders and liver diseases
- Bio-pesticide ingredients from natural sources
- Business plan and bio-plant know-how in biodiversity field

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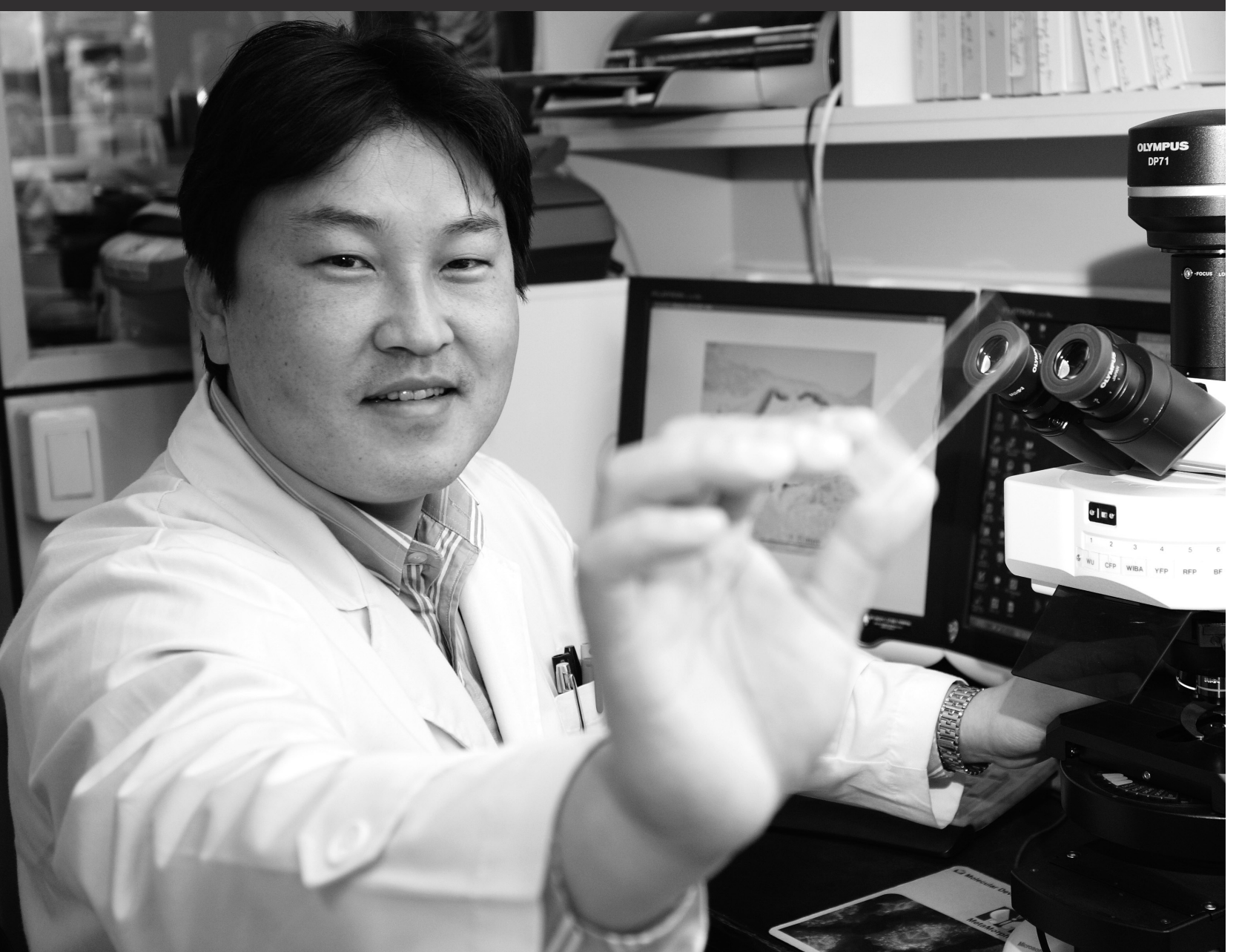

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- Microbial Biotechnology
- Bio-diversity based enzymes for industrial uses
- Microbial natural products for pharmaceutical uses

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

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- 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

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

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- Search and development of bio-materials for agriculture including biological control agents, insecticides and insect repellents from natural resources
- Provide imaging and analytical services, including scanning and transmission EM for bio-research

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

RESEARCH AREAS

Development of bio-materials based on biodiversity and FT (fusion technology)
- Unique enzymes from insect and related (symbiotic for example) microorgnaisms.
- 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 platform technology for metabolic disease control
- Study of drug mechanism and target identification.
- Development of nutraceuticals or lead compound from plat and edible sources.

Development of antibiotic biomaterials from natural sources
- Search for the inhibitors of type III secretion system in plant-pathogenic G(-) bacteria.
- Screening of antifungals for plant pathogenic fungi.

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

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.

Discovery of signaling modulators using wild type and a calcineurin mutant of *Cryptococcus neoformans*
- Using specific signal mutants of Cryptococcus 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. Two compounds from plant extracts were isolated and their structures and biological activities were determined.

SELECTED PUBLICATIONS

Sung Uk Kim (Corresponding)
Int J Syst Evol Microbiol. 63(4):1304-10.
Pedobacter luteus sp. nov., isolated from soil

ENVIRONMENTAL BIOTECHNOLOGY RESEARCH CENTER

We aim to develop industrial platform technologies using high-tech ecogenomics and biological resources in response to three United Nations Environmental Conventions on Biodiversity, Climate Change, and Combating Desertification.
To achieve these goals, we focus on the development of integrated fusion technologies combined with plant science, microbial science (including microalgae), and environmentally-friendly materials science.

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RESEARCHERS

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- Enhancement of multi-resistances of plants using natural lipids and plant green biotechnology on natural rubber

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- Ecophysiology, ecogenomics and ecoinformatics of microalgae and cyanobacterial bloom
- Optimization of mass cultivation of microalgae, using wastewater

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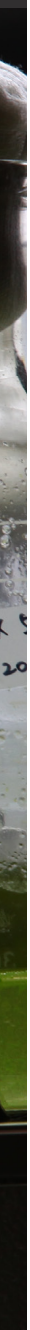
- Microbial taxonomy and genetic engineering of microalgae for enhanced lipid production and growth



RESEARCH AREAS

Microalgae research

Using diverse microalgae in carbon dioxide sequestration and production of microalgal biomass for biofuel and biorefinery.

Microbial community research

Development of functional microbial communities for bioremediation of contaminated soil and analysis of their microbial diversity and functions.

Biomaterials research

Discovery and mode-of-action studies of new bioactive substances from microorganisms and plants/ Engineering and combination of secondary metabolite biosynthetic elements from different bacteria to generate novel products.

ACHIEVEMENTS

Increased lipid productivity in microalgae for biofuel production

Domestic microalgae strains were collected from Korean freshwaters and screened for high lipid production. Diverse molecular techniques have been applied to increase lipid productivity by manipulating lipid production pathways. To find out optimal cultivation system, a lot of strains, environmental conditions, and culturing methods are being compared.

Development of functional microbial communities for bioremediation

The functional microbial communities (FMCs), capable of highly dechlorinating PCE/TCE, were obtained from contaminated sediments. We analyzed the bacterial structure of the FMC and their dynamics during dechlorination of PCE/TCE.

Mechanism of cyanobacterial bloom and its control

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

Environmentally safe natural bioactive substances from plants

Bioactive lipid compounds that enhance multiresistances in plants to abiotic and biotic stresses were found and are being applied to agricultural fields.

SELECTED PUBLICATIONS

Hee-Sik Kim (Corresponding)
Bioresour Technol. 131:195-201.
Microalgae-associated bacteria play a key role in the flocculation of *Chlorella vulgaris*

Hee-Mock Oh (Corresponding)
Bioresour Technol. 127:482-8.
Ettlia sp. YC001 showing high growth rate and lipid content under high CO_2

Hee-Sik Kim (Corresponding)
FEBS Lett. 587(4):370-7.
Lipid droplet synthesis is limited by acetate availability in starchless mutant of *Chlamydomonas reinhardtii*

Chi-Yong Ahn and Hee-Mock Oh (Corresponding)
Int J Syst Evol Microbiol. 63(2):484-9.
Arenimonas daechungensis sp. nov., isolated from the sediment of a eutrophic reservoir

Chi-Yong Ahn (Corresponding)
J Appl Phycol. 25(3):875-82.
Optimization of flocculation conditions for *Botryococcus braunii* using response surface methodology

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DIVISION OF BIOLOGICAL INFRASTRUCTURE

- MICROBIAL RESOURCE CENTER
- LABORATORY ANIMAL RESOURCE CENTER
- INTERNATIONAL BIOLOGICAL MATERIAL RESEARCH CENTER
- HUMAN DERIVED MATERIAL CENTER
- KOREA NATIONAL PRIMATE RESEARCH CENTER
- BIO-EVALUATION CENTER
- ABS RESEARCH SUPPORT DEPARTMENT
- LMO RESEARCH SAFETY CENTER

As a national supporting system for biotechnology, the Korea Biological Resource Center (KBRC) has been strengthening to manage biological resources and information, and providing the basis of research support. Also, it has helped to foster the bioindustry for providing biological resources to research institutes, academia and industries.

MICROBIAL RESOURCE CENTER

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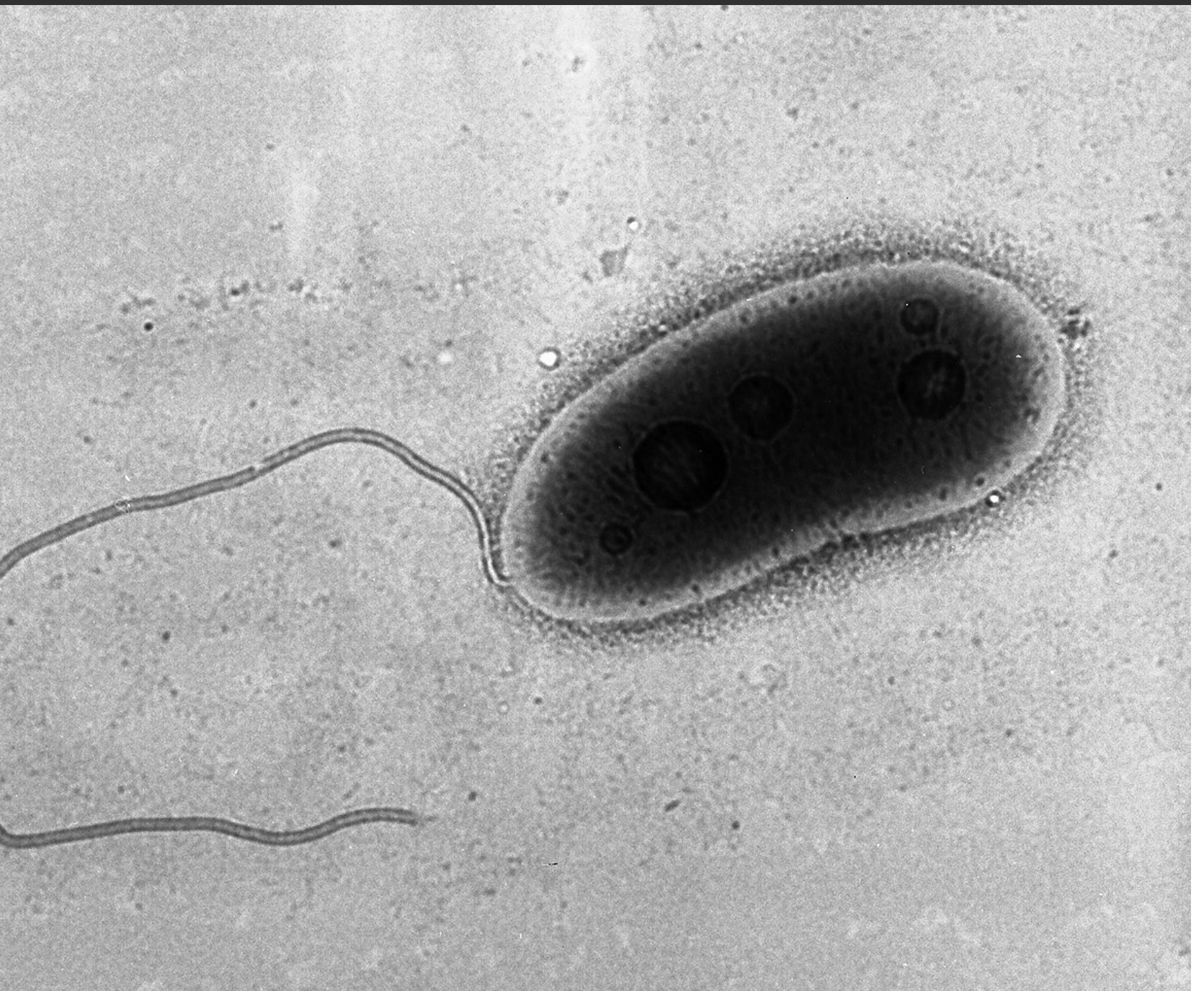
As part of the national bio-infrastructure for biological resources, Microbial Resource Center, known as Korean Collection for Type Cultures (KCTC), is a biotechnology think-tank in which performs bio R&D. The main goal of the KCTC is to collect, preserve and distribute microbial resources.



RESEARCHERS

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- Curator for animal cell lines and patent resources

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- Management of KCTC
- Curator for actinobacterial resources

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- Curator for anaerobic bacteria and lactic acid bacterial resources
- Development of probiotics using bioprospecting technology

Kee-Sun Shin ksshin@kribb.re.kr
- Curator for yeast resources
- Study on the value creation of microbial resources

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- Curator for filamentous fungi resources
- Genome evolution, metagenomics, microbial ecology

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- Curator for archaea, extremophiles, and gram-positive bacterial resources

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- Microbial diversity, taxonomy and ecology

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- Microbial diversity and biocontrol agents

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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.

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.

ACHIEVEMENTS

Collection, preservation and distribution of microbial resources

KCTC is ranked as third place in the world for acquiring 2,094 strains, including bacteria, actinobacteria, yeasts, filamentous fungi, anaerobes, archaea, animal and plant cell lines, microalgae and patent strains. And KCTC preserved 66,546 cases for long-term preservation and distributed 6,036 strains to researchers. KCTC, as a worldwide culture depositories stipulated by the Budapest Treaty, also played a significant role in deposition of international patent microorganisms.

Research activities

KCTC has published 65 papers, described 32 new species, and registered 4 patents of which included an international patent. KCTC also endeavors to develop bioinformatics tools (e.g., CLUSTOM, PyroTrimmer, MycoDE) since analysis of high-throughput NGS sequencing data becomes essential for studying microbial taxonomy and ecology in recent days. By the successful completeness of our bioinformatics projects in near future, KCTC is expected to play a crucial role for conducting state-of-the-art researches in microbiology related fields, including rapid screening of new microbial resources and the application research for microbial resources. We also isolated new extremophilic microbial resources from deep sub-seafloor sediment and rumen of a Korean native cattle (Hanwoo). The novel archaeal methanogens isolated from rumen and fecal samples will be contributed for the elucidation of the molecular mechanisms for biocontrol of methane emission and human obesity.

Construction of an information network and support of various services

KCTC has constructed local and global networks of Microbial Resource Centers. domestic and international databases were connected through KCTC's main services that provides microbial resource information to the public. KCTC held eleven workshops, and offered technical supports for management of microbial resources. And the citation number of microbial resources of KCTC is continued to grow over 10% annually during 2011-2013 (Google scholar*). The increase in the annually estimated number of users is, to a large extent, a reflection of an increase in the quality of biological resources stocked in KCTC.

SELECTED PUBLICATIONS

Kee Sun Shin (First)
Anton Van Leeuwenhoek. 103(5):971-8.
Hoeflea halophila sp. nov., a novel bacterium isolated from marine sediment of the East Sea, Korea

Byoung Chan Kim (Corresponding)
Int J Syst Evol Microbiol. 63(6):1942-6.
Oscillibacter ruminantium sp. nov., isolated from the rumen of Korean native cattle

Kyung Sook Bae (Corresponding)
Int J Syst Evol Microbiol. 63(11):4000-5.
Polaribacter sejongensis sp. nov., isolated from Antarctic soil, and emended descriptions of the genus *Polaribacter, Polaribacter butkevichii* and *Polaribacter irgensii*

Kyung Mo Kim (Corresponding)
PLoS One. 8(5):e62623.
CLUSTOM: a novel method for clustering 16S rRNA next generation sequences by overlap minimization

LABORATORY ANIMAL RESOURCE CENTER

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The goal of our center is to establish a national infrastructures for laboratory animal resources and intramural service core for animal experimentations. For these purposes, we are collecting mouse resources, developing technologies, generating animal models for human diseases, and providing services for researchers in biomedical research fields. We have been collecting, preserving and distributing laboratory animal resources since 1984. We are developing technologies for the quality control of the laboratory animals, generating genetically engineered mice (GEM) and perform *in vivo* validation of genes associated with human diseases. Recently we have started international cooperation on development of GEM and it's primary phenotyping to complete mammalian functional genome encyclopedia.

RESEARCHERS

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

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

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- Genetic monitoring of laboratory animals Health Safety of LMO

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- Health monitoring of laboratory animals

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

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

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- Supports for veterinary care and histopathological analysis
- Microbiological quality control of laboratory animals

RESEARCH AREAS

Laboratory animal resources center
- Collection, maintenance, and allocation of laboratory animal resources.
- Breeding 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.
- 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.
- Training of laboratory animal techniques.

ACHIEVEMENTS

A highly representative and the largest Korean laboratory animal resource bank
- Deposits of laboratory animal resources: 560 strains
- Distribution of laboratory animal resources : animals 7,601

Quality control center for laboratory animals
- Health monitoring: 3,104 animals
- Mouse genotyping: 4,103 animals
- Animal clearing: 50 strains

Training in laboratory animal techniques
- The 35th Laboratory Animal Workshop was held on November 20-21, 2012.

International cooperation with ICLAS and AMMRA
- 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: 87 cases
- Pathological experiment: 88 cases
- Hematological and biochemical analyses: 84 cases
- Education service associated with animal ethics and appropriate animal experiments for animal experimenters : 4 times

SELECTED PUBLICATIONS

Chul-Ho Lee (Corresponding)
Cardiovascul Res. 99(4):743-50.
NQO1 activation regulates angiotensin-converting enzyme shedding in spontaneously hypertensive rats

Chul-Ho Lee (Corresponding)
Diabetes. 62(9):3093-102.
Inverse agonist of nuclear receptor ERRgamma mediates antidiabetic effect through inhibition of hepatic gluconeogenesis

Chul-Ho Lee (Corresponding)
Gut. 62(7):1044-54.
Estrogen-related receptor gamma controls hepatic CB_1 receptor-mediated CYP2E1 expression and oxidative liver injury by alcohol

Chul-Ho Lee (Corresponding)
Int J Biochem Cell Biol. 45(8):1538-45.
The orphan nuclear receptor small heterodimer partner negatively regulates pancreatic beta cell survival and hyperglycemia in multiple low-dose streptozotocin-induced type 1 diabetic mice

Chul-Ho Lee (Corresponding)
J Biol Chem. 288(22):15937-46.
Insulin directly regulates steroidogenesis via induction of the orphan nuclear receptor DAX-1 in testicular leydig cells

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 to provide researchers with a variety of materials, including indigenous medicinal knowledge and 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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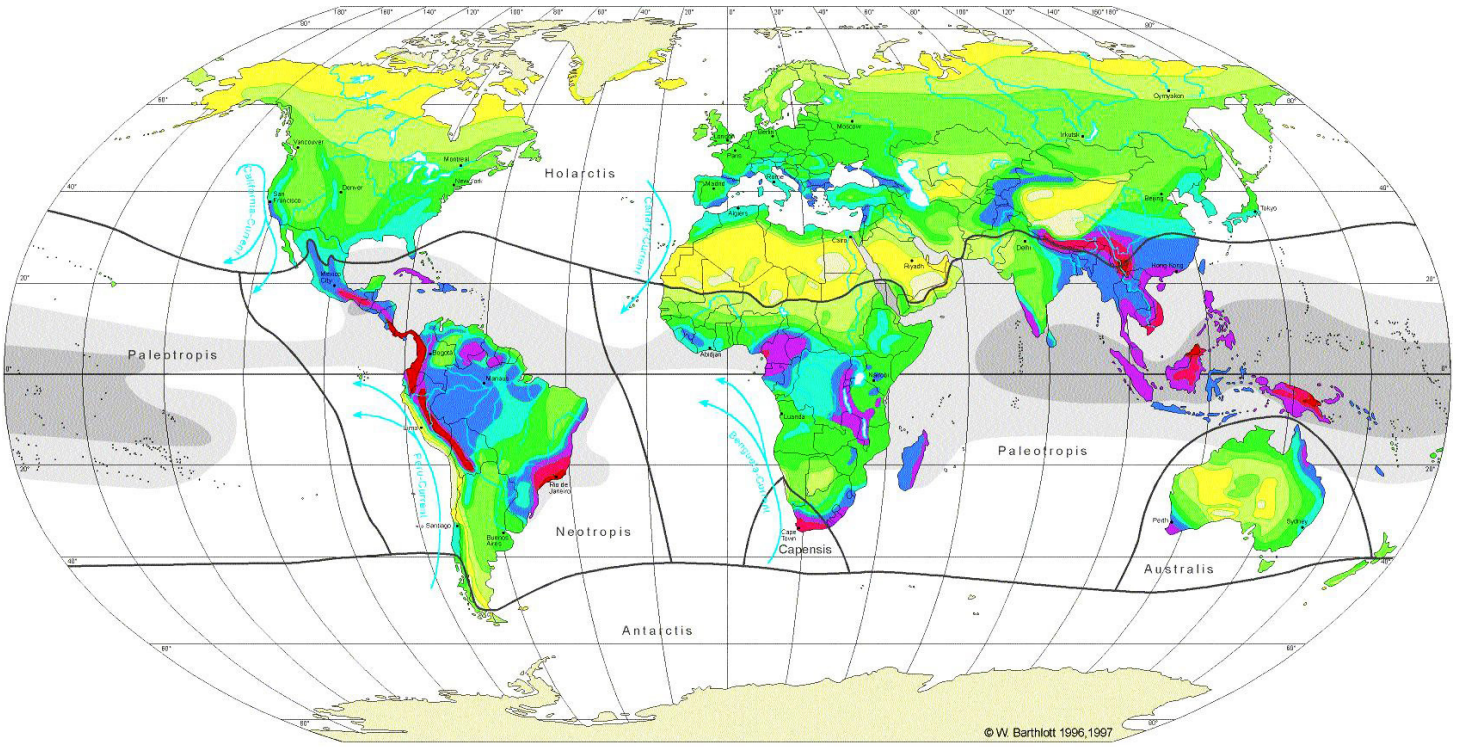

RESEARCHERS

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- Plant taxonomy
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RESEARCH AREAS

- Operation and management of four collaborative biological material research centers for 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.

- Establishment and operation of a supply system for efficiently providing biological materials to leading research groups within scope of the assigned project.

- Development of new natural drugs, nutraceuticals and other commercially important natural products.

ACHIEVEMENTS

Establishment of the International Biological Material Research Center

Center organization has been completed. Equipment and facilities have been set up: highly-sensitive equipment (LC/MS and electric microscopes) and an expanded herbarium (storage capacity over 100,000 voucher specimens). In addition, nearly 630,000 plant extracts have been distributed to date.

Procurement of Foreign Biological Materials China and neighboring countries

- Establishment of the Korea-China Biological Material Research Center in Kumming, China.
- Personnel (1 expert from Korea) and research equipment set up.

Central and South America

- Establishment of the Korea-Costa Rica Biological Material Research Center in Santo Domingo de Heredia, Costa Rica.
- Personnel (1 expert from Korea) and research equipment set up.

South-East Asia

- Establishment of the Korea-Indonesia Biological Material Research Center in Tangerang, Indonesia.
- Personnel (1 expert from Korea) and research equipment set up.

Indochina Peninsula

- Establishment of the Korea-Vietnam Biological Material Research Center in Hanoi, Vietnam
- Personnel (1 expert from Korea) and research equipment set up.

SELECTED PUBLICATIONS

Joongku Lee (First)
Genet Mol Res. 12(4):4515-25.
Molecular phylogenetic relationships among members of the family Phytolaccaceae *sensu lato* inferred from internal transcribed spacer sequences of nuclear ribosomal DNA

Joongku Lee (Corresponding)
Ann. Bot. Fennici 50(1-2): 95-98.
Cordiglottis longipedicellata (Orchidaceae), a new species from Vietnam

Joongku Lee (Corresponding)
Ann. Bot. Fennici 50(1-2): 99-102.
Capparis daknongensis (Capparaceae), a new species from Vietnam.

Joongku Lee (Corresponding)
Ann. Bot. Fennici 50(4): 258-262.
Argostemma glabra (Rubiaceae), a new species from Vietnam.

HUMAN DERIVED MATERIAL CENTER

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Our main goal is to collect, preserve and distribute cDNA clones derived from human and mouse through Korea Human Gene Bank (KHGB) which is the national bio-infrastructure for human cDNA resources. Our center also established a solid platform for genome sciences, and archived many world-leading research products through international cooperation. We are actively collaborating with many academic and industry research groups to contribute to genome technology advancement in Korea.

RESEARCHERS

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- Bioinformatics: Disease associated protein network analysis by systems biology

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- Bioinformatic: Discovery and characterization of fusion genes and integrative analysis of genomes by next generation sequencing platform

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- NGS sequencing

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- Large-scale collection and distribution of human cDNA clones

RESEARCH AREAS

Curation and management of cDNA clones derived from human and mouse
- Collection and preservation of human cDNA clones
- Collection and preservation of mouse cDNA clones
- Distribution of cDNA clones of human and mouse to academia, research institutes and industries.

Development of core technologies for valuable microbial resources
- Development of platform technologies for the management, preservation and taxonomy of useful microbial resources.

Construction of an information network and support of various services related with microbial resources
- Construction of local and global networks for microbial resources.
- Support the related information and providing workshops, conferences, consultations, etc.

ACHIEVEMENTS

Korea Human Gene Bank (KHGB): Collection, preservation and distribution of cDNA clones derived from human and mouse.

Korea Human Gene Bank (KHGB) is the national bioinfrastructure for human cDNA resources. The KHGB contains 17,000 human cDNA clones including about 10,000 full-length cDNAs which was collected by 21 century frontier human functional genome project. In addition, it has 16,000 mouse cDNA clones including about 10,000 full-length cDNAs which was obtained from NIH, USA by collaboration.
These human and mouse cDNA clones have been currently distributed into researchers through KHGB. We also developed and provide core technologies for collecting human cDNA clones and constructing a genome-wide recombinant protein expression system.

Construction of next-generation sequencing platform

The sequencing facility on human derived material center is equipped with major next generation sequencing available on the market, including Roche's GS-FLX 454, Iilumina's Hiseq2000, Iilumian's Hiseq2500 and Iilumian's Miseq, which allow human derived material center's sequencing capacity to be over 100GB per day. Using these cutting edge platforms, our center offers high-throughput DNA sequencing service at vary short time. We can ensure you the best solution that covers current genomic research and large scale project. In particular, we developed various component base systems for genome analysis services including genome sequencing (De novo sequencing,
Whole genome resequencing, Whole genome resequencing), transcriptome sequencing (Exome sequencing, RNA-seq sesequencing), ChIP-seq sequencing, Metagenome 16s rRNA sequencing, providing customized services according to customers' needs. And also, our bioinformatics core provides computing, data infrastructure, and bioinformatics support for customers as well as to develop plans to meet bioinformatic service needs.

Mi-PGAS: a web server for microbial genome analysis

The annotation of large amounts of microbial genomes from next-generation sequencing platforms needs to be rapid, high-throughput, and fully integrated and automated. Thus, we have developed a web server for the automated annotation and comparative analysis of microbial genomes called pipeline for microbial genome analysis service (Mi-PGAS). Mi-PGAS uses contigs as the input, with/without a reference sequence or assembled continuous sequences, in FASTA format files. Mi-PGAS identifies protein-coding regions and, tRNA and, rRNA genes, assigns functions to the genes, finds transposable elements and tandem repeats, and visualizes all of the annotation results using a genome browser and in tabular form. In addition, if the contigs are uploaded with a reference sequence, pseudo-assembly based on BLAT alignment results, and a comparative analysis module containing a synteny map and variants analyseis report are available.

SELECTED PUBLICATIONS

Nam-Soon Kim (Author)
PLoS One. 8(10):e77099.
Phosphorylation of FOXP3 by LCK downregulates MMP9 expression and represses cell invasion

Nam-Soon Kim (Author)
FISH & SHELLFISH IMMUNOLOGY. 34(5). 1390~1394
Establishment of a transgenic zebrafish EF1α:Kaede for monitoring cell proliferation during regeneration.

KOREA NATIONAL PRIMATE RESEARCH CENTER

The NPRC was established within KRIBB as a major national infrastructure component to support industrial, academic and research institutions in the development of xenotransplant organs, providing animal models for research in regenerative medicine and incurable diseases, and evaluating the preclinical trials of new drug candidates.

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RESEARCHERS

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- Developing cell and tissue resources derived from nonhuman primates and conducting research for their applications
- Developing new breeder miniature pigs for research and development of bio-organs

Sang-Rae Lee srlee@kribb.re.kr
- Maintaining quality standards of primate resources by SPF health monitoring
- Development of neuronal disease models (Stroke, Dementia, Parkinson's disease) with non-human primates

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- Human and non-human primate comparative genomics
- Primate molecular genetics & Primatology
- Identification and molecular characterization of primate genes

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- Developmental biotechnology and bio-regenerative medicine in non-human primates and mini-pigs

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- Transgenic animal model in Xenotransplantation research and support
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- Developmental biotechnology study on nonhuman primate and mini-pig

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- Microbiological monitoring of non-human primates
- Comparative analysis of human and non-human primate genome
- Identification and molecular characterization of non-human primate genes

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- Developmental biotechnology study on non-human primate and mini-pig
- Molecular study of developmental biology with primates and pig

RESEARCH AREAS

Acquisition, propagation and distribution of specific pathogen free (SPF) primate resources

Acquiring and distributing SPF primate resources to industrial, academic and research institutions.

Standardization in handling of and regulating lab requirements for primate research
- Maintaining quality standards of 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 primate resources at the international level.

Xenotransplantation research

Transplanting organs (e.g. pancreatic islet, heart) from transgenic germ-free pigs into SPF primates and analyzing the efficacy and safety of the organs transplanted.

Regenerative medical research and applications

Using 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 primates 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 primate diseases, which have metabolic pathways most similar to human, 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.

Molecular identification and characterization of non-human primate genes

Investigation of molecular mechanisms of gain and loss of genes in various primates.

Collaboration and support for nationwide non-institutional research involving primates

Providing specialized technologies and information about primate care and facilities to other researchers, and conducting collaborative research for the development of related technologies.

ACHIEVEMENTS

Procurement of SPF primate resources, maintenance and breeding of healthy SPF animals, and preclinical evaluation of biomedical technologies

The NPRC currently houses six types of SPF primates: rhesus monkeys, cynomolgus monkeys, African green monkeys, Japanese monkeys, squirrel monkeys and common marmosets - a total of 346 animals.

Transfer of primate-related resources and techniques to national partners of industrial, academic and research institutions

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

Establishment of disease model using primates

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 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 mini-pigs useful in organ xenotransplantation.

SELECTED PUBLICATIONS

Kyu-Tae Chang (Corresponding)
PLoS One. 8(4):e60758.
Selection of new appropriate reference genes for RT-qPCR analysis *via* transcriptome sequencing of cynomolgus monkeys (*Macaca fascicularis*)

Sun-Uk Kim (First)
J Neuroimmunol. 259(1):26-36.
Peroxiredoxin I is a ROS/p38 MAPK-dependent inducible antioxidant that regulates NF-κB-mediated iNOS induction and microglial activation

Sun-Uk Kim and Kyu-Tae Chang (Corresponding)
Mol Reprod Develop. 80:233-41.
Efficient production of transgenic mice by intracytoplasmic injection of streptolysin-O-treated spermatozoa

Jae-Won Huh and Kyu Tae Chang (Corresponding)
PLoS One. 8(2):e56034.
Selection of appropriate reference genes for RT-qPCR analysis in a streptozotocin-induced Alzheimer's disease model of cynomolgus monkeys (*Macaca fascicularis*)

BIO-EVALUATION CENTER

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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 developmental and evaluational infrastructure for optimizing, analyzing, and standardizing 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 commercialization.

RESEARCHERS

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- Molecular Pharmacology
- Efficacy evaluation of immunomodulatory and anti-cancer agents

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- Genetic Characterization of LMOs

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- In vivo efficacy evaluation of drug candidates

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 rices, chilli peppers, potatoes, poplars and rootstocks forwatermelons. We also conduct National Environmental Monitoring on domestic soybeans, corns and oilseed rapes and the inspect the extent of genetic contamination by imported LMOs.

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

Jong Soon Kang (Corresponding)
Food Chem Toxicol. 55:353-7.
Protective effect of silymarin against ethanol-induced gastritis in rats: Role of sulfhydryls, nitric oxide and gastric sensory afferents

Soo Jin Oh (Corresponding)
Chem-Biol Interact. 204(2):80-7.
Alterations in hepatic metabolism of sulfur amino acids in non-obese type-2 diabetic Goto-Kakizaki rats

Ji Eun Yun (First)
Int J Cancer. 133(3):645-53.
Downregulation of cell-free miR-198 as a diagnostic biomarker for lung adenocarcinoma-associated malignant pleural effusion

Jung-Ho Park (First)
Proteins-Struct Funct Bioinf. 81(5):874-83.
ACA-specific RNA sequence recognition is acquired via the loop 2 region of MazF mRNA interferase

Soon-Chun Jeong (Corresponding)
Theoret Appl Genet. 126(4):1103-19.
Dynamic genetic features of chromosomes revealed by comparison of soybean genetic and sequence-based physical maps

ABS RESEARCH SUPPORT DEPARTMENT

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As part of the national bio-infrastructure for biological resources, ABS Research Department play the main role in the project of comprehensive services for the Access to genetic resources and Benefit-Sharing (ABS) under the supervision of the Ministry of Science, ICT and Future Planning. The others are steering a committee of national authority in the area of bio-resources, Institutional Review Board (IRB), Institutional Animal Ethnics Committee and Institutional Biosafety Committee (IBC).

RESEARCHERS

Young Hyo Chang yhchang@kribb.re.kr
- Management of ABS Research Department
- Researching laws, regulations, and current international trends on ABS

Han Chul Lee hanchul@kribb.re.kr
- Steering a Institutional Animal Ethnics Committee, IRB, and IBC

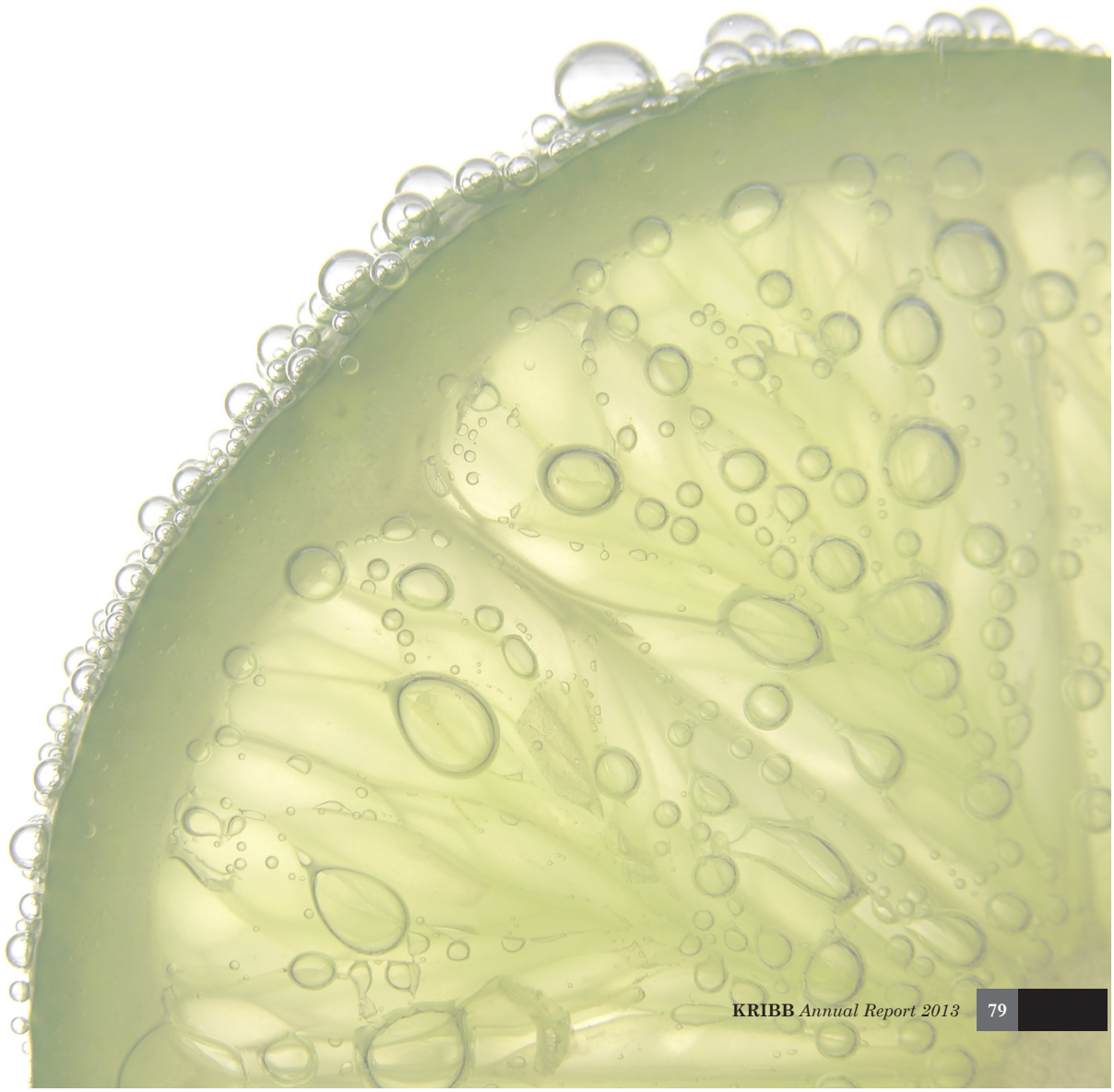
Tae Eun Jin tejin@kribb.re.kr
- Steering a committee of national authority in the area of bio-resources
- Researching laws, regulations, and current international trends on ABS

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.

SELECTED PUBLICATIONS

Young Hyo Chang and Tae Eun Jin
1. ABS guidebook for academic research
2. Good practice for academic research on genetic resources



LMO RESEARCH
SAFETY CENTER

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LMO Research Safety Center is responsible for the biosafety of LMOs(Living Modified Organisms) for test & research use and has being carried out LMO safety management project supported from MSIP (Ministry of Science, ICT and Future Planning). We'd like to contribute to develop biotechnology through making and improving a safe LMO research environment. To achieve the goal, there are running 4 research areas in LMO safety management and these are as follow.

- Secure the safety of LMO research facilities
- Expand safety culture by intensifying the education & PR of LMO safety management
- Strengthen capabilities to expand the infrastructure for testing/research LMO risk management
- Enhance the efficient implementation of laws and institutions by improving the LMO safety management system

RESEARCHERS

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RESEARCH AREAS

Secure the safety of LMO research facilities
- Improve safety management via fact-finding surveys for 1, 2-class LMO facilities and on-site inspections and checks
- Prepare a method to unify a window to communicate the focusing of safety management depts., in each agency
- Develop various standard guidelines to set up a self-safety management system for research facilities

Expand safety culture by intensifying the education & PR of LMO safety management
- Expand field trip-type safety education programs and operate them regularly
- Specialize and diversify LMO safety education
- Conduct strategic PR campaigns to raise awareness of LMO research management
- Activate the exchange of opinions and information between LMO research institutes

Strengthen capabilities to expand the infrastructure for testing/research LMO risk management
- Manage LMO research institutes' risk & develop new LMO safety management technology
- Specialized testing/research LMO safety management information system
- Secure the foundations of LMO safety management-dedicated institutions to efficiently implement national policies

Enhance the efficient implementation of laws and institutions by improving the LMO safety management system
- Improve laws and institutions & develop policies for testing/research LMOs & Develop LMO safety management policies and expand the planning system
- Produce a database of information such as facility reports/permits/closure, set up an activation system for self-reporting and application
- Clarify the management system to export/import, produce and distribute testing/research LMOs and support the implementation of laws and institutions
- Prepare guidelines, i.e., manuals, evaluation criteria by reviewing and

ACHIEVEMENTS

LMO safety management training, public relations, information systems, and build a culture of safety Infra
- develop/operate various LMO safety management education programs and develop education materials
- establish and operate an information system for testing/research LMO safety management
- conduct PR activities to spread a testing/research LMO safety culture

Development of the LMO safety evaluation technology & establishment of the research safety management criteria
- Develop basic technology to prepare the criteria for testing/research LMO development/experiment deliberation
- Development safety management criteria for new LMOs using research facilities
- Publish and distribute a manual for measures and action procedures for unintentional leaks of LMOs from research facilities

Establishment of the safety management base, i.e., streamlining of testing/research LMO laws and system
- Prepare an amendment (draft) following the LMO Act amendment, i.e., ordinance, enforcement rules, combined notification, etc.
- Prepare guidelines for 1, 2-class research facility safety management, i.e., detailed criteria for regular inspections and safety education
- Support to set up a detailed LMO safety management enforcement plan for testing/research LMOs on an annual basis
- produce and distribute a manual and interpretation handbook for testing/research LMO laws and institutions
- establish methods to enhance the efficiency of LMO facility safety management

Securing safety of the LMO research facilities and monitoring export/development safety management
- On-site inspections for 1, 2-class facilities
- Collect on-site comments via information exchange meetings with research facility investigators and managing staff
- Publish and distribute 'on-site inspection cases' to inform on good safety management practices of LMO research facilities
- Visit and conduct fact-finding surveys, LM mouse importing institutions and production/research facilities
- Support approval deliberation by the export deliberation committee; conduct follow-up checks after isolation/trial packing experiments

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DIVISION OF RESEARCH & BUSINESS DEVELOPMENT

- TECHNOLOGY TRANSFER CENTER
- KRIBB & INDUSTRY COLLABORATION 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 businesses(SMB) and technology projects.

TECHNOLOGY TRANSFER CENTER

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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 incubating bio start-ups which are potential candidates for establishing joint ventures with partner companies that provided with highly valued technology from KRIBB.

MAIN FUNCTIONS

Intellectual Property Management : Building a strong patent portfolio

- Managing 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

- Creating new startups / joint ventures (Institute Enterprise)
- Arranging fund investment for spin-off KRIBB companies
- Creating the Venture

ACHIEVEMENTS

Creating/Securing Superior Technology

- Number of patent Applications and Registrations from 2011 to 2013
- Number of Registered Patents (accumulated) 2013

Year	Application	Registration
2011	378	202
2012	369	201
2013	302	171

Year	Domestic	Overseas	Total
2013	857	333	1,190

Technology Transfer

Commercialization

- 237 intellectual properties are transfers to industry until 2013
  → Estabilised an in-house venture, 'Mico Biomed' in June 2009 as a joint venture between KRIBB and Komico Inc.
- Estabilised an industry-academia partnership company, 'Inji Bio' in September 2013 as a joint venture between KRIBB, GIST, and Inforpia Inc.
- Number of in-house venture establishment (accumulated) : 21 as of 2013

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The role of government-funded research institutes as a locomotive of Creative Economy has been emphasized to develop the core technologies essential for ushering in new future, such as new drug development, nano material, renewable energy and convergence of IT-BT-NT technologies.
The venture and small-to-medium businesses with technological edge 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.
Industry Collaboration Center has two main roles, one is to establish creative economy ecosystem of the bio-based enterprises and the other is to support start-up or medium-sized enterprises to consolidate their technological and developmental competence.
With various experts and infrastructure of KRIBB, we provide technical advice to reinforce the competitiveness of the companies and to incubate Bio-venture companies in KRIBB. This systematic support aims to improve the success rate of the start-up business bodies and create many high-quality jobs through the convergence with existing industries, which in turn leads to the emergence of new markets and industries.

MAIN FUNCTIONS

Establishment of ecosystem of the bio-based enterprises

- Industry & Institutes Cooperation of the Biorefinery, Biopharmaceutical and Bio-convergence

Technical advice and support for small to medium-sized enterprises(SMEs)

Operation as a hub in the center of the collaboration between industry and research institutes

- Tasks involved with linking industry to research bodies
- Supporting small business joint research and development projects

Establishment of small business support strategies and plans

- Program for technological competitiveness of small businesses
- Program for selecting and supporting innovative enterprises

Construct and operate the infrastructure for bio-start-up companies

Business Incubation of biotech start-ups at Bio Venture Center

ACHIEVEMENTS

Enhancing competitiveness of small businesses and technical support

Joint projects for technological development of small business : 8 Projects, USD 4.2M(2012~2014)

Incubating start-ups and SMEe companies

- Area within the Bio-Venture Center : 2,508m^2, 3 floors
- Currently 14 bio-companies are in the Bio-Venture Center
- Since 2000, 58 companies have graduated and 8 were listed companies

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BIOTECHNOLOGY PROCESS ENGINEERING CENTER

Our goal 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.

Developement 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 hydrolylsates, 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

Woo Young Jeon (First)
Bioproc Biosyst Eng. 36(6):809-17.
Effect of heterologous xylose transporter expression in *Candida tropicalis* on xylitol production rate

Eun-Gyo Lee (Corresponding)
Int J Mol Sci. 14(1):1728-39.
Gamma-aminobutyric Acid production using immobilized glutamate decarboxylase followed by downstream processing with cation exchange chromatography

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DIVISION OF KRIBB STRATEGIC PROJECTS

- KOREA BIOSAFETY CLEARING HOUSE
- BIOTECH POLICY RESEARCH CENTER
- VIRAL INFECTIOUS DISEASE 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, stem cell and drugs for cancer. The Division also extends policy support for biotechnology by providing biosafety information and undertaking biotechnology policy research.

KOREA BIOSAFETY CLEARING HOUSE

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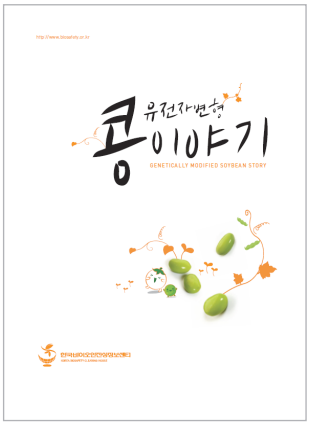
The Korea Biosafety Clearing House (KBCH) is dedicated to the promotion of public awareness and exchange of information, survey and research, and international co-operation on issues regarding Living Modified Organisms (LMOs), adhering to related requirements as per the “Cartagena Protocol on Biosafety” and the “Act on Transboundary Movements, etc. of LMOs”.

Biosafety Protocol Article 20 (Information Sharing and the BCH)
A Biosafety Clearing House (BCH) is hereby established as part of the “clearing house mechanism” under Article 18, Paragraph 3 of the Convention.

LMO Act Article 32 (Korea Biosafety Clearing House)
The head of the Competent National Authority (CNA) may designate the Korea Biosafety Clearing House to be responsible for performing matters concerning the management and exchange of information on Living Modified Organisms (LMOs).



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- Monitoring of adherence to LMO regulations, management of information regarding biosafety

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- Management of budget and affairs, public awareness and relationship regarding Access to Genetic Resources and Benefit- Sharing(ABS)

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

Jeongsuk Jo chojs@kribb.re.kr
- Collection of information regarding LMOs, conduct of surveys

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).
- Support 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).

Improvement of Public Awareness & Communication
- Management of Korean and English Biosafety Portals and family sites.
- Publications such as the Biosafety Whitepaper, the quarterly Biosafety Journal, etc.
- Hosting of communication activities (LMO forums, international seminars, essays on biosafety, debate competitions, etc).

Survey & Research
- Survey of public perceptions.
- Establishment of database consisting of LMO and BIO related statistics.
- LMO and bioindustry trend analysis.
- Analysis of the industrial impact of the ABS Protocol.

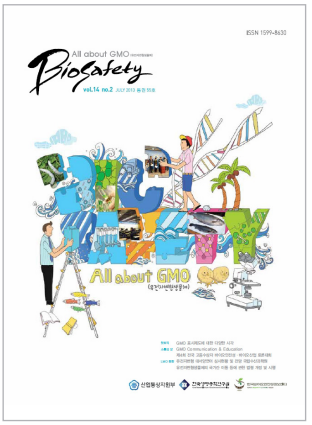
ACHIEVEMENTS

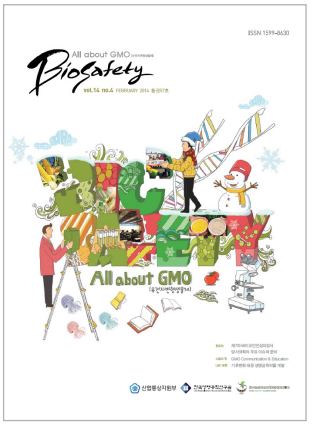
Compliance with the LMO Act and the Biosafety Protocol

Although its actual work in the management of LMO information and issues began six years ago, KBCH as a role player of an official organization began in January 2008. 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 consists of the collection and distribution of accurate information on LMOs, the promotion of public awareness on LMOs, and participation in various related activities. Over the past six years, KBCH has handled approximately 23,000 domestic cases regarding LMOs, such as import approvals for LMOs-FFP (food and feed, and for processing), facilities registration, etc. KBCH has fulfilled its duty to disclose all collected information to the public by various means, such as the Internet, media and in printed form, let alone deliver some pertinent information to the BCH.

Promotion of Public Awareness and Participation

To promote awareness and participation, especially with the public, KBCH does its best in order to play an indispensable role in assuring biosafety, as stipulated in the Protocol. Above all, KBCH conveys to the public both positive and negative aspects of LMOs, facilitating public discussion concerning LMOs to be conducted based on facts.
To this end, it operates the Korean "Biosafety Portal", participates in discussions on high-profile Internet sites, such as "AGORA" on DAUM and "Knowledge IN" on NAVER, and distributes printed materials published by the KBCH, such as the quarterly "Biosafety", the "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 Essay Competition" and "Biosafety Debate Competition" for middle and high school students, which attracts hundreds of applicants nationwide every year.





BIOTECH POLICY RESEARCH CENTER

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Nominated and established by the Ministry of Science and Technology in 2004, the Biotech Policy Research Center aims to assist the government in establishing biotechnology policies. To do so, the center investigates domestic and international biotechnology policy information and runs a portal site(bioin, www.bioin.or.kr) to enhance the public understanding of biotechnology and biotechnology policies. The center also develops and provides biotechnology statistics, patents, bibliometrics, and market analysis. Additionally, the center organizes and supports various networks among expert groups related to biotechnology.

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- Tech trends & Policy Research

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 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 reaching the second stage of the development goal set in Bio-Vision 2016.
- Annual Action plans for Bio-Vision 2016, Stem cell Comprehensive Plan & 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 policymakers 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 policy forum, BT expert discussion and BT Seminar.

International Collaboration

- To participate in the annual Session of the OECD Working Party on Biotechology.
- To participate in BAKAS-KOLIS-KASBPNEBS-RTP B&B-NYKB-KRIBB Symposium.

VIRAL INFECTIOUS DISEASE RESEARCH CENTER

Influenza pandemics generally occur following the emergence of new strains of influenza viruses that can be transmitted to humans from other animal species and spread easily within the human population on a worldwide scale. An influenza pandemic of this nature is regarded as a global disaster, threatening public health with high morbidity and mortality. Therefore, it is necessary to formulate plans to counter current and future influenza pandemics. The overall objective of our center is to develop new vaccine technologies and antiviral strategies to broadly address protective immune responses against various subtypes of influenza viruses, especially the current pandemic influenza virus (novel 2009 influenza A [H1N1]) and the highly pathogenic avian influenza virus, which are potential candidate viruses of future influenza pandemics.

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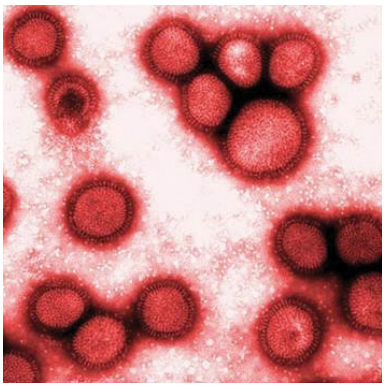
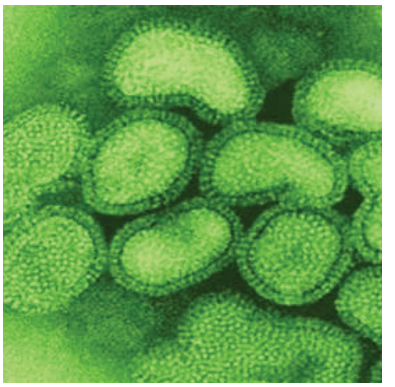
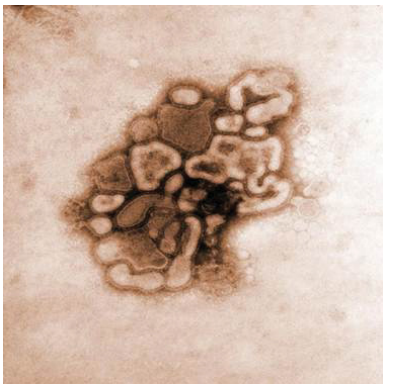
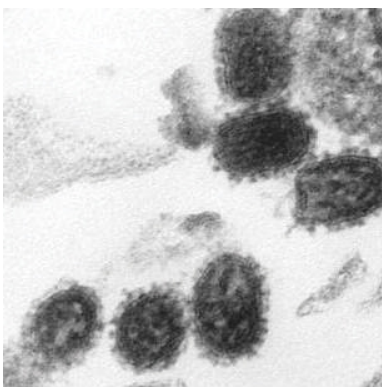
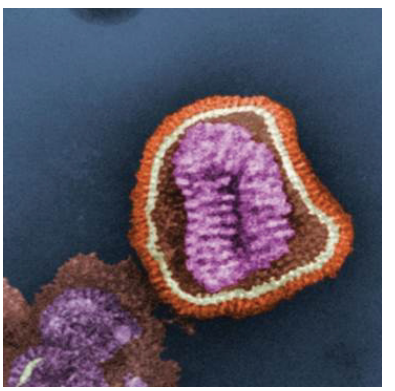
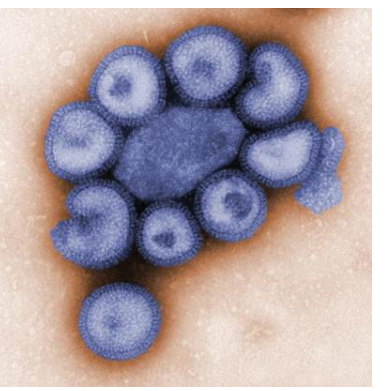

RESEARCHERS

Sang-Hyun Kim skim@kribb.re.kr
- Development of vaccine adjuvants derived from cell-membrane nano-vesicles
- Development of nanovesicle-based antigen delivery system as a next-generation vaccine platform

Daesub Song sds1@kribb.re.kr
- Application of adjuvant candidate to large animal models
- Study of interspecies transmission of influenza viruses
- Surveillance of mammalian derived influenza viruses in Korea and development of viral vaccines for animals

Doo-Jin Kim golddj@kribb.re.kr
- Development of universal influenza vaccines
- Immunomodulatory and antiviral effects of OMVs

Sun-Woo Yoon syoon@kirbb.re.kr
- Identification of influenza virus pathogenicity
- Determinants of host susceptibility to influenza

RESEARCH AREAS

- Development of new vaccine technologies including subunit, genetic, and live attenuated vaccines capable of inducing cross-protective immunity.
- Development of a new vaccine adjuvant using cell membrane nano-vesicle (OMV) and investigation of its immune-modulatory mechanism.
- Development of camel derived single domain antibody as an antiviral agent against pandemic influenza viruses
- Basic research on influenza viruses including surveillance and genetic characterization.

ACHIEVEMENTS

Development of universal influenza vaccines

- Among the influenza antigens such as HA, M2, and NP, we have developed new vaccine candidates based on a conserved stalk domain of HA. Animal studies have revealed that our universal vaccine candidates induce strong and broad antibody response, leading to cross-protection against homologous and heterologous influenza infections. The universal vaccine candidates have also been used for the production of HA stalk-specific monoclonal antibodies from camels. We are developing a therapeutic agent based on the camelid single-domain antibodies since the HA stalk-specific antibodies have exhibited cross-reactivity to diverse influenza subtypes.

Development of a new vaccine adjuvant using OMVs and the investigation of its immune-modulatory mechanisms

- As an efficacious vaccine adjuvant candidate, we have developed modified-OMVs generated from Gram-negative bacteria. The efficacy of OMV adjuvant has been evaluated in various animal model including mice, ferret, beagle dogs, and pigs. These OMV-based adjuvant and antigen delivery nano-particles are promising biomaterials for a next-generation vaccine development.

Development of a new antiviral candidate using camel-derived single domain antibody against pandemic influenza viruses

- Camelid and cartilaginous fish produce functional antibody isotype composed of heavy chain-only, without the light chain, in addition to the classical antibodies containing two heavy and two light chains. These heavy chain antibodies recognize the antigen via a single domain referred to as VHH. The VHH or single domain antibody can be produced at low cost in E. coli. These valuable properties of single domain antibody including solubility and stability, high affinity and specificity for their cognate antigen, small size and strict monomeric behavior offer diverse applications in diagnostic and preventive measures. Currently, we are investigating an efficacy of single domain antibody-based universal antiviral effects on influenza viruses for pursuing the commercialization of it.

Basic research of influenza viruses, including surveillance, genetic characterization, and interspecies transmission mechanism

- We have isolated influenza viruses from avian (wild migratory birds and ducks), companion animals (dogs and cats), pigs, and horses in Korea (Na et al., 2013, Epidemiology and infection). The surveillance data is used to understand evolutionary paths and to guide fundamental research, including research on transmission and pathogenesis.
- We have identified diverse AI virus isolates and have understood how these viruses evolve, adapt, and transmit. In addition, we have several projects include the elucidation of the molecular mechanism by which influenza viruses acquire increased pathogenicity and transmission. And the mechanism of interspecies transmission of influenza viruses has been investigated using canine and swine models (Kim et al., 2013, Influenza and other respiratory disease)

SELECTED PUBLICATIONS

Daesub Song (Corresponding)
Archiv Virol. 158(7):1533-41.
Molecular epidemiology and phylogenetic analysis of porcine epidemic diarrhea virus (PEDV) field isolates in Korea

Daesub Song (First)
Influen Other Resp Virus. 7(3):265-70.
Inter- and intra-species transmission of canine influenza virus (H3N2) in

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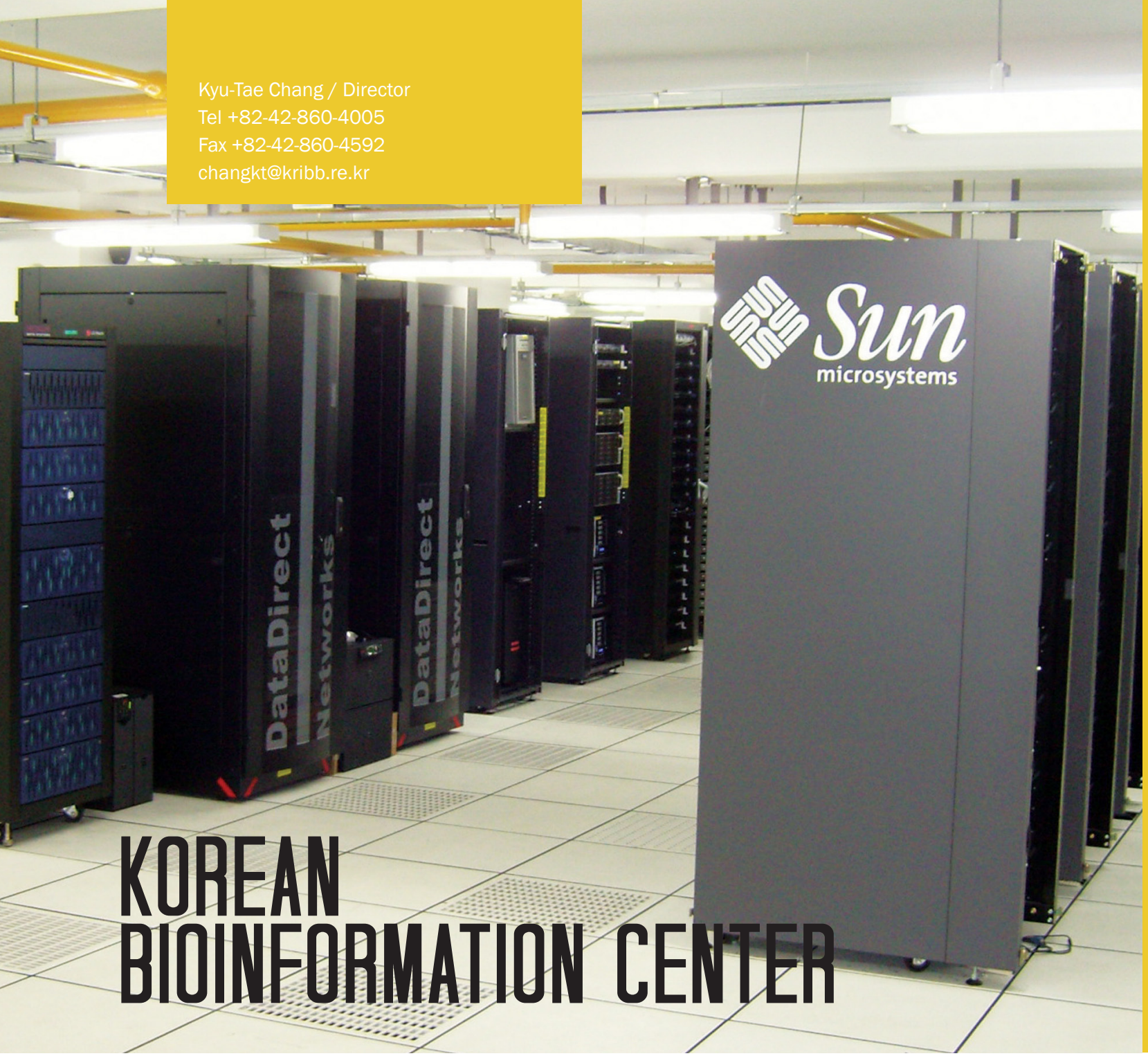

KOREAN BIOINFORMATION CENTER

The Korean Bioinformation Center (KOBIC) is the national research center for bioinformatics which plays a key role in various areas such as genomics, proteomics, systems biology, and personalized medicine. KOBIC is also responsible for the integration and management of bioresource/biodiversity information from various research laboratories and institutions across the country.

KOBIC provides a centralized data access portal to promote sharing and utilization of the data among research groups.

RESEARCHERS

Haeyoung Jeong hyjeong@kribb.re.kr
- Microbial genome sequencing and analysis

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- Bio-resource and Bioprospecting information

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- Bioinformatics algorithm and system development

In-Sun Chu chu@kribb.re.kr
- Biomedical informatics

Namshin Kim deepreds@kribb.re.kr
- Rare diseases and cancer genome analysis by next-gen sequencing
- De novo assembly & population genetics by next-gen sequencing

Byungwook Lee bulee@kribb.re.kr
- Processing NGS data gene expression analysis and epigenomic regulation

Bo Kyeng Hou bkher71@kribb.re.kr
- Systems biology and chemoinformatics

Seungwoo Hwang swhwang@kribb.re.kr
- Systems bioinformatics and gene expression data analysis

Jinhyuk Lee jinhyuk@kribb.re.kr
- Structural Biology
- Molecular Modeling

Jin Ok Yang joy@kribb.re.kr
- Development and analysis of miRNA expressions
- Controlled studies of complex diseases and different cancer types
- Development of a system for transient analysis of chromatin structure

RESEARCH AREAS

Bioresource Information Unit
- Construction of an integrated information system for national bioresources.
- Development of national data standards.
- Building national collaborations and liaison networks.

Genome Information Analysis Unit
- Genome, transcriptome, and proteome analysis of human diseases.
- Network-based analysis of multi-omics data.
- Design and construction of integrated pipeline for multi-omics data.
- Genome sequencing and analysis of biological resources.

Genome Information Development Unit
- Construction and development of biological databases.
- Development of bioinformatics algorithms/ tools and systems.
- Development of omics analysis methods/systems.

NGS Integrative Analysis Unit
- De novo genome assembly and their comparative genomics studies.
- De novo transcriptome assembly and association with diseases.
- Genome mutation analysis for rare disease and cancer genomes.
- Genome variation analysis and population studies & genetics.

Computer Infrastructure Team
- Management and development of servers, clusters, and storage systems.
- Support for developing web-based solutions and applications.
- Implementation of supercomputing infrastructure for Big Data.

Biomedical Informatics Team
- Biomedical informatics for multi-omics data analysis
- Development of integrated analysis system of cancer genome data
- Bioinformatics research for personalized medicine and cell therapy.

Structural Biology Team
- Protein structure modeling and refinement.
- Protein-ligand Docking and Virtual Screening.

Systems Bioinformatics Team
- Development of algorithms, tools, and DBs for systems bioinformatics.
- Network-based analysis of gene expression data.

ACHIEVEMENTS

In an effort to support bioinformatics and genomics research in Korea, we carry out multifaceted tasks with emphases on (i) integrative system for national biomedical research information, (ii) analysis systems for highthroughput genomic sequence data, (iii) collection and systematic organization of omics data, (iv) infrastructure for systems network bioinformatics, (v) lung cancer multi-omics data production and integrative analysis, and (vi) research & education support and collaborative network.

SELECTED PUBLICATIONS

Namshin Kim (Corresponding
BMC Genomics. 14:519.
Whole-genome resequencing of Hanwoo (Korean cattle) and insight into regions of homozygosity

Sanghyuk Lee (Corresponding)
Nucleic Acids Res. 41:D252-7.
miRGator v3.0: a microRNA portal for deep sequencing, expression profiling and mRNA targeting

Byungwook Lee (Corresponding)
PLoS Genet. 9(2):1003229.
Genetic landscape of open chromatin in yeast

Sang Cheol Kim (First)
PLoS One. 8(5):e63290.
Stouffer's test in a large scale simultaneous hypothesis testing

Jinhyuk Lee (First)
Process Biochem. 48(1):162-8.
Inhibition of tyrosinase by gastrodin: An integrated kinetic-computational simulation analysis

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OCHANG BRANCH INSTITUTE

- NATURAL MEDICINE RESEARCH CENTER
- CHEMICAL BIOLOGY RESEARCH CENTER
- TARGETED MEDICINE RESEARCH CENTER
- WORLD CLASS INSTITUTE CENTER

Ochang Branch Institute conducts research activities to build up the pipeline and platform for new bio-drugs at national level. Major research areas include; medicinal resources assessment based on metabolomic analysis of natural products, and system establishment to discover new physiologically active substances. The Institute is also involved in identifying inhibitors targeting diseases and clinical candidates. Going further, the Ochang Branch Institute carries out joint research activities with global renowned research institutions.

NATURAL MEDICINE RESEARCH CENTER

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

RESEARCHERS

Sei-Ryang Oh seiryang@kribb.re.kr
- 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

Young Kook Kim kimyk@kribb.re.kr
- Establishment of screening systems for metabolic diseases
- Development of bioactive compounds specifically against obesity and diabetes

Kyung-Seop Ahn ksahn@kribb.re.kr
- Evaluation of anti-inflammatory and antiasthmatic activity of natural products
- Identification of new bio-markers for asthma/ COPD treatment

Dur Han Kwon dhkwon@kribb.re.kr
- Evaluation natural products for anti-viral activity in vitro & in vivo
- Development of new active compounds against viral diseases including influenza virus, rotavirus, corona virus, rhinovirus and enterovirus

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

Su Ui Lee iamsuui@kribb.re.kr
- Development of cell-based assays for HCS and HTS
- Identification and validation of bioactive small molecule

RESEARCH AREAS

Natural product Chemistry
- Isolation of bioactive materials from plant and microbial sources.
- Elucidation of natural product structure using analytical instruments (HPLC, LCMS, NMR).

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.
- Researches of the inhibitory activity of respiratory viruses.
- Research of molecular targets for metabolomics diseases and cancers.

Natural product library
- Production of plant extracts from domestic and foreign plant sources.
- Management of Plant Extract Bank and natural compound library.

Metabolomics research
- Discrimination of geological origin based on natural product metabolics.
- Identification of natural product markers for discrimination of sources.

ACHIEVEMENTS

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

Development of anti-viral materials
We discovered several kinds of natural compounds attenuating viral infection via NK cell activation or inhibiting viral reproduction. These actives are under investigation towards pre-clinical test for anti-viral pharmaceuticals.

Construction of biomaterial infra-structure
Plant materials were collected and their extracts were deposited in the Plant Extract Bank (over 5,000 domestic and 21,000 international extracts) and distributed to researchers.

Industrial research
We have licensed out two natural drug candidates (Han Kook Shin Yak pharmaceutical Co. Ltd, and Yungjin Pharm. Co. Ltd), one lead compound for synthetics (A-ju Pharmaceutical Co. Ltd) for Asthma/COPD, a neutraceutical candidate for atherosclerosis (Unigen Ltd) and a drug candidate for cholesterol lowering agents (Dong-Hwa Pharm. Ind. Co. Ltd).

SELECTED PUBLICATIONS

Sei-Ryang Oh (Corresponding)
Chem. Pharm. Bull. 61(9):920-926
Anti-allergic Flavones from Arthraxon hispidus

Kyung-Seop Ahn (Corresponding)
Food Chem Toxicol. 62:506-13.
Diallyl-disulfide, an organosulfur compound of garlic, attenuates airway inflammation via activation of the Nrf-2/HO-1 pathway and NF-kappaB suppression

Kyung-Seop Ahn (Corresponding)
Food Chem Toxicol. 62:681-6.
Inhibitory effects of Pycnogenol (French maritime pine bark extract) on airway inflammation in ovalbumin-induced allergic asthma

CHEMICAL BIOLOGY RESEARCH CENTER

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The goals of center are discovering the bioactive compounds from microorganisms and plants, and identifying their cellular target for application to chemotherapeutics development. To accomplish this goal, we adopt chemical biology techniques based on metabolomics, genomics, proteomics and cellulomics technology using bioactive metabolites to develop medicinal and bio-functional compounds.

RESEARCHERS

Jong Seog Ahn jsahn@kribb.re.kr
- Microbiology and cell biology
- Chemical biology

Young-Soo Hong hongsoo@kribb.re.kr
- Molecular microbiology
- Combinatorial synthetic biology of natural product biosynthetic genes

Jae-Hyuk Jang jangjh@kribb.re.kr
- Microbial natural products chemistry
- Chemical biology

Sung-Kyun Ko ksk1230@kribb.re.kr
- Chemical biology
- Target protein identification and target molecule interaction

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

RESEARCH AREAS

Anti-cancer

Screening new bioactive compounds from microbial secondary metabolites regulating tumor cell proliferation and metastasis, and identifying their cellular targets.

Obesity / Diabetes

Developing anti-obesity and anti-diabetic lead compounds with regulatory roles in metabolism and gene expression.

Anti-osteoporosis

Developing new bioactive compounds inhibiting osteoclast differentiation from microorganisms and plant resources.

Immune modulators

Developing bioactive compounds regulating immune cell response and communication from natural products.

Oxygen signaling modulator

Discovering bioactive compounds modulating oxygen radical cellular signaling for anticancer, anti-aging and cosmetics.

Microbial secondary metabolites library

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

Combinatorial and Synthetic Biology

Create novel organic molecules through deliberate in vivo and in vitro engineering of these pathways for production of human and veterinary pharmaceuticals, specialty chemicals, and high value biomaterials.

ACHIEVEMENTS

Discovery of anti-osteoporosis drug

Salubrinal could affect the differentiation of both osteoblast and osteoclast, and be developed as an excellent anti-osteoporosis drug. Modulation of ATF4 and NFATc1 expressions through eIF2α phosphorylation could be a valuable target for the treatment of osteoporosis.

Explored the crucial role of SP1 in the regulation of CEP131 gene transcription

The identification of functional mechanism of SP1 in CEP131 gene expression during the cell cycles should extensively be done in more detail for unraveling other proteins involved in CEP131 mediated carcinogenesis and metabolic diseases. Conclusively, this study is the first report showing the important SP1 binding sites on CEP131 promoter, contributing to further study of CEP131 function in centrosome.

Discovering of Protein tyrosine phosphatase 1B and inflammation inhibitor

Secondary metabolites isolated from the marine-derived fungus Penicillium sp. JF-55, a new styrylpyrone-type metabolite, penstyrylpyrone, and two known anhydrofulvic acid and citromycetin. These compounds showed PTP1B inhibitory activity in a dose-dependent manner, and kinetic analyses of PTP1B inhibition suggested that these compounds inhibited PTP1B activity in a competitive manner. In an effort to gain more biological potential of the isolated compounds, the anti-inflammatory effects of compounds.

Oligomycin A enhances apoptotic effect

Development of resistance to TNF-related apoptosis-inducing ligand (TRAIL) in tumor cells is one of the important problems in cancer treatment. Oligomycin A isolated from a Streptomyces, was found to enhance TRAIL-induced apoptosis in HeLa cells. Oligomycin A enhances apoptotic death of cervical cancer cells to TRAIL through upregulation of CHOP-mediated DR5 expression following ER-stress.

SELECTED PUBLICATIONS

Jong Seog Ahn and Bo Yeon Kim (Corresponding)
Cellular Signal. 25(2):552-60.
Osteoporosis regulation by salubrinal through eIF2α mediated differentiation of osteoclast and osteoblast

Jong Seog Ahn and Bo Yeon Kim (Corresponding)
Gene. 513(1):75-81.
Regulation of CEP131 gene expression by SP1

Jae-Hyuk Jang (first)
Marine Drugs. 11(4):1409-26.
PTP1B inhibitory and anti-inflammatory effects of secondary metabolites isolated from the marine-derived fungus Penicillium sp. JF-55

Jong Seog Ahn and Bo Yeon Kim (Corresponding)
Molecular Carcinogen. 52(2):85-93.
Oligomycin A enhances apoptotic effect of TRAIL through CHOP-mediated death receptor 5 expression

TARGETED MEDICINE RESEARCH CENTER

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Our aim is to validate drug targets and develop drug candidates which are effective against chronic diseases such as inflammation, virus, metabolic diseases and cancer.

RESEARCHERS

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

Sangku Lee sangku@kribb.re.kr
- Organic synthesis
- Medicinal chemistry

Hyun Sun Lee leehs@kribb.re.kr
- Natural products chemistry
- Development of botanical drugs for treatment of metabolic disorders

Hyun-Jun Lee hjlee@kribb.re.kr
- Control of inflammation by innate and adaptive immune mechanisms

Sunhong Kim sunhong@kribb.re.kr
- Signal Transduction in mTOR and GPCR pathway
- C. elegans genetics
- Validation of drug target

Sungchan Cho sungchan@kribb.re.kr
- Drug discovery for treatment of metabolic and viral diseases
- Research on Spinal Muscular Atrophy and its application for drug discovery

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

RESEARCH AREAS

Drug discovery for treatment of metabolic and inflammatory diseases
- Identification of small molecule inhibitors targeting key components in triacylglycerol synthesis and anti-inflammatory pathway via high-throughput screening (HTS).
- Generation of lead compounds through structure-activity relation (SAR) study.
- Pharmacological validation in animal disease model.

Chronic disease modulation
- Screening of cellular response modulators involved in immune cell activation.
- Researches of the inhibitory activity of respiratory viruses.
- Research of molecular targets for metabolic diseases and cancers.

Natural product Chemistry and metabolomic study
- Isolation of bioactive materials from plants.
- Elucidation of natural product structure using analytical instruments (LCMS, NMR).
- Identification of natural product markers for standardization and discrimination of natural sources.

Natural product library
- Production of plant extracts from domestic and foreign plant sources.
- Management of Plant Extract Bank and natural compound library.

ACHIEVEMENTS

Identification of a selective inhibitor targeting DGAT2

We identified and validated a small molecule inhibitor of diacylglycerol acyltransferase 2 (DGAT2), a key enzyme in triacylglycerol synthesis, as a therapeutic candidate for metabolic diseases such as liver steatosis, hyperlipidemia, and type II diabetes.

Identification of a selective antagonist targeting GPCR

A small molecule competitive antagonist of one of the important inflammatory GPCR has been identified through HTS campaign. SAR study is ongoing to validate the target.

Construction of biomaterial infra-structure

Plant materials were collected and their extracts were deposited in the Plant Extract Bank (over 5,000 domestic and 21,000 international plant extracts) and distributed to researchers.

Industrial research

We have licensed out two natural drug candidates (Hankook Shinyak Co. and Youngjin Pharma. Co.), one lead compound for synthetics (A-ju Pharmaceutical Co. Ltd) for Asthma/ COPD, a nutraceutical candidate for atherosclerosis (Unigen Ltd).

SELECTED PUBLICATIONS

Sunhong Kim (Corresponding)
Molecule Cells. 36(3):267-72.
Leucine-rich repeat-containing G-protein coupled receptor 5/GPR49 activates $G_{12/13}$-Rho GTPase pathway

Hyun Sun Lee (Corresponding)
Organic Biomol Chem. 11(5):849-58.
Discovery of indolyl acrylamide derivatives as human diacylglycerol acyltransferase-2 selective inhibitors

WORLD CLASS INSTITUTE CENTER

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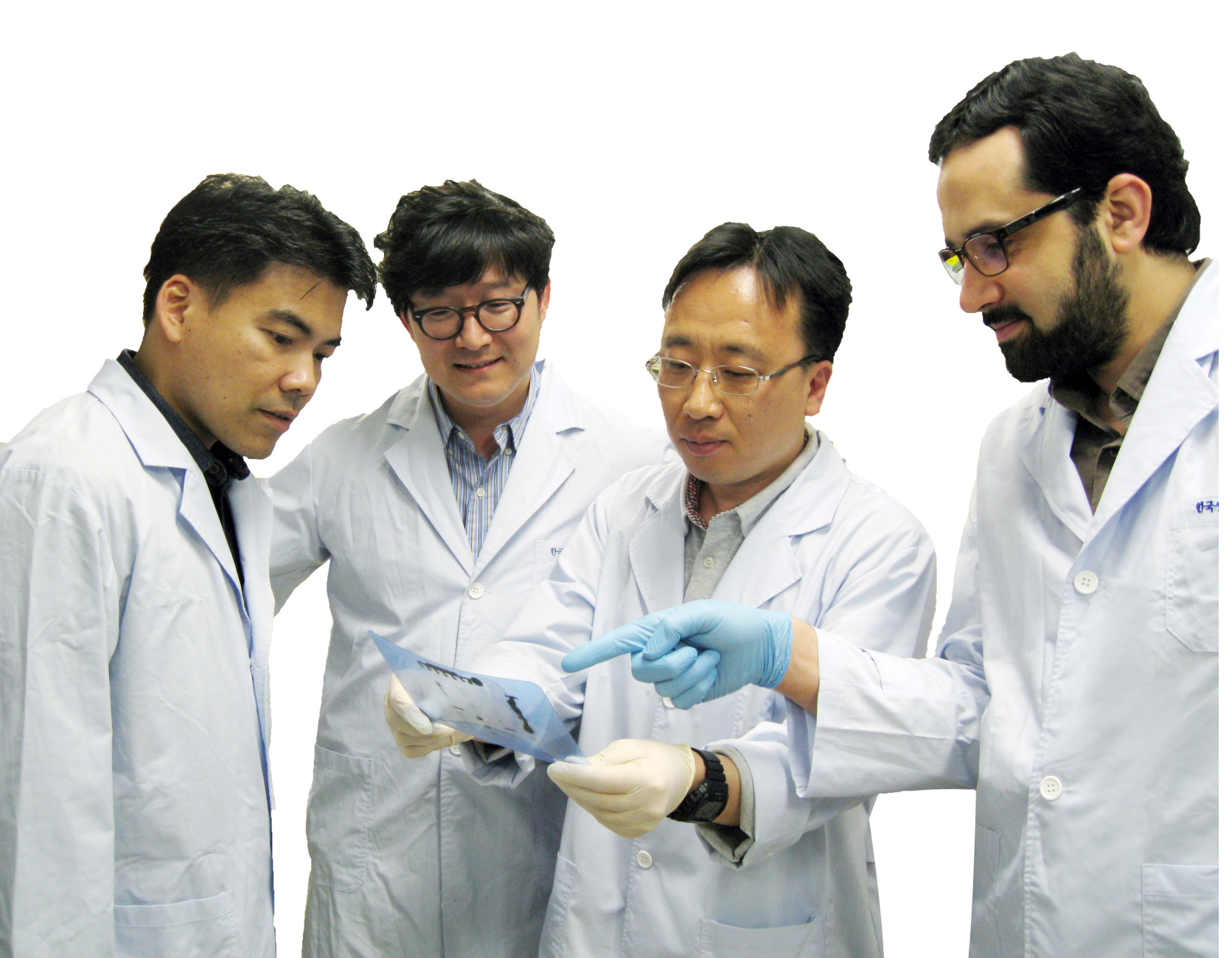
World Class Institute (WCI, Center for Kinomics-based Anticancer Research) aims at achieving outstanding result through open innovation and global network. Based upon the 13 billion won grant in total for 5 yrs until 2014 (2.5 bil/yr), WCI is focusing on identification of cancer-specific proteins and discovery of anticancer therapeutics candidates from microbial secondary metabolites or medicinal plants without side effect of most drugs so far developed.

WCI is composed of 8 non-Koreans including WCI director, Raymond Leo Erikson from Harvard University, as well as 8 Koreans as the main members. Global collaboration is now being actively conducted with 8 renowned foreign scientists from institutes including Harvard Medical School, MIT, U. Minnesota, U. Michigan, NIH, U. Torronto. and U. Pittsburgh. http://ckar.wci.re.kr



RESEARCHERS

Raymond Erikson erikson@fas.harvard.edu
- Molecular Cell Biology

Bo Yeon Kim bykim@kribb.re.kr
- Cancer Molecular Cell Biology
- N-end rule pathway and protein degradation
- Osteoporosis
- Epigenomics
- Radiation biology

Jong-Pyung Kim kimjp@kribb.re.kr
- Natural product chemistry
- Oxidative stress / Antioxidants and functional cosmetics

Kab Seog Yoon kabyoon@kribb.re.kr
- Plant metabolite analysis, peptide mass analysis, chemical mass analysis

Dong-Ho Choung dhc@kribb.re.kr
- NMR Spectroscopy, Structural Biology, Molecular Structural Analysis

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- Cancer Cell Biology

JoonSung Hwang hwangj1@kribb.re.kr
- Skin Cancer, Skin Inflammation, Hair Growth and Alopecia, Animal Models of Skin Diseases and Translational Research

Ahmed Goda agoda@kribb.re.kr
- Cancer Cell Biology

RESEARCH AREAS

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.
- Regulation of cilia formation in association with cancer.

Anticancer drug candidate discovery and its functional study using computer modeling, proteomics, and so on
- Polo box domain (PBD) of PLK1 inhibitor: in silico screening and robotic HTS screening of chemical libraries.
- Study on one of the key cancer regulator mTOR complex2 and cell division modulator Check kinse 1 (Chk1).
- Identification of centrosomal protein Cep131, a key molecule for cancer cell division.

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

ACHIEVEMENTS

- 25 international SCI publications including PNAS, Molecular Cell, Autophagy, JBC and etc.
- Global collaboration with Nobel laureate

SELECTED PUBLICATIONS

Bo Yeon Kim (Corresponding)
Autophagy. 9(7):1100-3.
The N-end rule proteolytic system in autophagy

Bo Yeon Kim (Corresponding)
J Biol Chem. 288(36):25924-37.
A chrysin derivative suppresses skin cancer growth by inhibiting cyclin-dependent kinases

Jong Seog Ahn and Bo Yeon Kim (Corresponding)
PLoS One. 8(1):e53908.
STK295900, a dual inhibitor of topoisomerase 1 and 2, induces G_2 arrest in the absence of DNA damage

Bo Yeon Kim (Corresponding)
Proced Natl Acad Sci. 110(10):3800-5.
UBR box N-recognin-4 (UBR4), an N-recognin of the N-end rule pathway, and its role in yolk sac vascular development and autophagy

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JEONBUK BRANCH INSTITUTE

- BIOREFINERY RESEARCH CENTER
- ECO-FRIENDLY BIOMATERIAL RESEARCH CENTER

Jeonbuk Branch Institute was established with the core objective of developing functional materials through the application of biotechnology techniques, such as metabolic engineering, natural material engineering and bioprocess engineering. Our goal is to industrialize these biomaterials for applications in energy, food, agriculture and the environment.

BIOREFINERY RESEARCH CENTER

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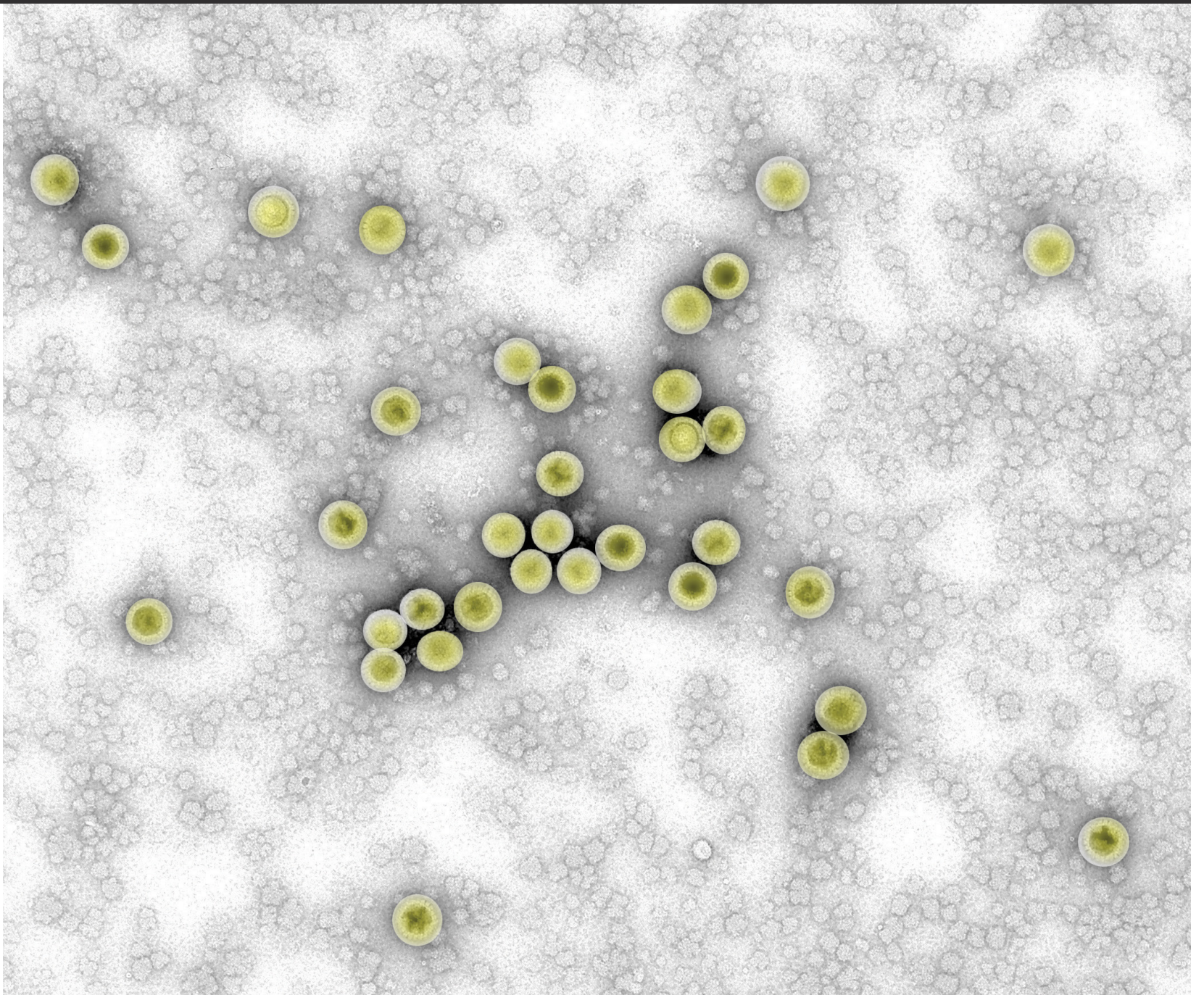
Our goal is to develop biotechnologies and bioprocesses for the production of microbial metabolites, proteins, industrial enzymes and bioenergy, all of which are useful for the pharmaceutic, nutraceutic, dietetic, cosmetic, feed, fine chemical and other industries.



RESEARCHERS

Chul Ho Kim kim3641@kribb.re.kr
- Biorefinery and Bioenergy, Functional biomaterials, Bioprocess

Jeong-Woo Seo jwseo@kribb.re.kr
- Microbial genetic and metabolic engineering
- Technologies for sustainable microbial oil/ refinery

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

Seonghun Kim seonghun@kribb.re.kr
- Glycoengineering and glyco(bio)technology
- Development of sugar platform technologies for biorefinery using renewable bioresources

Jong Hyun Choi jhchoi@kribb.re.kr
- Development of platform technologies for screening useful enzymes/metaboic pathways using high thoughput technology
- Development of the tool box applicable to the white biotechnology based on synthetic biotechnology

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 biochemcal 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, BVMO, coldadapted esterase and deoxyribose 5-phosphate aldolase(DERA) based on fluorescence intensity.
These new strategies combined with HTS system could screen various new enzyems 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

Chul Ho Kim (Corresponding)
Renewable Energy. 54:150-5.
Bioethanol production using the sequential acid/alkali-pretreated empty palm fruit bunch fiber

Jeong-Woo Seo (Corresponding)
Bioproc Biosyst Eng. 36(7):959-963.
Production of lipids containing high levels of docosahexaenoic acid from empty palm fruit bunches by *Aurantiochytrium* sp. KRS101

Jeong-Woo Seo and Chul Ho Kim (Corresponding)
Bioresour Technol. 130:719-24.
The production of 1,3-propanediol from mixtures of glycerol and glucose by a Klebsiella pneumoniae mutant deficient in carbon catabolite repression

Jeong-Woo Seo and Chul Ho Kim (Corresponding)
J Ind Microb Biotechnol. 40(2):227-33.
The role of aldehyde/alcohol dehydrogenase (AdhE) in ethanol production from glycerol by *Klebsiella pneumoniae*

Jong Hyun Choi and Jae Jun Song (Corresponding)
Biochem Bioph Res Co 441:567-572 .
A novel multifunctional cellulolytic enzyme screened from metagenomicresources representing ruminal bacteria

ECO-FRIENDLY BIOMATERIAL RESEARCH CENTER

Our aim is to develop eco-friendly biomaterial for broad-biological activity (against infectious diseases, human beings, immune synapse, and inflammation) from the natural resources (plant, microorganism, and marine sources)

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RESEARCHERS

Mun-Chual Rho rho-m@kribb.re.kr
- 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

Woo Song Lee wslee@kribb.re.kr
- Identification of infection related target molecules and establishment of screening systems for infectious diseases
- Isolation and structure elucidation of bioactive compounds

Hyo Kon Chun hkchun@kribb.re.kr
- Metabolomics studies of fermented products
- Functional studies of fermented food

Joong Su Kim joongsu@kribb.re.kr
- The development of sugar plateform technology to produce bioactive carbohydrate derivatives
- The development of aldol condensation enzymes available to white biotechnology

Cha Young Kim Kimcy@kribb.re.kr
- Molecular metabolic engineering for production of secondary metabolites in microbe and plant systems
- Molecular farming for the production of valuable proteins such as vaccines in plant systems

Su-Jin Park sjpark@kribb.re.kr
- In vitro and in vivo screening and mechanism studies of antiviral drugs
- Molecular genetic analysis and pathogenesis of viruses causing enteritis & pneumonia (Coronavirus, Rotavirus, Influenzavirus, etc.) in cows, pigs and poultry

Young Min Kim U9897854@kribb.re.kr
- Enzymatic modification of bio-active material
- Discovery of enzyme for carbohydrate engineering

Young Bae Ryu ybryu@kribb.re.kr
- Isolation and structural identification of bioactive compound from natural product
- Discovery of enzyme for carbohydrate engineering

Hyung Jae Jeong hjeong21@kribb.re.kr
- Quantitative and qualitative analyses of active compounds in biomaterials
- Maintenance of analytical equipments

Hyun-Mee Oh ohhm@kribb.re.kr
- Development and utilization of the cell-based and in vivo animal system to study of the biological activity of the active materials or compounds and identify the protective mechanism of the active materials against immune diseases

Chul Lee leechul@kribb.re.kr
- Activity-guided isolation of bioactive constituents from natural products
- Chemical structure determination of natural products

Kyung Sook Jung jungks@kribb.re.kr
- Therapeutic mechanism of the active materials and compounds on experimental animal models for immune diseases

Chan Sun Park chansun@kribb.re.kr
- Microorganism screening, sequencing and application

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 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 related diseases.

In vitro and in vivo antiviral evaluations
We have identified methods of culture and quantitative titration for several viruses including influenza virus, rotavirus, coronavirus, rhinovirus and enterovirus; and we are developing new active biomaterials and immune-therapies against viruses, including virology, mechanism of action, in vitro activity and animal models.

Identification of biomaterials against inflammatory diseases
- Development and utilization of cell-based screening system for the new active substrates with anti-inflammatory activity:
- Screening system for the inhibitor or 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 the active compounds from natural resources and determine the structure of the compounds:
- Development of active compounds showing anti-inflammatory activity through the inhibition of cell adhesion molecules, TLRs and IL-6 signaling.

- Identify the biological target and the pharmacological properties:
- Norkurarinol showed the anti-viral activity through the activation of IRF-3, followed by IFN-beta induction.
- Demonstrate the anti-viral effect of KR-200 after coxsackievirus A21 infection: KR-200 inhibit the NF-kB and AP-1 activation and inflammatory cytokine production induced by coxsakievirus 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 the expression of proinflammatory cytokine (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

Mun-Chual Rho (Corresponding)
Toxicol Appl Pharm. 269(1):70-80.
Oleanolic acid acetate inhibits atopic dermatitis and allergic contact dermatitis in a murine model

Woo Song Lee and Young Min Kim (Corresponding)
Appl Microbiol Biotech. 97(18):8151-61.
Characterization of a novel steviol-producing beta-glucosidase from *Penicillum decumbens* and optimal production of the steviol

Woo Song Lee and Young Bae Ryu (Corresponding)
Bioorg Med Chem. 21(13):3730-7.
Dieckol, a SARS-CoV $3CL^{pro}$ inhibitor, isolated from the edible brown algae *Ecklonia cava*

Woo Song Lee and Su-Jin Park (Corresponding)
Bioorg Med Chem. 21(15):4706-13.
In vitro antiviral activity of phlorotannins isolated from *Ecklonia cava* against porcine epidemic diarrhea coronavirus infection and hemagglutination

Cha Young Kim (Corresponding)
Physiol Plantarum. 148(2):189-99.
Expression of the sweetpotato R2R3-type *IbMYB1a* gene induces anthocyanin accumulation in *Arabidopsis*

APPENDICES

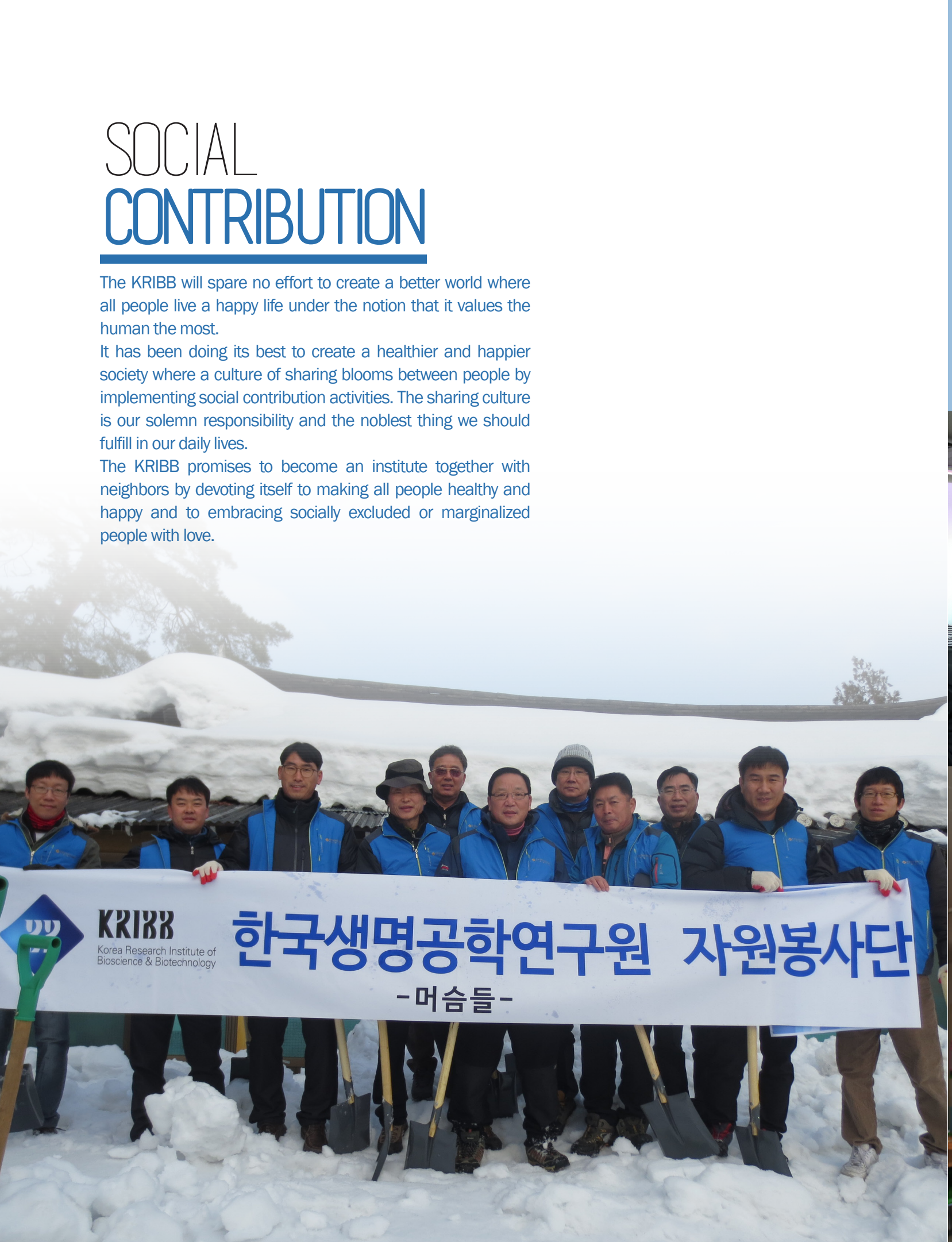
- SOCIAL CONTRIBUTION
- DONATION FOR EDUCATION
- OUTSTANDING RESEARCH ACHIEVEMENTS
- RESEARCHER INDEX

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 KIRBB 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.


Go! KRIBB 멘토와 함께하는
"바이오 교실"
GO! KRIBB멘토의 바이오교실

OUTSTANDING RESEARCH ACHIEVEMENTS

Improving load-tree health by leaf-colonizing bacteria

Choong-Min Ryu (Feb. 2013)

From the epiphytic (leaf-colonizing) microbes, the beneficial bacteria through massive screening assay sprayed load-trees such as ginkgo tree and cherry trees resulting promoting plant tolerance against multi-stresses. Bacteria application in the spring resulted to reduce disease appearance caused by insect and microbial attacks and to increase performance under natural condition. The bacteria that utilized in this study are not harmful to animal, human, and even plants because the bacteria classified as GRAS (Generally Recognized As Safe) and isolated from foods.

Results present that environment friendly protocol with beneficial bacteria was developed and improving plant fitness and tolerance to biotic and abiotic stresses.

The first discovery of novel methanogens in the rumen of Korean native cattle, "HanWoo'.

Byoung-Chan Kim (Mar. 2013)

For the isolation and purification of hydrogenotrophic methanogens, a novel anaerobic cultivation technique was developed by Dr. Byoung-Chan Kim's research group at the Biological Resource Center. By the novel cultivation technology, Dr. Kim's team isolated more than 100 novel strains of methane-producing Archaea (Methanogen) from the rumen (the first compartment of the stomach of ruminants) of Korean native cattle and fecal samples of Korean native individuals for the first time in Korea and performed their genome analyses. These newly isolated methanogens are the first of their kind in Korea. Although the methane-producing Archaea strains can be isolated, it is difficult to cultivate and maintain them.

The Biological Resource Center, part of KRIBB, conducts active research into methods of culturing and preserving strict anaerobic extremophiles. Through these methods, Dr. Kim's team has successfully reported Korea's first novel species of methane-producing Archaea strains from the rumen of Korean native cattle, "Han-Woo" and designated it '*Methanobrevibacter boviskoreani* JH1'.

The Technology for Manufacturing Recombinant Vaccine of PCV2 Which is One of Wasting Diseases is Developed

Daesub Song & Daegwin Jeong (Mar. 2013)

Porcine Circovirus Type 2 (PCV2) is considered as the causative agent of Post-weaning Multisystemic Wasting Syndrome (PMWS) which is a pathogenic organism exercising great influence on mortality after weaning, having a serious impact on the swine production industry mortality after weaning.

PCVs targets mainly immune cells in pigs, and Lymphocyte loss was observed from lymph nodes of PCV2 affected pigs from a histological perspective. In this regard, PCV2 causes a severe immunosuppression and enhances susceptibility to secondary or concomitant microbial infections, resulting in the increased susceptibility to diseases of all kinds.

The currently developed manufacturing technology for recombinant vaccine of PCV2 will pave the way for localization in a swine vaccine market which has been dominated by multinational companies, expecting import substitution effect.

Bacterial chemical dialogues through gaseous compounds

Choong-Min Ryu (May. 2013)

In biological organisms, communications plays a critical role on surviving under environmental conditions. Besides diverse chemical signals, low molecular and gaseous volatiles as a signal molecule between bacteria were discovered and characterized using by multi-omics technologies.

In this study, the research team in KRIBB showed bacterial volatiles as a signal compound between bacteria-bacteria communications for the first time. Even under the physical separation, certain bacterial group such as a Gram-positive bacterium *Bacillus sutilis* that can be often isolated from Korean traditional fermented food contributed the alteration of bacterial stress resistance like multi-drug resistance in a Gram-negative *E. coli*.

The data broaden our knowledge on a novel mechanism to develop susceptibility to antibiotic resistance and provide a new molecular drug target.

Dillenia tetrapetala (Dilleniaceae), a new species from HonBa Natural Reserve, Vietnam based on Morphological and Molecular Data

Joongku Lee (May. 2013)

A new species *Dillenia tetrapetala* Joongku Lee, T.B.Tran & R.K.Choudhary (Dilleniaceae) is described from HonBa Natural Reserve of the Khanh Hoa province of Vietnam. Detailed illustration and taxonomic comments are provided along with a table listing the differential characters to the closely related taxa. Phylogenetic analyses using nrITS region of ribosomal DNA and *psbA-trnH* intergenic spacer region of chloroplast DNA sequences were also performed which confirmed the status of *D. tetrapetala* as a distinct species. The plant is considered endangered based on IUCN red list criteria because of its restricted distribution.

Dillenia tetrapetala has a very narrow distribution range in Vietnam which fortunately falls under the reaches of the protected forest areas of HonBa Natural Reserve. The natural habitat of this species is well protected from anthropogenic activities but the site within the natural reserve needs to be marked for long term monitoring of its population in close coordination with the management authorities. Furthermore, the species is soughted after for its strong wood value. If care is not taken to protect, this species will probably be lost. The limited distribution of the species and that too with an estimated population size of less than 250 mature individuals, justifies an assessment of a preliminary (not yet submitted to IUCN/the Vietnam Red List authority) conservation status as Endangered category under criterion D, according to IUCN (2010) Red List Criteria.

Estrogen-related receptor γ controls alcoholic liver injury

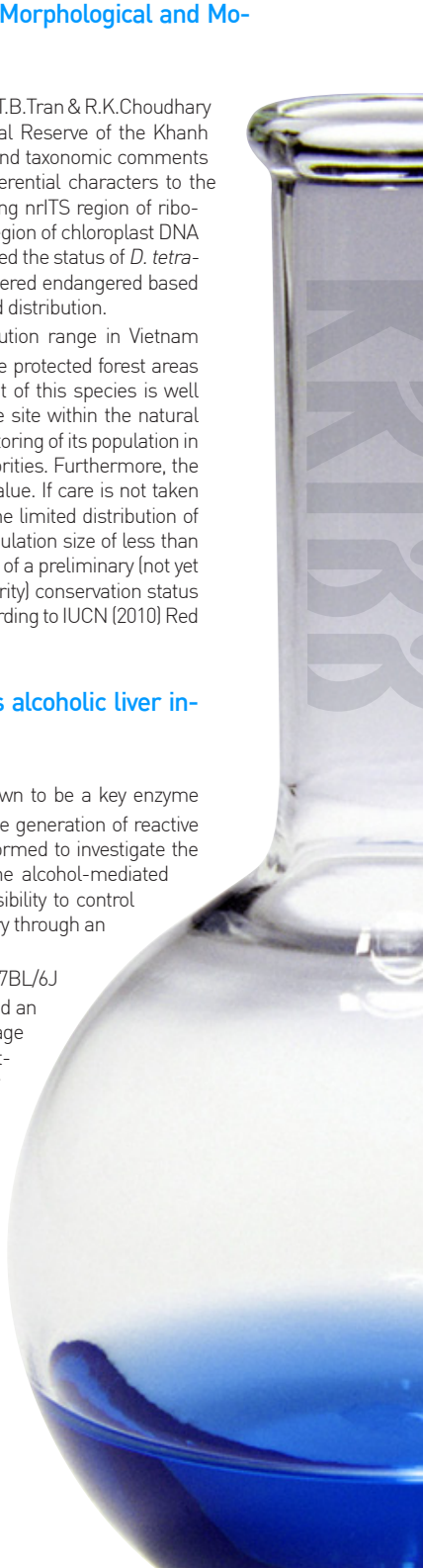
Chul-Ho Lee (Jun. 2013)

The cytochrome P450 (CYP2E1) has been known to be a key enzyme causing alcohol-induced liver injury through the generation of reactive oxygen species (ROS). This research was performed to investigate the role of nuclear hormone receptor ERRγ in the alcohol-mediated regulation of CYP2E1 and to examine the possibility to control alcohol-mediated oxidative stress and liver injury through an ERRγ inverse agonist.

For chronic alcoholic hepatosteatosis study, C57BL/6J mice were administered alcohol for 4 weeks and an inverse agonist of ERRγ were given by oral gavage for the last 2 weeks of alcohol feeding. The treatment of an ERRγ inverse agonist significantly ameliorates chronic alcohol-induced liver injury in mice through inhibition of CYP2E1-mediated generation of ROS

This research has shown that suppression of alcohol-mediated oxidative stress and liver injury by and ERRγ-specific inverse agonist may be a novel and attractive therapeutic approach for the treatment of alcoholic liver disease.

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



Inpyo Choi & Haiyoung Jeong (Jul. 2013)

TXNIP, which is induced by oxidative stress, is a known regulator of intracellular ROS. Txnip KO old mice exhibited elevated ROS levels in hematopoietic cells and showed a reduction in hematopoietic cell population. Loss of TXNIP led to a dramatic reduction of mouse survival under oxidative stress. TXNIP directly regulated p53 protein by interfering with p53- mouse double minute 2 interactions and increasing p53 transcriptional activity. Txnip KO mice showed downregulation of the antioxidant genes induced by p53. Introduction of TXNIP or p53 into Txnip KO bone marrow cells rescued the HSC frequency and greatly increased survival in mice following oxidative stress.

These data demonstrated that TXNIP gene is the factor associated with maintenance and generation of hematopoietic stem cells in the environment where the hematopoietic stem cells are aging or under stress. Overall, we identified that TXNIP gene increases or maintains the expression of p53, which is a tumour suppressor and anti-oxidant gene. According to their research, the TXNIP gene performs an important role of restricting decomposition of p53 by directly splicing with p53.

Through this research, we have laid out the basis for fundamental technology development to maintain homeostasis of hematopoietic stem cells and to regulate generation and differentiation of hematopoietic stem cells, based on the utilization of TXNIP gene. Going further, our research will offer key factors critical to the development of technologies for maintaining and generating hematopoietic stem cells as well as for cancer treatment and regulation of aging.

Survival mechanism of human pathogenic *Vibrio vulnificus*

Myung Hee Kim (Jul. 2013)

We determined the complex structure of NanR, a repressor of the nan genes responsible for Neu5Ac catabolism, and its regulatory ligand, ManNAc-6P, in the human pathogenic bacterium *Vibrio vulnificus*. Structural studies combined with electron microscopic, biochemical, and in vivo analysis demonstrated that NanR forms a dimer in which the two monomers create an arched tunnel-like DNA-binding space, which contains positively charged residues that interact with the nan promoter. The interaction between the NanR dimer and DNA is alleviated by the ManNAc-6P–mediated relocation of residues in the ligand-binding domain of NanR, which subsequently relieves the repressive effect of NanR and induces the transcription of the nan genes. Survival studies in which mice were challenged with a ManNAc-6P–binding-defective mutant strain of *V. vulnificus* demonstrated that this relocation of NanR residues is critical for *V. vulnificus* pathogenesis.

The catabolic utilization of Neu5Ac is important for bacterial pathogenesis, so molecules that target NanR may have several advantages over conventional antibiotics as unique antimicrobial reagents. First, such molecules could reduce the growth rate of invading pathogens, which would help the immune system to eliminate pathogens from the host. Second, the use of antagonists to block the binding of ManNAc-6P to NanR is unlikely to disturb the normal flora of the host because the mechanisms that regulate the nan genes in typical commensal bacteria differ from those in *V. vulnificus*. Therefore, our results provide a starting point for the design of antibiotics to target life-threatening *Vibrio* species.

Identification of Malate Dehydrogenase 2 as a Target Protein for a HIF-1 Inhibitor LW6 Using Chemical Probes

Misun Won (Aug. 2013)

A series of LW6-derived chemical probes were designed and synthesized by installing a clickable tag and a photoactivatable moiety. Using an clickable probe with flourescent tag, we found that LW6 localized in the mitochondria. In addition, Malate dehydrogenase 2 (MDH2) of TCA cycle was identified as a target protein of LW6 by 2-D PAGE with double photolabeling of both LW6 and a negative control. In parallel with the MDH2 inhibition, LW6 and MDH2 inhibitor L-thyroxine suppressed hypoxia-induced HIF-1a accumulation by inhibiting mitochondrial respiration. In conclusion, LW6 binds to MDH2 blocking mitochondrial respiration, resulting in increased local oxygen tension for degradation of HIF-1α.

A high level of MDH2 expression was associated with shorter, relapse-free survival and chemoresistance of prostate cancer patients. The study of the HIF-1α inhibitor LW6 concerning inhibition of MDH2 activity will provide information on the relevance of MDH2 to cancer and its clinical benefit.

Charting microbial phenotypes in multiplex nanoliter batch bioreactors

Sung Ho Yoon (Aug. 2013)

We devised a multiplexed microfluidic batch culture chip that enables microbial growth in 24 sets of discrete bioreactors (1 nL each), while simultaneously allowing the assessment of eight different culture conditions in parallel. The flow channels and culture reactors were designed to maintain a uniform distribution of cells in each reactor, and to conduct experiments in triplicates in a single run. The evaporation of the cell culture medium present in each of the batch reactors was overcome by placing the chip in a humidified incubator and incorporating anti-evaporation channels around the reactor within the chip.

We demonstrate the versatility of the device by performing growth curve experiments with *Escherichia coli* and microbiological assays of antibiotics against the opportunistic pathogen *Pseudomonas aeruginosa*. Our study highlights that the microfluidic system can effectively replace the traditional batch culture methods with nanoliter volumes of bacterial cultivations, and it may be therefore promising for high-throughput growth phenotyping as well as for single-cell analyses.

Inverse agonist of nuclear receptor ERRγ mediates antidiabetic effect

Chul-Ho Lee (Sep. 2013)

We have checked hepatic ERRγ expression induced by fasting and diabetic conditions resulted in elevated levels of gluconeogenic gene expression and blood glucose in wild-type mice. Also, we were able to recognize that the ablation of hepatic ERRγ gene expression reduced the expression of gluconeogenic genes and normalized blood glucose levels in mouse models of T2DM: *db/db* and diet-induced obesity (DIO) mice. In addition, a hyperinsulinemic-euglycemic clamp study and long-term studies of the antidiabetic effects of ERRγ-specific inverse agonist, in *db/db* and DIO mice demonstrated that the ERRγ-specific inverse agonist normalizes hyperglycemia mainly through inhibition of hepatic glucose production.

Our findings suggest that the ability of inverse agonist of ERRγ to control hepatic glucose production can be used as a novel therapeutic approach for the treatment of T2DM.

Small molecules enable OCT4-mediated direct reprogramming into expandable human neural stem cells

Janghwan Kim (Dec. 2013)

We previously developed a novel paradigm of cell activation and signaling-directed (CASD) lineage conversion for direct reprogramming of fibroblasts into cardiac and neural precursor cells. This method is based on the transient overexpression of iPSC factors (cell activation, CA) in conjunction with lineage-specific soluble signals (signaling directed, SD). Such a strategy was used to generate human induced neural stem cells (hiNSCs) with 4 to 6 pluripotency factors, including OCT4, SOX2, KLF4 and microRNAs by other research groups. Our long-term goal is to develop simpler and safer reprogramming methods for cell-based applications and, ultimately, to apply this reprogramming strategy pharmacologically *in vivo* for tissue regeneration.

To develop simpler and safer reprogramming methods, we adoped a stratey to identify and combind small molecules to replace genetic factors. Consequenctly, we reported a proof-of-concept study that a cocktail of only small molecules could replace 3 of the 4 reprogramming factors under the CASD lineage-reprogramming paradigm to enable OCT4-only iNSC reprogramming of human neonatal and adult fibroblasts. The reprogrammed human iNSCs are functional NSCs both in vitro and in vivo in various aspects of characterization. In addition, tumors are absent when the iNSCs were transplanted into mouse brain.

Our OCT4/CASD and chemical cocktail strategy can be applied not only to direct reprogramming to neural cells, but also to various human cells which can be used for disease modeling and cell therapy.

RESEARCHER INDEX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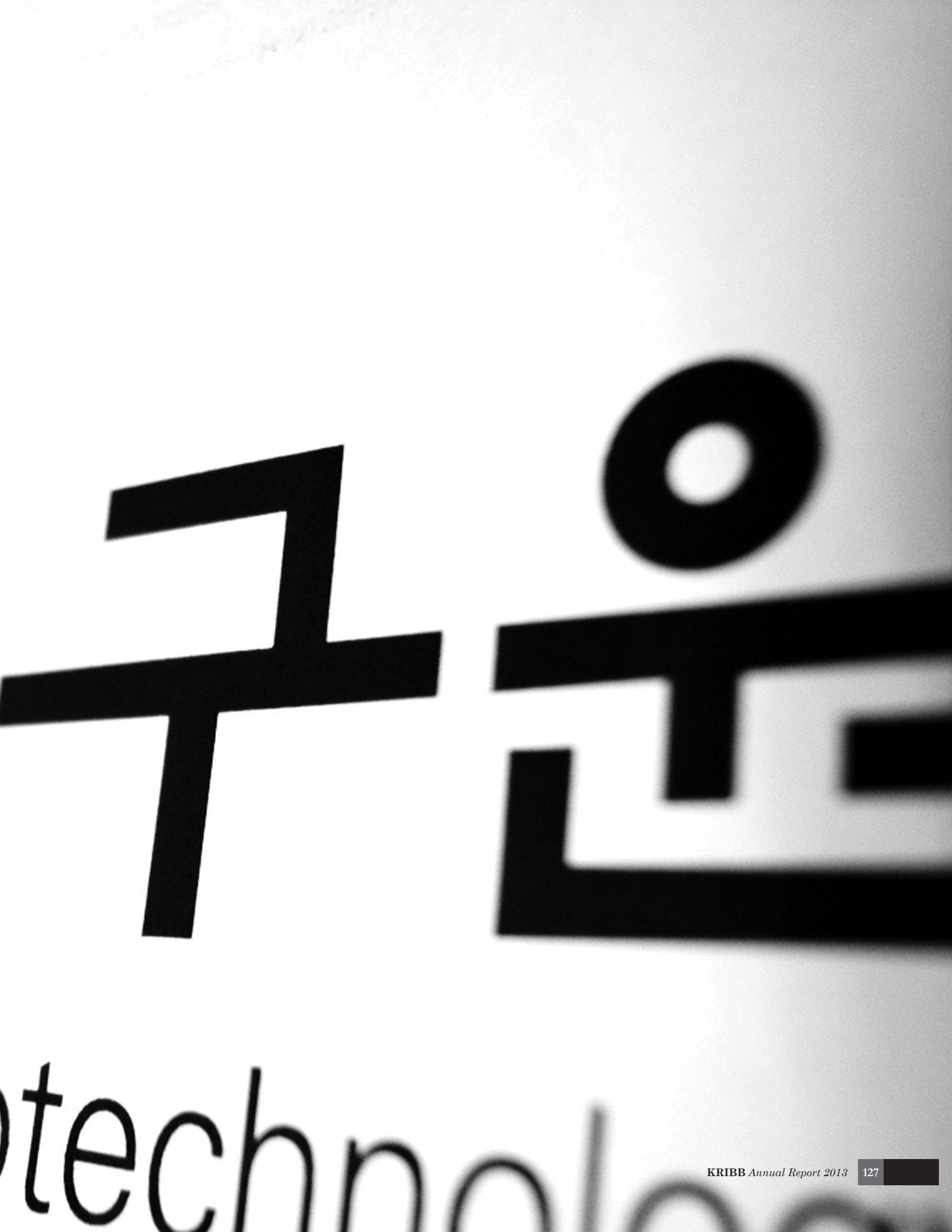

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